Minutes of the FGC Pest Management Technical Advisory Committee
Wednesday, 24 February 2010: 10:00 – 11:00 am PST
Teleconference

Present:	Robb Bennett (Chair), BC MoFR	Coast pest management
	Ward Strong, BC MoFR	MoFR pest management research
	Jim Corrigan, BC MoFR	Interior pest management
	Staffan Lindgren, UNBC	University pest management research
	Peter de Groot, CFS Sault Ste Marie	CFS pest management research
	Dan Gaudet, Vernon Seed Orchard Company	Interior industry orchards
	Jack Woods, SelectSeed	Forest Genetics Council
	Tim Crowder, Timberwest Forest Company	Coast industry orchards
Guests:	Gary Giampa, BC MoFR	MoFR orchards
Regrets:	Darrell Wood, BC MoFR	TIB administration
	Chris Walsh, BC MoFR	MoFR orchards

ACTION ITEMS

Bennett	Continue with revisions to Business Plan
Bennett	Compile IID & IIG survey results
Strong, Woods	Clarify minor details in Leptoglossus IR proposal
All	Review draft budget table and funding request

IMPORTANT DATES

Budget request finalized by 15 March; presentation to FGC 25 March. 31 Jan 2011 – deadline for receipt of 2010/11 project progress reports and 2011/12 proposals.

1. **BUSINESS MEETING CALL TO ORDER** – 10:00 AM. Formal agenda was not prepared. No changes to previous minutes (16/ii/10) requested.

2. **BUSINESS ARISING FROM 16 FEBRUARY 2010 MINUTES** – Only funding and overhead issues action items were reviewed.
   a. **Funding issues (Bennett, Woods).** Release of project funds by research administrators at UAlberta and UNorthern BC has been organized. Travel approvals and 2010/11 contracting procedures are currently unresolved.
   b. **Proposals overhead (Strong, Lindgren, Woods).** No resolution yet to this on-going issue; discussion continues among administrators. PM TAC will accept individual proposal overhead allotments for now and wait for further direction from Forest Investment Account administrators.

3. **NEW BUSINESS** (see draft budget table in Appendix and attached proposals and proposal budgets) –
   a. **Research proposals (Strong).** .
      i) **Research lab (MoFR).** IUFRO travel funds now indicated as a separate line item in the budget. Proposal and budget otherwise unchanged. Proposal and budget accepted.
      ii) ***Dioryctria* reproductive biology (UoAlberta).** Budget request increased from $8 800 to $10 500 to cover an additional month of salary support; proposal unchanged. Management recommendations resulting from this project will be developed in consultation with Strong, Corrigan, *et al*. as necessary; "*abietella* group" used by C. Whitehouse in presentations refers to BC populations of *D. abietivorella*. Proposal and budget accepted.
      iii) ***Leptoglossus* mark/release/recapture (UNBC).** Proposal and budget unchanged from 13 Feb minutes. Travel funds for Strong are separate from travel funds requested in research lab proposal; thesis defense is expected in September 2010; a publication should result from this work. Proposal and budget accepted.

iv) ***Leptoglossus* IR & visible light (SFU).** Proposal and budget unchanged from last meeting. Proposal requires clarification of minor details (use of tanglefoot adhesive in Objective 3, effects of tanglefoot on trap reflectance, and accessibility of Sechelt study site). **Strong will clarify issues with proposal proponents, Woods will provide contact information for CanFor forester now in charge of Sechelt site.** Results from this work and from *Leptoglossus* m/r/r work will provide basis for monitoring and control trials. Proposal and budget accepted.

iv) **Pesticides trials (CropHealth).** Proposal and budget unchanged from last meeting. Progress reports from contractor are very good; seed processing data should be available in April; probability of registration is excellent for any products found to be effective; following proof of efficacy, next stage should be development of new chemical-based management protocols for particular host/pest scenarios (*e.g*., *Dioryctria* in Fdi). Proposal and budget accepted.

b. **Operational proposal (Bennett).**

i) **Pest management interior operations (MoFR)**. Proposal and budget unchanged from last meeting. Budget amount can be reduced, if necessary. Proposal and budget accepted.

c. **New research project (*Contarinia*).** Research quantity of pheromone is now available and a new *Contarinia* project is now possible. Budget table entry ($33 000) is for a single full year (1 April – 31 March) of a several year research project. Funding, if approved, will arrive well after start of field season. Therefore, proposal will be developed with a budget figure reflecting the reality of work that can be accomplished during remaining field season time within the fiscal year (*i.e.*, actual expenditures in first year will likely be considerably less than $33 000). Budget figure accepted.

d. **Development of formal budget table and funding request.** Full funding for projects 2-5 is the main priority. Reductions can be made, if necessary, to projects 6 and 7 (interior operations, *Contarinia*) and, grudgingly, to project 1 (lab operations). Bennett will prepare a draft budget table outlining two funding options: 1) full funding for all projects and 2) reduced funding for projects 6 and 7 (see appendix). **Bennett will circulate draft budget table and funding request to PM TAC members for discussion and revision.** Final draft should be sent to Woods by 15 March, in preparation for presentation to FGC on 25 March.

4. OTHER NEW BUSINESS –

a. **Next meeting.** Further development of funding request will be done by e-mail discussion.

4. ADJOURN. Meeting adjourned at 11:00 am PST.

Minutes compiled by R. Bennett, 24 February 2010.

Draft rollup budget table in Appendix on next page
Proposals and budgets follow Appendix

Appendix

PM TAC budget table draft (24/ii/10) – 2010/11 fiscal year

Current Projects	2009/10	16/ii/2010 2010/11	24/ii/2010 "option 1"	24/ii/2010 "option 2"
1 Lab operations	10 000	13 700	13 700	13 700
2 Dioryctria UA	39 300	8 800	10 500	10 500
3 Lepto MRR UNBC	45 000	8 500	8 500	8 500
4 Lepto IR	33 400	34 000	34 000	34 000
5 Pesticide trials	29 100	32 000	32 000	32 000
6 Interior operations	18 200	25 000	25 000	18 000
Subtotal	190 000	**122 000**	**123 700**	**116 700**
New Projects				
7 Contarinia SFU		33 000	33 000	16 000
Subtotal	190 000	**155 000**	**156 700**	**132 700**
Salaries				
Robb and Ward	170 000	170 000	**170 000**	**170 000**
Total	360 000	**325 000**	**326 700**	**302 700**

2010/11 Budget Form

Forest Genetics Council of British Columbia
Pest Management Sub-Program

Activities and Costs

In **the cost breakdown** table below, list project activities and related costs. If needed, explanatory comments may be added below the table. *If additional sources of funding are being used in this project, please provide details*
Note: Information in this section will be routinely and publicly released.

Applicant: Ward Strong
Project title: CONE AND SEED PEST RESEARCH PROGRAM: LABORATORY OPERATIONS

Activity	Salary	Equipment	Travel	Materials, supplies	Other	Admin.	Total
Travel to field sites, collaborator facilities, conferences and meetings			3,500			175	3,675
Travel to Seoul, Korea for IUFRO conference			4,500			225	4,725
Materials and supplies for in-house and collaborative projects				5,000		250	5,250
FGC request: Totals by cost category	$	$	$ 8,000	$ 5,000	$	$ 650	$ 13,650

Explanatory comments:

Details of other funding:

Requested from FGC:	$13,650
Other source:	$
Other source:	$
Other source:	$
Total Project Budget:	$13,650

Proposal Form

Forest Genetics Council of British Columbia
Pest Management Subprogram

Application Form

Project Title:
CONE AND SEED PEST RESEARCH PROGRAM: LABORATORY OPERATIONS

Name of Applicant/Project Leader Ward Strong

Legal Name of Organization: BC Ministry of Forests

Mailing Address:
3401 Reservoir Rd
Vernon, BC V1B 2C7

Telephone: 250-260-4763
Fax: 250 542-2230
E-Mail Address: ward.strong@gov.bc.ca
Financial Officer: Jill Peterson

Outline of Project
This proposal addresses the need for the Cone and Seed Pest Researcher to travel to meetings, conferences, and work sites, as well as for experimental and lab supplies to ensure the progress of multiple in-house research projects, and to assist with collaborative projects

Project Duration (# of years): 1	Project year (1st, 2nd, etc.): 1

Estimated Project Costs: 13,650

Total requested for FY 2010/11: $_____13,650_____	FY 2013/14: $_____	Estimated overall project cost: $_____
FY 2011/12: $_____	FY 2014/15: $_____	

Project Description

Please use the following headings.

Needs:

Describe background, specific pest management needs or benefits to be achieved, and how this project will support Forest Genetics Council objectives.
This project will

- provide support for the collaborative projects with other research institutions, including laboratory facilities and supplies and access to field research sites.
- Carry out or assist with in-house projects. Ongoing trials: irrigation effects on mountain pine beetle; Synanthedon effects on tree health; monitoring for adult Dioryctria and Contarinia. Short-term projects: Leptoglossus egg parasitoid studies; Leptoglossus bagging study to determine the timing of leptoglossus damage; Leptoglossus spray trial to determine whether a novel pesticide application procedure is successful; Contarinia density / damage relationship; other minor projects as the need arises
- Provide travel money for the Cone and Seed Pest Researcher. Needs: travel to research locations; travel to collaborating institutions for meetings with researchers and graduate students; travel to meetings, conferences, and professional development events.

Objectives:

To support collaborative research, and carry out multiple in-house projects.

Procedure:

Details of collaborative projects are not listed here.
In-house projects:

- Irrigation effects on MPB. Blocks 8 and 10 of the Kalamalka Forestry Centre are pines that have been partially attacked for several years. In 2007 I set up an irrigation trial to determine the effects of irrigation on attack rates. 10 replicates pairs were randomly assigned standard drip irrigation or no irrigation. Attack rates for each tree are monitored annually. This will be the final year of this trial.
- Synanthedon effects on tree health. In 2007 I set up a paired-tree trial to determine the long-term effects of Synanthedon attack. This is envisioned as a 10-year trial or longer. Two ramets of each of about 61 clones were assigned treatment (all synanthedon manually removed twice a year) or control (Synanthedon left on tree). Tree health is assessed twice a year as well.
- Leptoglossus egg parasitoid study. This will be with the assistance of a graduate student from Italy. Experimental details to be worked out in the future.
- Leptoglossus bagging study: Assist Mike Carlson with putting up to 14 leptoglossus-exclusion bags on individual trees. Bags will be removed for 10-day periods throughout the year to help pinpoint when Leptoglossus is most damaging.
- Leptoglossus spray trail. Other studies have indicated that Leptoglossus are most damaging in early spring, before our current monitoring techniques can easily detect them. Two well-timed sprays of Sevin at this time might dramatically reduce seed loss, regardless of subsequent lepto densities. Several seed orchards will be divided into thirds, with no sprays, standard spray applciations, or the two-early-spray treatments applied to each third.
- Contarinia density / damage. In the anticipation that no money will be made available for a more concerted effort with this project, I plan to monitor individual orchards with Contarinia

pheromone, and then monitor the subsequent damage levels, to get a start on a baseline density / damage relationship.

Location:

Kalamalka Forestry Centre; seed orchards in the Okanagan area.

Output and Deliverables:

- Upgraded management recommendations to seed orchard managers
- Oral report at the BCSOA meeting
- Written report(s) in TIC Talk, the CTIA Newsbulleting, or both

Who will benefit from this work?

- Industry and government seed orchard managers
- Seed users-- the forest industry
-

Budget:

Complete the attached budget form and provide a detailed cost breakdown for the first year. Show contributions from other sources if applicable. For multi-year projects, the Forest Genetics Council can provide no guarantee of funding beyond the first year.

Project Team:

List organization of project team members; including the contact name, address, and phone number for each

Signature Block:

Name (authorization for application): _____

Signature:_____ Date:_____

2010/11 Budget Form

Forest Genetics Council of British Columbia
Pest Management Sub-Program

Activities and Costs

In **the cost breakdown** table below, list project activities and related costs. If needed, explanatory comments may be added below the table. *If additional sources of funding are being used in this project, please provide details*
Note: Information in this section will be routinely and publicly released.

Applicant: Dr. Maya Evenden/Caroline Whitehouse
Project title: Reproductive biology of *Dioryctria abietivorella*

Activity	Salary	Equipment	Travel	Materials, supplies	Other	Admin.	Total
Data analysis, technical writing: April – September 2010 ($1,525/12 x 6 months)	9,150.00					1372.50	**10522.50**
FGC request: Totals by cost category	9,150.00					1372.50	**10522.50**

Explanatory comments:
Funding will provide graduate student salary during data analysis and technical writing between May-September 2010.

Details of other funding:

Requested from FGC:	$ 10522.50
Other source:	$
Other source:	$
Other source:	$
Total Project Budget:	$ 10522.50

Proposal Form

Forest Genetics Council of British Columbia
Pest Management Subprogram

Application Form

Project Title:
Reproductive biology of *Dioryctria abietivorella*

Name of Applicant/Project Leader
Dr. Maya Evenden

Legal Name of Organization:
University of Alberta, Biological Sciences Department

Mailing Address:
CW405, Biological Sciences Department
University of Alberta, Edmonton, AB T6G 2E9

Telephone: 780-492-1873
Fax: 780-492-7150
E-Mail Address: mevenden@ualberta.ca
Financial Officer: Marjorie Grady, marjorie.grady@ualberta.ca

Outline of Project

The fir coneworm moth, *Dioryctria abietivorella* Groté, is an important seed orchard pest. Pest control of *D. abietivorella* using traditional management methods is difficult and alternative control techniques such as pheromone-based mating disruption are required. Behavioural assays, in the lab and field, have been used to assess the mating behaviour, reproductive trade-offs and oviposition behaviour of female *D. abietivorella*. Results from this project will be essential for the development of an integrated pest management program to target this economically important pest.

Funds for 2010-11 will be used to finish this project. Activities include collection of data on lifespan and mating status; data analysis; and writing a final report with management recommendations.

Project Duration (# of years):	Project year (1st, 2nd, etc.):
3 years	3rd

Estimated Project Costs:

Total requested for FY 2010/11: $_8768.75_____	FY 2013/14: $_____	Estimated overall project cost: $_____**8768.75**_____
FY 2011/12: $_____	FY 2014/15: $_____	

Project Description

Needs:

Limited pest control of *D. abietivorella* has been achieved using dimethoate and alternative control techniques such as pheromone-based mating disruption are required for efficacious management. These management strategies require resolution of the mating behaviour, reproductive trade-offs and oviposition behaviour of female *D. abietivorella*. Work for this project was conducted in seed orchards in the north Okanagan, B.C. The main objectives for the 2009 field season were to assess seasonal flight phenology, mating status throughout the flight period, female calling behaviour, adult longevity and egg production. The majority of work was conducted in the Douglas-fir breeding orchards located at the Kalamalka Research Centre (KRC) and all insects for laboratory and field experiments were reared from Douglas-fir cones collected at KRC.

Mating Behaviour

It is important to know when moths are reproductively active, during the adult lifespan, season and day, in order to develop pest management tactics that target reproductive behaviours such as pheromone-based monitoring, mating disruption or attract and kill technologies.

1. Light trap monitoring

   Objectives:

   - To determine the flight phenology and reproductive status of female *D. abietivorella* moths in seed orchards throughout the flight season.
   - **Management objective:** Knowledge of reproductive biology is essential to successful pheromone control or behavioural management of *Dioryctria*. With good information on the timing of female flight and how this may change with season, we can better target pheromone introductions to the orchard. We will also have an indication of flight duration, suggesting whether moths originate within or outside the orchard of interest. Moths originating outside the orchard of interest may have mated before arriving, thus potentially scuttling mating disruption efforts. Understanding mating status will also help us evaluate the likelihood of mating outside the orchard of interest, and the motivation for multiple matings, both of which can reduce the chance of success for pheromone-based control. In general, when designing a pheromone based control method, the more knowledge we have of the reproductive behaviour of the target insect, the greater the likelihood of success.

2. Calling behaviour

   Objectives:

   - To determine when, within day and season, female moths release pheromone to attract males.
   - To determine if female calling behaviour varies with female age.
   - To determine if female attractiveness varies with female age.
   - **Management Objective:** This information will assist in evaluating the potential for pheromone control techniques, as well as help optimize insecticide control efforts. The most efficient mating-disruption techniques use "puffers" to disseminate pheromone. Knowing exactly when the females are calling will enable us to optimize the timing of pheromone release to maximize disruption of the female calling, while minimizing the amount of expensive pheromone used. Furthermore, we will be able to modify pheromone release through the season if we know that aging females call differently or become less attractive with age. This information can also be used to maximize the efficacy of pesticide applications by spraying when the insects are most active, and therefore most susceptible.

Trade-offs between reproduction and longevity

It is important to know the potential adult lifespan of moths so that pest management activities targeting mating and reproduction can be appropriately timed. It is important to assess longevity of mated and virgin moths as reproductive activity often results in a trade-off with adult longevity in moths and can result in a shortened adult lifespan. Knowledge of adult longevity will also allow us to pick appropriate age intervals for experimentation on calling and oviposition behaviours.

1. Adult Longevity

Objectives:

- To determine the lifespan of virgin and mated male and female *D. abietivorella* moths in the laboratory.
- To determine if lifespan is modified by mating status.
- **Management objectives:** This information will help guide insecticide control programs, determine extent of generation overlap, and help in making decisions about future damage potential based on current *D.* abietivorella densities. For example, if overwintered adults of *D. abietivorella* live only a short period, then perhaps a single well-timed spray against adults will result in season-long control. Further, we might base a mating-disruption effort on the longevity of mated females, and then find that virgins live many weeks longer than mated females, leading to failure of the mating disruption effort.

Objectives:

1) Completion of data analysis associated with the behavioural assays discussed in the previous section.

2) Technical report and scientific publication writing.

Procedure:

Data analysis will be completed by June 1, 2010 and writing should be concluded by no later than September 30, 2010.

Location:

University of Alberta, Edmonton, Alberta

Output and Deliverables:

Final report to the Forest Genetics Council
Report in an industry and public seed and seedling extension topics publication
Publications in peer-reviewed scientific journals

Currently in preparation for the Canadian Entomologist: Invited review (January 21, 2009) Whitehouse, C.M., Roe, A.D., Strong, W.B., Evenden, M.L. and Sperling, F.A.H. The biology and management of North American seed-feeding *Dioryctria*.

Who will benefit from this work?

Seed orchard managers, seed users, and the scientific community in the areas of forest management and ecology, as well as entomology.

Budget:

See attached

Project Team:

C.M. Whitehouse
Department of Biological Sciences, University of Alberta, Edmonton, AB, T6G 2E9
Tel: 780-492-3080
Fax: 780-492-9234
cmw7@ualberta.ca

W.B. Strong
British Columbia Ministry of Forests, Kalamalka Forestry Centre, Vernon, BC, V1B 2C7
Tel: 250-260-4763
Fax: 250-542-2230
ward.strong@gov.bc.ca

M.L. Evenden
Department of Biological Sciences, University of Alberta, Edmonton, AB, T6G 2E9
Tel: 780-492-1873
Fax: 780-492-7150
mevenden@ualberta.ca

Signature Block:

Name (authorization for application): _____

Signature: _____ Date: _____

2010/11 Budget Form

Forest Genetics Council of British Columbia
Pest Management Sub-Program

Activities and Costs

In **the cost breakdown** table below, list project activities and related costs. If needed, explanatory comments may be added below the table. *If additional sources of funding are being used in this project, please provide details*
Note: Information in this section will be routinely and publicly released.

Applicant: Staffan Lindgren, UNBC
Project title: Early season dispersal, host selection and abundance of *Leptoglossus occidentalis* in Kalamalka Seed Orchard

Activity	Salary	Equipment	Travel	Materials, supplies	Other	Admin.	Total
Analysis and writing	6,000		1,000			1,500	**8,500**
FGC request: Totals by cost category	$ 6,000	$	$ 1,000	$	$	$ 1,500	$ 8,500

Explanatory comments: UNBC is directing faculty to request 25% of salary cost as overhead on contracts. Travel costs are for one trip for Tamara Richardson to visit Kalamalka Seed Orchard, and one trip fro Dr. Strong to visit UNBC. UNBC contribution is Dr. Lindgren's time, as well as contributions to cover miscellaneous activities from his NSERC Discovery Grant.

Details of other funding:

Requested from FGC:	$8,500
Other source: UNBC	$1,000
Other source:	$
Other source:	$
Total Project Budget:	$9,500

Proposal Form

Forest Genetics Council of British Columbia
Pest Management Subprogram

Application Form

Project Title: Early season dispersal, host selection and abundance of *Leptoglossus occidentalis* in Kalamalka Seed Orchard

Name of Applicant/Project Leader Name: B. Staffan Lindgren

Legal Name of Organization: UNBC, Ecosystem Science and Management

Mailing Address:
3333 University Way
Prince George, BC
V2N 4Z9

Telephone: 250-960-5846
Fax: 250-960-5539
E-Mail Address: lindgren@unbc.ca
Financial Officer:

Outline of Project: The objectives of this study are to investigate and describe the dispersal patterns of *L. occidentalis* into spring seed orchards, to determine factors influencing within-orchard dispersal and host selection, to estimate population abundance in seed orchards and assess the efficiency of a visual monitoring system.

Project Duration (# of years): 3	Project year (1st, 2nd, etc.): 3rd

Estimated Project Costs:

Total requested for FY 2010/11: $__8,500_____	FY 2013/14: $_____	Estimated overall project cost: $_$7,500_____
FY 2011/12: $_____	FY 2014/15: $_____	

Project Description

Needs:

The western conifer seed bug, *Leptoglossus occidentalis* Heidemann (Hemiptera: Heteroptera:Coreidae) is a serious seed orchard pest in southern interior British Columbia. *L. occidentalis* is responsible for substantial seed loss in lodgepole pine and Douglas-fir, and less substantial seed loss in other conifer species (Hedlin *et al.* 1980, Connelly and Showalter 1991, Strong *et al.* 2001). Pesticides are used multiple times per season to combat *L. occidentalis*, yet substantial seed loss still occurs. As of 2008 British Columbia seed orchards produced approximately 55% of the seed used in reforestation efforts in the province and the Ministry of Forests and Range wishes to increase this amount to 75% by 2013 (Forest Genetics Council of BC, 2008). One of the major obstacles to achieving this objective is the loss of seed to insect damage, particularly *L. occidentalis*.

Currently there are no quantitative monitoring methods and no economic threshold for *L. occidentalis*. Fundamental questions about the life history of *L. occidentalis* remain unanswered, such as how they disperse into and between seed orchards and what factors influence their choice of host tree. Investigating these questions will assist in the development of effective census methods and pest management strategies in conifer seed orchards for *L. occidentalis*.

Citations:

Connelly A. E. and Showalter T.D. 1991. Seed losses to feeding by *L. occidentalis* (Heteroptera: Coreidae) during second year cone development in western white pine. Journal of Economic Entomology. 84 (1): 215-217.

Forest Genetics Council of British Columbia Annual Report 2007/2008. Available from http://www.fgcouncil.bc.ca/FGCAnnRpt-0708-Web.pdf [accessed 2009-03-11].

Hedlin A.F., Yates III H.O., Tovar D.C., Ebel B.H., Koerber T.W. and Merkel E.P. 1981. Cone and Seed Insects of North American Conifers. Canadian Forestry Service, USDA and Forest Service and Secretaria de Agricultura y Recursos Hidraulicos, Mexico.

Strong W.B., Bates S.L. and Stoehr M.U. 2001. Feeding by *L. occidentalis* (Hemiptera:Coreidae) reduces seed set in lodgepole pine (Pinaceae). *The Canadian Entomologist* 133: 857-865.

Objectives:

1. Determine spring immigration patterns:
    a. Establish if *L. occidentalis* form an edge effect as they immigrate into spring seed orchards or if they appear in a random pattern.
    b. Establish if immigration patterns of *L. occidentalis* into spring seed orchards occur in a predictable manner from year to year.

2. Determine factors influencing within-orchard dispersal and host selection by collecting data from a selected set of cones from favoured and unfavoured clones in lodgepolepine, including:
    a. Establishing favoured clones in pine orchard 307.
    b. Comparing infrared reflectance
    c. Comparing terpene profiles;
    d. Obtaining cone counts and seed yield data;
    e. Measuring cone length and mass;
    f. Establishing if clones favoured by *L. occidentalis* remain consistent from year to year.

3. Estimate population abundance project and estimate efficiency of visual monitoring system.

Procedure:

Fieldwork has concluded for this project and data analysis and writing have yet to be completed. Analytical methods to be used for each component of the project are outlined below:

1. **Determine spring immigration patterns**: Spatial point process models using the Spatstat package in R statistical software (Baddeley and R. Turner, 2005) will be used to model the variation in *L. occidentalis* intensity sequentially (for each monitoring event) within orchard 307 in 2008 and 3009. I will be able to detect orchard level immigration and infestation patterns over time (i.e. presence of early season edge effects) using these methods. Cone crop, seed set and clone identity will be incorporated into models to determine if insect density is a spatially varying function of

any of these the covariates. I will determine if spatial patterns are consistent from year to year.

2. **Determine factors influencing within-orchard dispersal and host selection:** All analyses will be done with R statistical software (R Development Core Team, 2008)
    a. Tree attributes mediating host selection: I have an extensive data set including terpene and IR profiles of each tree. I will use backwards binomial logistic regression models to determine which host attributes are the most significant attractants to *L. occidentalis*.
    b. Differences between favoured occupied, favoured unoccupied and non-favoured clones: The above analysis will provide significant host selection cues. Analysis of variance and post hoc means comparisons tests will be used to determine if the three clone types are statistically distinct with respect to attributes deemed significant from the logistic regression models.
    c. Year to year difference in clone preferences: Linear regression will be used to model the influence of clone, year and their interaction on the average number of insects found per clone and also the proportion of ramets of each clone bearing insects.

3. **Estimate population abundance and estimate efficiency of visual monitoring system**: Much of this work has already commenced and the results will be available in the forthcoming 2010 interim report. Recaptures of *L. occidentalis* in orchard 307 were too low to obtain population estimates for each sampling occasion so it was impossible to validate field surveys with population estimates. I plotted the number of insects observed in orchard 307 on each sampling occasion over time using Microsoft Excel and R statistical software (R Development Core Team, 2008) to visualize population trends. These numbers were also plotted with the number of *L. occidentalis* found during concurrent field surveys to determine if there was a relationship between the two types of surveys. No relationship was observed. I will obtain 2008 and 2009 population abundance estimates for the entire sampling interval in orchard 307 using the robust population estimator in MARK statistical software (White and Burnham 1999). *L. occidentalis* populations were sufficiently high in the Douglas-fir plot for population estimates to be made. The Schnabel method, the Schumacher-Eschemeyer method (Krebs 1999) (both closed population estimation methods), the Jolly-Seber method (Krebs 1999) (an open population estimation method) and whole tree count methods (Southwood & Henderson 2000) were used to estimate population size. Population estimates were plotted with the number of insects found during concurrent field surveys to determine if there was a relationship between population estimates and field surveys again it was not possible to establish a relationship. Estimates were calculated and plotted in Microsoft Excel and R statistical software (R Development Core Team, 2008).

Citations:

Baddeley and R. Turner (2005). Spatstat: an R package for analyzing spatial point patterns. Journal of Statistical Software 12 (6), 1-42. ISSN: 1548-7660. URL: www.jstatsoft.org

Krebs C.J. 1999. *Ecological Methodology*. Addison Wesley Longman, Menlo Park, CA.

R Development Core Team .2008. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN3-900051-07-0, URL http://www.R-project.org.

Southwood & Henderson .2000. *Ecological Methods*. Wiley-Blackwell, Hoboken NJ.

White G.C. and K.P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study Supplement. 46: 120-138.

Location:

Data analysis and writing will take place at the University of British Columbia, Prince George B.C.

Output and Deliverables:

Data set used for population modelling at UBC Okanagan.
Final report to the FGC.
Report for publication in TicTalk, CTIA Newsletter, or other industry publication.
Two to three publications in peer-reviewed, scientific journals.
Thesis submitted in partial fulfillment of Tamara Richardson's M.Sc. degree.

Who will benefit from this work?

Seed orchard managers and staff

Budget:

Complete the attached budget form and provide a detailed cost breakdown for the first year. Show contributions from other sources if applicable. For multi-year projects, the Forest Genetics Council can provide no guarantee of funding beyond the first year.

Project Team:

List organization of project team members; including the contact name, address, and phone number for each

Participants

Graduate student:

Name: Tamara Richardson
Degree program: M.Sc NRES (Biology)
University & Department: UNBC, Ecosystem Science and Management
Address (at university): 2500 2nd Avenue
City, Province: Prince George, BC
Postal code: V2L 1J3
Phone: 250-640-7546
Fax: N/A
Email: tamara.richardson@gmail.com
Alternate e-mail:
Citizenship: Canada

Academic supervisor:

Name: B. Staffan Lindgren
University & Department: UNBC, Ecosystem Science and Management
Address: 3333 University Way
City, Province: Prince George, BC
Postal code: V2N 4Z9
Phone: 250-960-5846
Fax: 250-960-5539
Email: lindgren@unbc.ca

Ministry of Forests:

Name: Ward Strong
Position: Research Scientist, Cone and Seed Pests
Department/Division: Kalamalka Forestry Center
Organization: BC Ministry of Forests and Range
Address: 3401 Reservoir Rd
City, Province: Vernon, BC
Postal code: V1B 2C7
Phone: (250) 260-4763
Fax: (250) 542-2230
Email: ward.strong@gov.bc.ca

Signature Block:

Name (authorization for application): _____

Signature:_____ Date:_____

2010/11 Budget Form

Forest Genetics Council of British Columbia
Pest Management Sub-Program

Activities and Costs

In **the cost breakdown** table below, list project activities and related costs. If needed, explanatory comments may be added below the table. *If additional sources of funding are being used in this project, please provide details*
Note: Information in this section will be routinely and publicly released.

Applicant: Gerhard Gries
Project title: Characterization and development of cone-derived infrared radiation and wavelengths of visible light for attraction of western conifer seed bugs, *Leptoglossus occidentalis*

Activity	Salary	Equipment	Travel	Materials, supplies	Other	Admin.	Total
1. determine behavioral responses of LOs to key wavelengths of visible lights; 2. determine whether the spectrum of visible light reflected off cones provides a stronger foraging cue than key wavelengths (associated with specific receptor sites). 3. determine whether cones-specific temperatures provide a more attractive IR foraging cue than temperatures cooler or warmer than those of cones; 4. investigate interactions between IR radiation and specific wavelengths of visible light; and 5. determine optimal trap size.	$ 21,158					$2,116	$23,274
Activities 3-5			$ 8,205		$1,500	$971	$10,676
FGC request: Totals by cost category	$21,158	$	$8,205	$	$ 1,500	$3,087	$33,950

Explanatory comments:
Salary ($21,158):

(a) PhD student Tracy Zahradnik: $11,000 (summer and fall term 2010 @ $5,500 each);
(b) Research Associate Dr. Stephen Takács: $1,000;
(c) Undergraduate Research Assistant: $9,158 (18 weeks @ $480 per week (=$8,640) plus 6% benefit ($518).

Travel ($8,205):

(a) 10 return ferry trips @ $51 each: $510;
(b) 20 nights of accommodation @ $65 per night: $1,300;
(c) 20 person-days per diems @ $45 each for graduate student and assistant: $45 x 40 days = $1,800;
(d) mileage: $0.51/km x 9,000 km: $4,5905

Administration (10% overhead)

Other:
(a) Partial maintenance cost for thermo imaging camera

Details of other funding:

Requested from FGC:	$33,950
Other source: NSERC-IRC	$10,000*
Other source:	$
Other source:	$
Total Project Budget:	$43,950

*(a) 1-term salary for graduate student ($5,500), (b) balance ($1,500) of maintaining cost for thermo imaging camera; (c) miscellaneous work by machine and electronic shops @SFU estimated at $3,000.

Proposal Form

Forest Genetics Council of British Columbia
Pest Management Subprogram

Application Form

Project Title:

Characterization and development of cone-derived infrared radiation and wavelengths of visible light for attraction of western conifer seed bugs, *Leptoglossus occidentalis*

Name of Applicant/Project Leader
Gerhard Gries

Legal Name of Organization:
Simon Fraser University

Mailing Address:
Gerhard Gries
Department of Biological Sciences
8888 University Drive
Burnaby, British Columbia V5A1S6, Canada

Telephone: 778-782-4392 (office), 778-782-5939 (laboratory)
Fax: 778-782-3496
E-Mail Address: gries@sfu.ca
Financial Officer: to be determined

Outline of Project

Electromagnetic cues for attracting and trapping western conifer seed bugs

Western conifer seed bugs, *Leptoglossus occidentalis* (LO), have long been the bane of conifer seed orchards in British Columbia and elsewhere. LO populations are difficult to monitor and manage, in part because there is no effective bait. There is evidence emerging that cone-derived infrared (IR) radiation and visible-light wavelengths attract LOs. This year's research will determine (*i*) the key wavelength(s) of visible lights, (*ii*) the cone temperate with the strongest IR stimulus, and (*iii*) combination of visible-light wavelengths and IR that are most attractive to LOs. Our overall objective is to develop an effective trap for (mass) trapping LOs in seed orchards.

Project Duration (# of years): 1	Project year (1st, 2nd, etc.):

Estimated Project Costs:

Total requested for FY 2010/11: **$**33,950	FY 2013/14: $_____	Estimated overall project cost: $_____
FY 2011/12: $_____	FY 2014/15: $_____	

Project Description

Needs

The western conifer seed bug, *Leptoglossus occidentalis* (LO), is a specialist herbivore that feeds on the contents of developing conifer seeds. Adult and nymphs cause conelet abortion and depressions of seed yield in seed orchards, particularly of lodgepole pine, *Pinus contorta* var. *latifolia* Engelmann, and western white pine, *Pinus monticola* Dougl. Ex D. Don (Connely and Schowalter, 1991; Strong *et al.*, 2001; Bates *et al.*, 2002). It is an important economic seed pest of coniferous trees in North America (Bates *et al*., 2001; Hedlin *et al.*, 1981). Means for monitoring and mass trapping LOs to alleviate their impact are very much needed.

Research Objectives

We (Takács et al., 2009; Zahradnik et al., unpubl.) have shown that (1) LOs use infrared radiation (IR) as a foraging cue to locate cones; (2) visual and very-near IR spectra (300 – 1000 nm) from cones and needles differ; (3) and in electroretinograms, LOs respond to specific wavelengths of visible light, indicating that they are multichroic. Our new research objectives are to:

1. determine behavioral responses of LOs to key wavelengths of visible lights;
2. determine whether the spectrum of visible light reflected off cones provides a stronger foraging cue than key wavelengths (associated with specific receptor sites);
3. determine whether cones-specific temperatures provide a more attractive IR foraging cue than temperatures cooler or warmer than those of cones;
4. investigate interactions between IR radiation and specific wavelengths of visible light; and
5. determine optimal trap size.

Procedure

Objective 1: To determine behavioral responses of LOs to key wavelengths of visible lights
In electroretinograms, LO eyes will be subjected to 10 nm to 20 nm bandwidths of UV and visible light ranging from 200-700 nm. These bandwidths will be generated either with a light emitting diode (LED), the OneLight instrument (a programmable single light source engine) or a MonoScan2000. Those wavelengths that elicit the strongest responses (here from referred to as “key wavelengths”) may indicate the presence of a receptor spectrally tuned for that wavelength. Attraction of male and female LOs to candidate key wavelengths of visible light will be tested in a chamber modified from a previous design (**1, 2**). The chamber will consist of a glass aquarium (50.5 × 26.7 × 33 cm high) nested inside a larger aquarium (61 × 33 × 41 cm high) with ice water between them, and a glass top covering the inner aquarium. A PVC tube (7 cm inner diam) will be sealed between the two aquaria in each of the two end sections to exclude water, allowing light stimuli to enter the inner aquarium. Test stimuli will consist of light emitting diodes (LEDs) or the OneLight instrument. Single insects will be released from an etched open Petri dish (10 cm diam) resting on a pedestal (9 × 9 × 10 cm) within the inner aquarium. They will be exposed to light stimuli entering the chamber through the PVC tubes. Insects climbing onto and walking 10 cm toward the distal end of an etched glass rod (0.8 × 45 cm) inserted through the Petri dish will be considered responders.

Objective 2: The spectrum of visible reflected off cones provides a stronger foraging cue than key wavelengths
Cones of Western white pine varying in colour from green to brown will be selected to determine their spectromatic profiles in the UV through to visible light range under natural sun. Spectromatic profiles will

be recorded using an HR4000 high-resolution spectrometer (Ocean Optics, USA). Recorded profiles will be programmed into the OneLight instrument, which is capable of emitting light spectra closely resembling those that were recorded and programmed. These spectra will be tested in electroretinograms to compare receptor responses to complete spectra of cones and to key wavelengths; all stimuli will be tested at the same intensity. In two-choice laboratory bioassays selected key wavelengths will be tested *versus* cone spectra emitted by the OneLight instrument for attraction of male, female and nymph LOs. Significantly stronger attraction of LOs to complete cone spectra than to selected key wavelengths will indicate that the spectrum of visible light reflected off cones provides the strongest visual foraging cue for LOs.

Objective 3: To determine whether cone-specific temperatures provide a more attractive IR foraging cue than temperatures cooler or warmer than those of cones
LOs will be immobilized with plasticine on a slide such that IR receptors face upwards. A sharpened tungsten recording electrode (Cool & Crawford 1970) will be micro-manipulated (Leitz micromanipulators M, Vienna, Austria) in the IR receptor and the reference electrode micro-manipulated in the thorax. IR receptor potentials will be measured in response to 0.5-s exposures to mirror-reflected IR stimuli emanating from a water flask which will be heated in increments of 10°C from 0°C to 100°C. Behavioural attraction of LOs to IR stimuli similar to those reflected off cones will be tested in paired-trap field experiments and two-choice laboratory experiments (for design see above). For field experiments, an experimental trap will be suspended 1.5 m above ground on the east and west side of each of 20 randomly selected trees. Traps will be made of PVC or metal pipe (15-25 cm × 10-18 cm diameter), capped at the bottom, wrapped in painters' tape, spray-painted, and covered with Tangle Trap adhesive (TangleFoot, Contech, Canada). The number of insects captured on each trap will be recorded every 30 min for the duration of the experiment, or at the end of experiments that tested color as a single stimulus. Cold traps with inherent weak IR stimulus will be kept cold by refilling the trap with ice water at each recording interval. Warm traps with an inherently stronger IR stimulus will be filled with a small layer of water (to standardize relative humidity) and warmed to the desired temperature by an electronic heating element. Significantly stronger responses by LOs to stimuli within the cone temperature range will support the hypothesis that the IR cue from cones is more attractive than other IR cues.

Objective 4: To investigate interactions between IR and specific wavelengths of visible light
Stimuli that were tested under Objectives1-3 and found to be most effective in attracting LOs will be tested in T-tube laboratory bioassays and paired-trap field experiments for potential additive or synergistic effects. Treatment stimuli will be binary combinations of attractive wavelengths of visible light and IR, whereas control stimuli will comprise only one of the two types of wavelengths. When a stimulus cannot be excluded, such as the colour of a trap, it will be selected based on its lack of behavioural activity when it was tested under Objectives 1 and 2. Significantly stronger attraction of LOs to combinations of attractive wavelength types will support the conclusion that foraging insects integrate multimodal information received by different receptors of various electromagnetic wavelengths.

Objective 5: To determine optimal trap size or type
A small and a large version of a pipe trap with optimal IR and other spectrometric characteristics (see Objective 4) will be tested in paired trap experiments (design as above). Each consecutive experiment will retest the better trap from the preceding experiment *versus* either a larger version of it (if the large trap was more effective before) or a smaller version of it (if the small trap was more effective before). Experiments will continue until the optimal trap size has been determined.

Location:

1. Gries laboratory at Simon Fraser University (SFU), Burnaby, British Columbia, Canada;
2. CANFOR Seed Orchard, Sechelt, British Columbia, Canada;
3. Kalamalka Forestry Centre, Vernon, British Columbia, Canada

Output and Deliverables:

1. Characterization of cone-derived infrared radiation and wavelengths of visible light that in combination most strongly attract western conifer seed bugs;
2. Development of a trapping device that incorporates theses electromagnetic wavelengths for mass trapping western conifer seed bugs

Who will benefit from this work?

1. Private and public Seed Orchard Managers
2. Seed users (forest industry)

Budget:

Total requested for FY 2010/11: $33,950 (detailed cost breakdown in budget form)

Project Team:

Tracy Zahradnik (PhD student in Gries-lab, Department of Biological Sciences, SFU, 8888 University Drive, Burnaby, British Columbia V5A1S6, laboratory phone: 778-782-5939); Ward Strong (British Columbia Ministry of Forests and Range, Kalamalka Forestry Centre, Vernon, British Columbia, Canada V1B 2C7, phone: 250-260-4763); Robb Bennett; (British Columbia Ministry of Forests and Range, Saanichton, British Columbia, Canada V8M 1W4, phone: 250-652-6593); Stephen Takács (Research Associate in Gries-lab); Research Assistant (Undergraduate Student in Gries-lab, to be determined); Gerhard Gries (phone: 778-782-4392).

Signature Block:

Name (authorization for application): _____

Signature:_____ Date:_____

References

Bates, S.L., Borden, J.H., Kermode, A.R. & Bennett, R.G. 2001. Impact of *Leptoglossus occidentalis* (Hemiptera: Coreidae) on Douglas-Fir seed production. J. Econ. Entomol. **93**: 1444-1451.

Bates, S.L., Lait, C.G. & Borden, J.H. & Kermode A.L. 2001 Effect of feeding by the western conifer seed bug, *Leptoglossus occidentalis*, on the major storage reserves of developing seeds and on seedling vigor of Douglas-fir. Tree Physiology, **21**: 481-487.

Cool, S.T. & Crawford, M.L.J. 1970 Tungsten microelectrode preparations for CNS recordings. *Rev. Sci. Instrum.* **41,** 1506-1507.

Connelly, A.E. & Schowalter, T.D. 1991 Seed losses to feeding by *Leptoglossus occidentalis* (Heteroptera: Coreidae) during two periods of second-year cone development in western white pine. J. Econ. Entomol. **84,** 215–217.

Hedlin, A.F., Yates III, H.O., Cibrian-Tovar, D., Ebel, B.H., Koerber, T.W. & Merkel, E.P. 1981 Cone and seed insects of North American conifers. Canadian Forestry Service. USDA Forest Service, and Secretaria de Agridtura y Recursos Hidrauïicos. Mexico. 122 pp.

Strong, W.B., Bates, S.L. & Stoehr, M.U. 2001 Feeding by *Leptoglossus occidentalis* Heidemann (Hempitera: Coreidae) reduces seed set in lodgepole pine. *Can. Entomol.* **133,** 857-865.

Takács, S., Bottomley, H., Andreller, I., Zahradnik, T., Schwarz, J., Bennett, R., Strong, W. & Gries, G. 2009 Infrared radiation on hot cones from cool conifers attracts seed-foraging insects. *Proc. R. Soc. B.* **276,** 649-655.

2010/11 Budget Form

Forest Genetics Council of British Columbia
Pest Management Sub-Program

Activities and Costs

In **the cost breakdown** table below, list project activities and related costs. If needed, explanatory comments may be added below the table. *If additional sources of funding are being used in this project, please provide details*
Note: Information in this section will be routinely and publicly released.

Applicant: Ward Strong
Project title: Pesticide Trials 2010

Activity	Salary	Equipment	Travel	Materials, supplies	Other	Admin.	Total
Contract to local pesticide research consultant					20,000	1000	21,000
Contract to cone & seed pest expert for cone half-cuts					5,000	250	5,250
Seed Extractions					5,000	250	5,250
Seed germination tests					500	25	**525**
FGC request: Totals by cost category	$	$			30,500	1,525	32,025

Explanatory comments:

Details of other funding:

Requested from FGC:	32,025
Other source:	$
Other source:	$
Other source:	$
Total Project Budget:	32,025

Proposal Form

Forest Genetics Council of British Columbia
Pest Management Subprogram

Application Form

Project Title: Pesticide Trials 2010

Name of Applicant/Project Leader Ward Strong

Legal Name of Organization:
BC Ministry of Forests

Mailing Address:
3401 Reservoir Rd
Vernon, BC V1B 2C7

Telephone: 250-260-4763
Fax: 250-542-2230
E-Mail Address: ward.strong@gov.bc.ca
Financial Officer: Jill Peterson

Outline of Project

Continue pesticide trials project from 2009, using the most promising pesticides to generate registration data.Data from 2009 has not been analyzed, so pesticide selection has not been made.Trials will be conducted in two tree species (Sx and Fd).

Project Duration (# of years):1	Project year (1st, 2nd, etc.):1

Estimated Project Costs: $**32,025**

Total requested for FY 2010/11: $**_$32,025**_____

FY 2011/12: $_____

FY 2013/14: $_____

FY 2014/15: $_____

Estimated overall project cost: $_____

Project Description

Please use the following headings.

Needs:

The seed orchard industry in BC relies heavily on the use to two pesticides to control its major insect pests. Both pesticides are likely to soon lose their registration status, leaving orchard managers with a lack of pest management options. This trial will help identify replacement pesticides for seed orchard registration.

Objectives:

To refine testing of the most promising pesticides tested in 2009, gathering data for registration. New pesticides may be tested if none of the 2009 products were promising.

Procedure:

One spruce and one Douglas-fir breeding orchard at the Kalamalka Forestry Centre will be selected. In each, 100 trees with cone crops will be identified. 10 treatments (yet to be determined) will be applied to each of 10 trees:

- *Treatments*
  - Water control
  - Grower standard (commercial formulation of dimethoate)
  - 4 insecticides to be determined (1 rate per product, either 1 or 2 applications)
  - Total of 10 treatments
- *Experimental set-up:*
  - Field-grown conifer trees, various sizes, at Kalamalka Research Centre, Vernon
  - 1 host, 10 treatments, 10 replicates (one tree per replicate), total 100 trees
  - One non-treated buffer tree around each sprayed plant
  - Complete block design
- *Application of treatments*
  - For each test product, one or two applications, timing to be determined in spring
  - Treatments applied with a hand-operated back-pack sprayer at 30 psi.
  - Application for thorough plant coverage, volume target 1000 liters / hectare.
- *Assessment: cone collection in early summer*
  - Late June to early July, 10 cones per tree X 100 trees.
  - Cones kept refrigerated for prompt shipping to contractor in Gibsons.
  - Evaluation of pest infestation by dissection of cones.
- *Assessment: cone collection in late summer to early fall*
  - When cones are mature, 10 cones per tree X 100 trees.
  - Cones sent to the Kalamalka Research Station.
  - Evaluation of seed quality from standard procedures (see below).
- *Assessment: phytotoxicity rating of plant damage*
  - Rating of phytotoxicity damage on a 1-unit scale from 0 (none) to 10 (dead).
  - One rating for each experimental tree at 0, 2, 7 and 21 days after treatment.

Seed extraction
-Seeds extracted from each harvested sample using standard small-lot procedures-Seeds X-rayed; count the filled, empty, and megastigmus-infested seeds

Seed germination

-10 tests (combined reps from each treatment)

Location:

Kalamalka Forestry Centre

Output and Deliverables:

Pesticide efficacy data for submission to PMRA in support of an URMULE pesticide registration application.

Oral and written reports at seed orchard meetings and industry newsletters.

Who will benefit from this work?

Seed orchard managers and pest management personnel.
Seed users (Industry)

Budget:

Complete the attached budget form and provide a detailed cost breakdown for the first year. Show contributions from other sources if applicable. For multi-year projects, the Forest Genetics Council can provide no guarantee of funding beyond the first year.

Project Team:

List organization of project team members; including the contact name, address, and phone number for each

Ward Strong, Ph.D., P.Ag.
Research Scientist, Cone and Seed Pests
B.C. Ministry of Forests & Range
Kalamalka Forestry Center
3401 Reservoir Rd
Vernon, BC Canada
V1B 2C7

Phone: (250) 260-4763
Fax: (250) 542-2230
email: ward.strong@gov.bc.ca

Signature Block:

Name (authorization for application): _____

Signature:_____ Date:_____

2010/11 Budget Form

Forest Genetics Council of British Columbia
Pest Management Sub-Program

Activities and Costs

In **the cost breakdown** table below, list project activities and related costs. If needed, explanatory comments may be added below the table. *If additional sources of funding are being used in this project, please provide details*
Note: Information in this section will be routinely and publicly released.

Applicant: Robb Bennett
Project title: Cone and seed pest management – Interior operations

Activity	Salary	Equipment	Travel	Materials, supplies	Other	Admin.	Total
Surveys/Extension (see below)	7,000						**7,000**
Projects (see below)	4,600						**4,000**
See below				6,000			**6,000**
See below			6,000				**6,000**
See below						1,400	**1,400**
FGC request: Totals by cost category	$ 11,600	$	$ 6,000	$ 6,000	$	$ 1,400	$ 25,000

Explanatory comments:

- Salaries -- ~0.33 FTE technical assistance for operational surveys and research including trials set-up, data collection, and reports.
- Travel – Field work at orchard, natural stand, and research sites. 1 return trip Vernon/Victoria per quarter for Biologist plus up to 2 return trips Victoria/Vernon per annum for project leader (~$400 each). Participation of Biologist in professional meetings, workshops, and other tech transfer activities.
- Materials & Supplies – Lab reference materials & publication costs (~ $1500). Equipment maintenance, office, lab, and field expenses.
- Administration costs – standard 5% Ministry of Forests & Range overhead on Forest Genetics Council projects.

Details of other funding:

Requested from FGC:	$
Other source:	$
Other source:	$
Other source:	$
Total Project Budget:	$

Proposal Form

Forest Genetics Council of British Columbia
Pest Management Subprogram

Application Form

Project Title:
Cone and Seed Pest Management – Interior Operations

Name of Applicant/Project Leader
Robb Bennett

Legal Name of Organization:
BC Ministry of Forests & Range

Mailing Address:
7380 Puckle Road
Saanichton BC V8M 1W4

Telephone: 250 652-6593
Fax: 250 652-5600
E-Mail Address: robb.bennett@gov.bc.ca
Financial Officer: Cheri Tayler

Outline of Project

This proposal seeks to cover operational expenses for the Interior seed pest management biologist's activities including all expenses associated with travel to orchard sites and related field work and extension activities, vehicle and facility maintenance, laboratory and office supplies, and wages for auxiliary technical support (as needed, ~ 0.33 fte) to assist in the establishment and/or monitoring of operational pest management trials and/or the analysis of resulting data and development of new operational techniques suggested by data analysis.

Project Duration (# of years): on-going	Project year (1st, 2nd, etc.): 15th

Estimated Project Costs:

Total requested for FY 2010/11: $_25 000	FY 2013/14: $_____	Estimated overall project cost: $_**25 000 per annum**
FY 2011/12: $_**25 000**__	FY 2014/15: $_____	

Project Description

Please use the following headings.

Needs:

Describe background, specific pest management needs or benefits to be achieved, and how this project will support Forest Genetics Council objectives.

Cone and seed insects can have serious impacts on conifer seed production and require routine professional management. Cone and seed pest management service to the Interior Tree Improvement Program is currently handled by a BC Ministry of Forest & Range biologist working out of the Kalamalka Seed Orchards site in Vernon, BC. This position was established in 1996 with FRBC funds; subsequently, funding was covered by the Operational Tree Improvement Program with base salary dollars coming from Ministry of Forests starting in late 1998. Oversight of this project was transferred to the Pest Management Program for the 2008-09 fiscal year. Having a pest management biologist stationed in the Interior has proved invaluable for servicing the needs of the conifer seed production community there. That community has been very happy with the level of service this position has provided them and is unanimously supportive of its continuation.

Objectives:

Outline objectives of the proposed work.

- Provide pest management extension services to all interior BC Ministry and private seed orchards and natural stand cone and seed dealers.
- Develop new (and improve existing) pest management protocols
- Prepare written extension reports for presentation to orchard managers and/or publication in venues such as CTIA News Bulletin, The Canadian Entomologist, *etc*.
- Participate in training in cone and seed pest management practices to professional foresters and biologists, orchard managers, and relevant technical personnel.
- Facilitate cone and seed pest management related research activities through collaboration with provincial, national, and international researchers whenever possible and feasible.

Procedure:

Briefly (up to 2 pages) describe technical details of the project, including methodology and projected dates for completing specific activities.

The Interior Cone and Seed Pest Management Biologist's duties include:

- (All quarters) Aids in seasonal surveys of the ministry, industry, and private orchards and natural stand cone crops to measure and assess potential pest infestations by: structuring survey designs and providing technical direction and training to orchard personnel in damage prediction and the detection, sampling, and identification of pests using accepted sampling techniques; providing integrated pest management recommendations based on the surveys (in keeping with federal, provincial, and local environmental laws) to reduce pest losses; conducting post-treatment evaluations to determine prescribed treatment effectiveness; communicating the findings to ministry and industry through verbal and written reports and in the scientific literature; providing on-site training in the use of control agents and procedures; conducting periodic reassessments of traditional procedures.
- (All quarters, as needed) Conducts experimental operational trials to test pest controls by: performing literature searches and liaising with federal/provincial, international, and industrial agencies to recommend testing of new pest management techniques; preparing and carrying out specific workplans including experimental design, implementation guidelines, and proposed analysis; conducting detailed evaluations of samples including germination tests, cone dissection, photographic records, insect/disease identification, and damage assessments; conducting statistical tests, evaluating results and conclusions, and preparing written reports for presentation to seed orchards across the province; and implementing experimental results through technology transfer.
- (All quarters, but primarily 3rd and4th) Summarizes surveys of cone and seed pests and their control in order to supply orchard managers and other personnel with information for annual plans and budgets by: analyzing data from orchard and natural stand surveys and trials; drafting summaries of actions and results; preparing written reports documenting trials and surveys; assisting the transfer of pest management technology by writing articles for newsletters and making formal and informal presentations to the seed orchard community, students, and academics.
- (All quarters, as needed) Conducts related seed pest management activities by: collecting and preserving sample material; attending forest pest management committee meetings; supervising seasonal technical staff; advising staff on the safe and effective use of pesticides, collecting, maintaining and distributing extension materials from other agencies; and co-operating with other provincial, federal, and international agencies in generating pest management information.

The Interior Cone and Seed Pest Management Auxiliary Assistant Biologist duties include:

- (All quarters, as needed) Under supervision of the Interior Cone and Seed Pest Management Biologist, assist as needed in operational surveys and in experimental trials set-up, data collection, and reports.

Location:

List facilities and/or field sites where the project activities will take place.

This project will be run from the established cone and seed pest management lab facility at the Ministry of Forests and Range Kalamalka Seed Orchards site in Vernon BC. Activities will take place at all Interior seed orchard sites and, where and when relevant, in natural stands or other field locations.

Output and Deliverables:

List the specific products to be produced as a result of this investment.

Advice and services will include the following:

- Visits to all orchard sites to aid in monitoring and assessment of crop pests.
- Advising orchard staff of crop pest status through oral and written reports and, as needed, providing training and direction in exercising pest management options and related matters.
- Delivering cone and seed pest management workshops to universities, community colleges, and other educational institutions as requested.
- Development of new and modification of existing pest management methods to enhance efficacy and environmental soundness.
- Development of, and active participation in, BC cone and seed pest management research conducted by other institutions (e.g., universities, Canadian Forest Service, private contractors)
- Technology transfer through regular contributions to newsletters, publications in scientific journals, and presentations to seed orchard groups and industry associations (e.g., BC Seed Orchard Staff Group) and professional associations (e.g., Entomological Society of Canada, Entomological Society of British Columbia, Western Forest Insect Work Conference).

Who will benefit from this work?

Who are the direct clients?

All Interior seed orchard managers and personnel and others involved in Interior conifer seed production

Budget:

Complete the attached budget form and provide a detailed cost breakdown for the first year. Show contributions from other sources if applicable. For multi-year projects, the Forest Genetics Council can provide no guarantee of funding beyond the first year.

Project Team:

List organization of project team members; including the contact name, address, and phone number for each

The "work team" is composed of

- R. Bennett, Project Leader, (& co-supervisor of Biologist) — BC Ministry of Forests & Range, 7380 Puckle Road, Saanichton BC V8M 1W4, 652-6593
- J. Corrigan, Biologist — BC Ministry of Forests & Range, 3401 Reservoir Road, Vernon BC V1B 2C7, 549-5696
- C. Walsh, Orchard Manager (& co-supervisor of Biologist) — BC Ministry of Forests & Range, 3401 Reservoir Road, Vernon BC V1B 2C7, 260-4777

The Biologist works closely with other Interior seed orchard managers and personnel and others involved in Interior conifer seed production. The "team" works in close collaboration with:

- W. Strong, Research Scientist — BC Ministry of Forests & Range, 3401 Reservoir Road, Vernon BC V1B 2C, 260-4763

Signature Block:

Name (authorization for application): Robb Bennett

Signature: _____ Date: 15 Feb 2010

FGC **Forest Genetics Council of British Columbia**

Forest Genetics Council of BC – Pest Management Sub-Program

Project Report: ☐ Interim

☐

Project Title:

Cone and Seed Pest Management – Interior Operations

Name of Project Leader:

Robb Bennett

Name of Organization:

BC Ministry of Forests

Mailing Address

7380 Puckle Road
Saanichton BC V8M 1W4

Telephone: 250 652-6593

Fax: 250 652-5600

E-Mail Address: robb.bennett@gov.bc.ca

Financial Officer: Cheri Tayler

Approved Project Funding: **$ 18 200**

Executive Summary: One or two paragraphs summarizing progress to date.

This on-going project has been in annual operation since 1996. As in previous years, the Interior seed pest management biologist provided relevant services to the Interior Tree Improvement Program. Services included orchard site visits, reports to Interior orchards, pest management advice to orchard personnel and general public, pest management representation and presentations at professional meetings, technical assistance to pest management research and operational projects, and continuing development of reference and research insect collections.

Objectives: One or two sentences. May be copied from proposal.

To cover operational expenses for the Interior seed pest management biologist's activities including all expenses associated with travel to orchard sites and related field work and extension activities, vehicle and facility maintenance, laboratory and office supplies, and wages for auxiliary technical support (as needed, ~ 0.33 fte) to assist in the establishment and/or monitoring of operational pest management trials and/or the analysis of resulting data and development of new operational techniques suggested by data analysis.

Procedures: Activities carried out to date. One to several paragraphs. May be copied from proposal.

This project is run from the established cone and seed pest management lab facility at the Kalamalka Seed Orchards site and provides pest management advice and extension services to all interior seed orchards and, on an as-requested basis, to and other relevant personnel. Advice and services include the following:

- Visits to all orchard sites to aid in monitoring and assessment of crop pests.
- Advising orchard staff of crop pest status through oral and written reports and, as needed, providing training and direction in exercising pest management options and related matters.
- Delivering cone and seed pest management workshops to universities, community colleges, and other educational institutions as requested.
- Development of new and modification of existing pest management methods to enhance efficacy and environmental soundness.
- Development of, and active participation in, BC cone and seed pest management research conducted by other institutions (e.g., universities, Canadian Forest Service, private contractors)
- Technology transfer through regular contributions to newsletters, publications in scientific journals, and presentations to seed orchard groups and industry associations (e.g., BC Seed Orchard Staff Group) and professional associations (e.g., Entomological Society of Canada, Entomological Society of British Columbia, Western Forest Insect Work Conference).

Results: Describe results to date. Figures, tables, and graphs are welcome. One-half to two pages.

- 41 Interior orchard site visits.
- 26 reports to Interior orchards.
- 20 pest control consultations/recommendations with Interior orchard personnel.
- 22 professional, business, & teleconference meetings (including ESBC, PMTAC, TIB).
- 9 presentations – e.g. to ITAC, WFIWC, seed orchard personnel.
- Ongoing technical assistance to PMTAC projects.
- Addressed 15 public enquiries.
- 8 different packages of materials supplied to Interior orchards (e.g. pheromone lures, cameras, collecting kits).
- 2 shipments of specimens sent to museum collaborators.
- Addition of about 1,400 insect specimens to reference/research collections.

Deliverables: What products have been produced as an outcome of this work? Should align with Output and Deliverables from proposal. One or two paragraphs.

As above:

- 26 reports to Interior orchards.
- 9 presentations – e.g. to ITAC, WFIWC, seed orchard personnel.
- 8 different packages of materials supplied to Interior orchards (e.g. pheromone lures, cameras, collecting kits).
- 2 shipments of specimens sent to museum collaborators.
- Addition of about 1,400 insect specimens to reference/research collections.

Future work: Suggestions for future directions, or next year's work planned for this project (if a multi-year project). One or two paragraphs.

Continuation in a manner similar to current and preceding years.

Robb Bennett
15 Feb 2010