

**Department of National Defence— CFB Esquimalt**  
**Environmental Science Advisory Committee**

**REPORT**

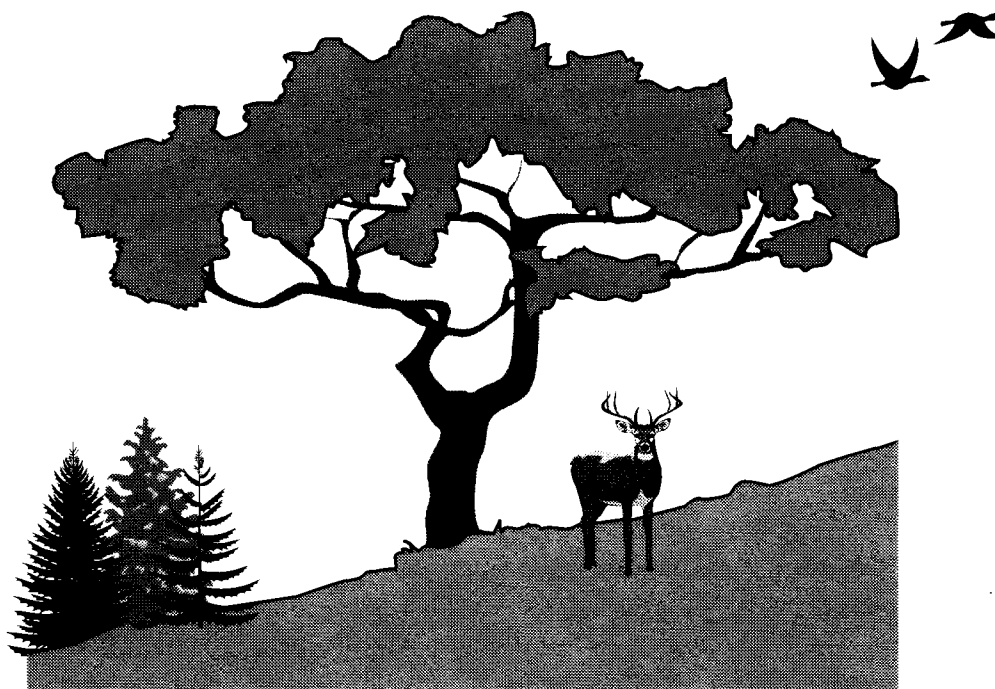
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**1997 Annual Report**

Prepared for the Committee by:

Arthur Robinson  
J.A. Trofymow

May, 1998



Natural Resources  
Canada

Canadian Forest  
Service

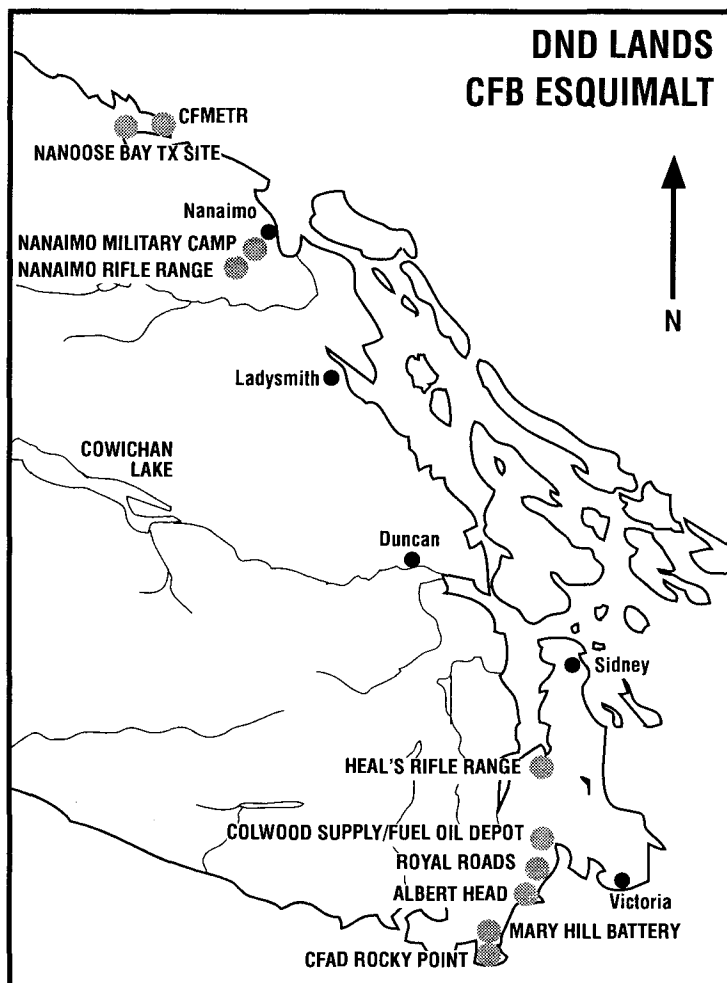
Ressources naturelles  
Canada

Service canadien  
des forêts

**Canada**

The Department of National Defence Science Advisory Committee (ESAC) – CFB Esquimalt was established in 1994 under a letter of understanding as a technical advisory committee reporting to the joint Department of National Defence / Canadian Forest Service Forest Resource Management Committee. ESAC is a multiagency committee composed of representatives from the Department of National Defence, Canadian Forest Service and Canadian Wildlife Service and representatives from Universities and other interested provincial agencies. The committee has the responsibility of providing professional expertise, advice and supervision of research being conducted on CFB Esquimalt properties and providing opportunities for dissemination of the research results.

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The Federal Land Forester  
Natural Resources Canada  
Canadian Forest Service  
Pacific Forestry Centre  
506 West Burnside Road  
Victoria, BC V8Z 1M5

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Natural Resources Canada  
Canadian Forest service  
Pacific Forestry Centre  
506 west Burnside Road  
Victoria, B.C.  
V8Z 1M5

Environmental Science Advisory Committee member agencies:

- |  |                            |
|--|----------------------------|
| * Department of National Defence           | * Canadian Forest Service  |
| * Canadian Wildlife Service                | * B.C. Ministry of Forests |
| * University of Victoria                   | * Royal Roads University   |
| * Lester B. Pearson College of the Pacific |                            |

The report was funded through the DND Forest Resource Management Program, jointly managed by the Department of National Defence and the Canadian Forest Service.

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# **DND Environmental Science Advisory Committee - CFB Esquimalt**

## **1997 Annual Report**

### **1. Summary**

The DND Environmental Science Advisory Committee was established in 1994 as a multi-agency technical advisory committee reporting to the DND Forest Resources Management Committee. The committee set up a formal permitting system to facilitate the tracking of proposals to do research on CFB Esquimalt lands. During 1997 a total of 24 proposals were received and 24 permits were issued. The committee met four times during the year to review policy and proposals.

To facilitate the communication and transfer of results of research on DND properties to member agencies as well as amongst researchers working on CFB Esquimalt lands the committee cosponsored one workshop during the year. The workshop was open to all project proponents who had done research on DND lands during the year and was held at Royal Roads University in Victoria. Eleven papers were presented by researchers. The workshop was attended by 30 representatives from various organizations and backgrounds.

This purpose of this report is to provide background on the committee, its terms of reference and information on the permitting process. As well the report provides research summaries of reports for projects completed in 1997 and annual reports for projects continuing in following years. A cumulative bibliography of reports on environmental research conducted on CFB Esquimalt lands since 1994 and available at the Pacific Forestry Centre Library is also provided.

### **2. Introduction**

Over the years various individuals and organizations carried out environmental research projects on Department of National Defence (DND) lands. As these lands have been relatively undisturbed due to the nature of their use, they have provided researchers with a unique opportunity, and hence their popularity. Much of this research was ad hoc and uncoordinated and no attempt was made to keep track of it.

As environmental issues and concerns became more important, attention began to be focused on the research values of the properties. In 1993 a workshop was sponsored by DND to determine what research had been carried out on the properties. Researchers and others were invited to the workshop to make presentations on their work. A report was produced that gave a compendium of the work done. It became evident that there was a need to track this research.

### **3. DND Environmental Science Advisory Committee - CFB Esquimalt**

As a result of the recognition of the need for a more formal arrangement to review and track research projects, DND and the Canadian Forest Service (CFS) worked together with the Canadian Wildlife Service and other agencies to organize a multi-agency committee to oversee research being carried out at Rocky Point. The committee was structured as a subcommittee under the terms of the DND/CFS Memorandum of Understanding on Forest Management. Soon after the committee was formed it became apparent that the committee's mandate for only the one property should be expanded to other properties. In 1995 the committee increased its mandate to include all DND properties at CFB Esquimalt. In 1996, the membership of the committee was expanded to include one representative from Royal Roads University.

**A. Organization and Terms of Reference** - The DND Environmental Science Advisory Committee (ESAC) - CFB Esquimalt was established in 1994 under a letter of understanding as a technical advisory committee reporting to the joint Department of National Defence/Canadian Forest Service Forest Resource Management Committee. ESAC is a multi-agency committee composed of representatives from the Department of National Defence, Canadian Forest Service, Canadian Wildlife Service, University of Victoria, Lester B. Pearson College of the Pacific, Royal Roads University and the B.C. Ministry of Forests with the responsibility of providing professional expertise, advise and supervision of research being conducted on CFB Esquimalt properties

The terms of reference of the committee was to review and evaluate research proposals for projects on DND lands and to advise DND on the proposals. The committee was to track the proposals and permits and to report on them.

The committee was also initiated to facilitate the establishment and review of projects for the Forest Canopy Station owned and maintained by the Lester B. Pearson College of the Pacific. This facility was built by the College in 1994 to allow researchers and student assistants access into the tree crowns in a stand of old Douglas-fir located on the Rocky Point property. The facility is operated under the auspices of a Forest Canopy Research Station Operating Committee (FCRSOC), a subcommittee reporting to ESAC. The FCRSOC committee is responsible for the day to day operation and safety and maintenance of the station.

**B. Research and Collection Activities Permit System** - To facilitate the tracking of the proposals the committee developed and implemented a formal permit process. Proposals are submitted to ESAC which reviews and evaluates the projects proposed for the properties and recommends to the DND/CFS Forest Resource Management Committee which should be permitted. As well, ESAC has the responsibility for collecting and archiving resulting research reports, making them available to member agencies of the committee as well as other interested agencies for use or subsequent cataloguing.



A Research and Collection permit is required for natural science activities within DND properties. Activities for which a permit is required include but may not be limited to:

- the collection of flora, fauna or geological specimens;
- research that involves being in an area to which general access by the public is restricted or prohibited;
- research that involves physical disturbance to the land or any other adverse effect on the environment;
- research that involves the setting up of scientific monitoring instruments or of structures used in connection with scientific research; and
- research that requires the exclusive use of any portion of a DND property.

Permits are issued on an annual basis and are applicable for the DND property (ies) for which they were issued. Permits may be issued for longer term projects (a maximum of three years in duration) but must be renewed annually.

Research by qualified researchers and institutions is encouraged on DND property especially research which contributes to the knowledge and understanding of the functioning of ecosystems and environmental management.

**C. Reporting Activities** - To facilitate the communication and transfer of results of research on DND properties to member agencies as well as amongst researchers working on CFB Esquimalt Lands the committee sponsors one workshops during the year. The workshop is open to all project proponents who have done research on DND lands during the year. Further details on results from these workshop are provided below.

Each permittee is required to submit an annual report on the results of the work done during the year or a final report if the project is finished. These reports are compiled and published by ESAC in an annual report. Further details on the research reports for permitted projects completed in 1997 and annual reports for permitted projects continuing in following years are detailed in the following sections and appendices. Reports on environmental research conducted on CFB Esquimalt lands since 1994 are archived at the Pacific Forestry Centre Library. A cumulative bibliography of these reports is provided In Appendix 1.

#### **4. Research Projects on DND Esquimalt Properties During 1997**

This past year, 1997, was the third full year of activity for ESAC which received a total of 24 proposals for research on CFB Esquimalt properties. Table 1 summarizes information on the proponent, title and brief description for each proposal received.

The committee met four times during the year to review and tract the status of the various proposals that were received. Of the 24 proposals received, 24 were approved and received permits. The status of these 24 approved proposals is shown in Table 2.

Researchers submitted written annual reports on their activity if projects are continuing and a final report when the project is complete. These reports are compiled as part of this annual report and are provided in Appendices 3 and 4.

**A. ESAC Workshop** - In January of 1998 at Royal Roads University, Victoria, the ESAC sponsored a workshop, providing an opportunity for the investigators to present the results of their studies. Thirty individuals attended the workshop (Appendix 2). Eleven presentations were made and final and annual reports from these presentations are included in Appendices 3 and 4.

**B. Forest Canopy Research Station Activities** - The Facility was accessed on 5 occasions during the year, mainly by Lester B. Pearson College.

**C. Geographic Information System Database Compilation and Conversion-** Over the last four years, staff from the Department of National Defence, Canadian Forest Service, Canadian Wildlife Service and other agencies have collaborated extensively through the Environmental Science Advisory Committee in the delivery of environmental programs on DND properties, particularly on southern Vancouver Island. During that period much information has been gathered to assess the ecological character of these lands. The committee initiated a project to merge these new data sets with the existing data and to begin a process of analysis to develop conservation management plans for these very significant properties.

As much of this information was in varying formats and quality a common Geographic Information System (GIS) format, Arc/Info, was decided upon. The GIS project funded by DND in Jan., 1997, compiled and converted the existing spatial data sets. The initial phases of the project were completed with the preliminary compilation and conversion of all the identified baseline data sets on 19 properties into a common Arc/Info format. Additional point data (on rare species, special sites, etc.) was converted into map coverages. The data is stored as Arc/Info coverages at the Canadian Forest Service where it is available to the three federal agencies through the use of Arc/View as the tool used to view data, display plans, produce small maps and query the database.

Remote access to this data by DND and other agencies has not yet been achieved due to technical difficulties. Instead data will be copied to a CD-ROM which will be made available to DND and CWS. The map coverages and point data need to be reviewed for accuracy.

## **5. Outlook for 1998**

The committee will continue its activities in 1998 reviewing and tracking the status of various research projects on DND Lands, sponsoring an annual workshop for researchers and compiling these results in an annual report. As well the committee is investigating setting up a WEB site to further facilitate the dissemination of research findings.

With the initial phases of the GIS project completed, the next component of the project (proofing of the map coverages and point data, updating of the data) will be initiated. The Arc/Info coverages will be copied on to a CD-ROM and made available to DND and CWS.

This increased capacity should greatly help highlight areas of significance or research interest to current and future investigators and to DND personnel conducting operations and training activities on these properties.

A workshop to be held in March, 1998 will review and revise conservation management plans for the 4 properties covered by the reports prepared by Madrone Consultants Ltd. (Reports # 11 and 14 in Appendix 1). The four properties are Albert Head, Mary Hill Battery, CFAD Rocky Point and Royal Roads.

**Table 1: Formal Research Project Proposals for DND Properties - 1997**

<i>Proposal #</i>	<i>Agency</i>	<i>Project</i>	<i>Proponent</i>	<i>Contact</i>	<i>Project Description</i>	<i>Location</i>
97- 1	Canadian Forest Service	Study of the Impact of Acorn Feeding Insects on the Garry Oak Ecosystem in the Southern Vancouver Island Area	Imre Otvos	Tony T.	A study to determine the proportion of Garry Oak acorns infested and killed by the filbert weevil and filbert worm and to determine the biology of the more damaging insect with the aim of reducing its damage.	MPB, RP
97- 2	Canadian Forest Service	Genetic Variation in Garry Oak ( <i>Quercus garryana</i> )	Edwards / Meagher	Tony T.	Study of genetic variation of Garry Oak with an assessment of genetic variation in different populations of Garry Oak.	MHB, CFMETR
97- 3	Canadian Forest Service	Sustainable Development of Natural Sources of Taxol: Ecophysiology of Pacific Yew ( <i>Taxus brevifolia</i> )	Al Mitchell	Tony T.	A study of physiological responses of Pacific Yew to seasonal changes in water, light, temperature and humidity to develop conservation options. Additional field measurements are to be made and preliminary statistical analysis completed.	RR, RP, CFOD
97- 4	Canadian Forest Service	Management of Spruce Weevil, <i>Pissodes strobi</i>	Michael Hulme	Tony T.	A study of parasites on the spruce weevil - <i>Pissodes strobi</i> . Release of parasite to attack spruce weevil and measure impact of parasite on weevil.	CFMETR, NTX
97- 5	Royal BC Museum	Bat Use of Man-made Structures on DND Lands	David Nagorsen	Garry F.	A study of bat use of man made structures. Monitoring of Townsend Big-eared bat colony to monitor population and do field studies of the colony.	MHB, RP
97- 6	Alula Biological Consulting	Sharp-tailed Snake ( <i>Contia tenuis</i> ) Inventory	Christian Engelstoft	Andy M.	This study is part of larger Sharp-tailed snake Inventory planned for the Coastal Douglas-fir Biogeoclimatic Zone. Method include searches for the snakes under natural cover objects as well as artificial cover objects on plots.	MHB, RP
97- 7	Canadian Wildlife Service	Microclimate Monitoring Station	Michael Dunn	Mike D.	The project is to operate a Microclimate Monitoring station installed in association with the Forest Canopy Research Station.	RPPC
97- 8	Malaspina University	Demographic Study of <i>Allium amplexans</i>	Allan Hawryzki	Andy M.	A long term study to monitor changes in population numbers and structure of <i>Allium amplexans</i> (slimleaf onion) populations using a stage-based matrix model.	CFMETR, NTX

<i>Proposal #</i>	<i>Agency</i>	<i>Project</i>	<i>Proponent</i>	<i>Contact</i>	<i>Project Description</i>	<i>Location</i>
97- 9	Ministry of Environment	Permanent Ecological Monitoring Plots on DND Lands at Rocky Point	Trudy Chatwin	Ken M.	The study involves the establishment of 2 long term monitoring sites (standard Smithsonian/Man and the Biosphere plots). One plot has been established in a coastal Douglas-fir ecosystem and a second is being established in a Garry oak ecosystem. Information to be collected on species composition, location, density and frequency for all woody species.	RP, RPPC
97- 10	University of Victoria	Community Ecology of the Canopy-Forest Floor Insect/ Arthropod Fauna from an Old Growth Forest	Neville Winchester	Neville	This study involves the documentation of the community composition of the canopy and ground insect/arthropod fauna in an old growth forest. This year's activities focus on arthropod feeding activities and on extension and demonstration.	RP, RPPC
97- 11	University of Victoria	Correlation Between Nitrogen of Litter/Soil and Mass of Collembola	J. Eakins/ J.Wessel	Richard	This study compares the nitrogen in the soil of an undisturbed site with that of a disturbed site and correlates the concentration of nitrogen with the mass of collembola at these sites.	RPPC
97- 12	Ministry of Environment	Urban Cooper's Hawk Nesting Habitats	Andrew Stewart	Ken M.	This is a survey of DND lands to locate active Cooper's hawk nest sites.	CFOD, RR
97- 13	Victoria Natural History Society	Purple Martin Nestbox Program	Darren Copley	Ken M.	This project is a nestbox program for the Purple Martin colony on the Colwood Supply/Fuel Oil Depot property. The nestbox program repairs and maintains nestboxes and monitors the population of Purple Martins.	CFOD, RR
97- 14	Ministry of Environment	Survey for Spotted Frog ( <i>Rana Pretiosa</i> ) in Fraser Valley	Laura Friis	Ken M.	This project is part of larger Spotted Frog survey being carried out in the Lower Fraser Valley. Potential sites will be surveyed for this frog species. Species identification will be confirmed by lab analysis.	Aldergrove
97- 15	University of Victoria	Establishment and Monitoring of Plots in the Garry Oak Ecosystem Restoration and Monitoring Program	Dr. Richard Hebda	Mike D.	This study is the remeasurement of permanent monitoring plots established to test methods for the removal of exotic species (broom and gorse) and the documentation of the regeneration of exotic and native species on the test plots.	MHB, RP
97- 16	Canadian Wildlife Service	Migration Monitoring of Neotropical Migrant Birds	Rhonda Milliken	Mike D.	This study involves migration monitoring of Neotropical birds by: visual census surveys; mist-netting surveys; banding; and radar monitoring surveys.	RP
97- 17	Canadian Wildlife Service	Video Production of Canadian Wildlife Service 50th Anniversary - Rocky Point on Site Shoot	Mike Dunn	Mike D.	This project involves video-taping of interviews on site and sites of bird monitoring for inclusion in a video production on the 50th anniversary of the Canadian Wildlife Service.	RP

<i>Proposal #</i>	<i>Agency</i>	<i>Project</i>	<i>Proponent</i>	<i>Contact</i>	<i>Project Description</i>	<i>Location</i>
97- 18	University of BC	Population/Quantitative Genetics of Garry Oak	Pak Tajundin Komar	Tony T.	This study to observe the population genetics, reproduction ecology/pheology, and seedling survival in natural populations of Garry Oak for designing gene conservation management of the species in B.C.	RP, MHB, AH
97- 19	Fisheries and Oceans Canada	Workshop '97 - Salmon - A Part of Our Lives	Tom Rutherford	Gail F.	*A workshop to provide stream stewardship volunteers from all over the province, to get together, share expertise and information and learn new techniques that will assist them in carrying out stream stewardship and enhance activities in their communities.	RR, RP, CFOD
97- 20	University of Victoria	Instructions in Field Methods in Restoration	R. Hebda / M. Ryan	Tony T.	This project is part of a UVIC course in the Restoration Program where field methods for ecosystem restoration will be taught.	RR
97- 21	University of Victoria	Effects of <i>Ariolimax columbianus</i> on Comm. Stru. Fungus	Christine Roberts	Tony T.	This study investigates the interrelationships between fungivorous invertebrates and fungal community structure, with differing forest floor features. The emphasis is on the role of the banana slug <i>Ariolimax columbianus</i> as a potential vector and aid to establishment of fungal spores.	RR
97- 22	BC Conservation Foundation	Inventory Habitat and Use by Salish Suckers	Mike Pearson	Tony T.	This study involves the survey and mapping of fish habitat in the Salmon River and in Bertrand and Tyre Creeks. The study will also ascertain the presence or absence of Salish suckers in the various reaches identified.	Aldergrove
97- 23	Lester B. Pearson College of the Pacific	Biology and Other Science Research Projects	Brown/Mehrotra		The Rocky Point Forest Canopy Research Station facility is located on DND lands at CFAD Rocky Point. Students from LBPC will assess the canopy station site and collect various data and prepare a report on the results.	RP
97- 24	Lester B. Pearson College of the Pacific	Rocky Point Forest Canopy Research Station Project	Catrin Brown		A committee will be set up to oversee the operation of the facility with LBPCP being the head of the committee. The objectives are to ensure that the facility is maintained in a safe operating condition, available to any researcher who wants to use it. The use of the facility will then be tracked.	RP

***Table 2: Status of Permits Issued - 1997***  
***DND Environmental Science Advisory Committee - CFB Esquimalt***

<i>Proposal #</i>	<i>Permit #</i>	<i>Applicant</i>	<i>Project Title</i>	<i>Approved</i>	<i>Status- Report</i>	<i>Status- Complete</i>	<i>Annual Report</i>	<i>Final Report</i>
97- 1	P031-97	Imre Otvos	Study of the Impact of Acorn Feeding Insects on the Garry Oak Ecosystem in the Southern Vancouver Island Area	13 Mar 97	17 Nov 97	30 Nov 97	6 Jan 98	
97- 2	P035-97	Edwards / Meagher	Genetic Variation in Garry Oak ( <i>Quercus garryana</i> )	13 Mar 97	17 Nov 97	30 Nov 97	6 Jan 98	
97- 3	P005-97	Al Mitchell	Sustainable Development of Natural Sources of Taxol: Ecophysiology of Pacific Yew ( <i>Taxus brevifolia</i> )	13 Mar 97	17 Nov 97	31 Dec 97	5 Jan 98	
97- 4	P030-97	Michael Hulme	Management of Spruce Weevil, <i>Pissodes strobi</i>	13 Mar 97	17 Nov 97	31 Dec 97	6 Jan 98	
97- 5	P010-97	David Nagorsen	Bat Use of Man-made Structures on DND Lands	13 Mar 97	17 Nov 97	31 Dec 97	15 Apr 98	
97- 6	P024-97	Christian Engelstoft	Sharp-tailed Snake ( <i>Contia tenuis</i> ) Inventory	13 Mar 97	17 Nov 97	31 Dec 97	6 Jan 98	
97- 7	P023-97	Michael Dunn	Microclimate Monitoring Station	13 Mar 97	17 Nov 97	31 Dec 97	9 Mar 98	
97- 8	P017-97	Allan Hawryzki	Demographic Study of <i>Allum amplectens</i>	13 Mar 97	17 Nov 97	30 Nov 97	5 Jan 98	
97- 9	P002-97	Trudy Chatwin	Permanent Ecological Monitoring Plots on DND Lands at Rocky Point	13 Mar 97	17 Nov 97	31 Dec 97	25 Mar 98	
97-10	P006-97	Neville Winchester	Community Ecology of the Canopy-Forest Floor Insect/ Arthropod Fauna from an Old Growth Forest	13 Mar 97	17 Nov 97	31 Dec 97	6 Jan 98	
97-11	P036-97	J. Eakins/ J.Wessel	Correlation Between Nitrogen of Litter/Soil and Mass of Collembola	21 Feb 97	17 Nov 97	24 Feb 97		9 Mar 98
97-12	P025-97	Andrew Stewart	Urban Cooper's Hawk Nesting Habitats	10 Mar 97	17 Nov 97	30 Sep 97		
97-13	P018-97	Darren Copley	Purple Martin Nestbox Program	13 Mar 97	17 Nov 97	31 Oct 97	6 Jan 98	

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97-14	P037-97	Laura Friis	Survey for Spotted Frog ( <i>Rana Pretiosa</i> ) in Fraser Valley	21 Feb 97	17 Nov 97	30 Apr 97	25 Mar 98	
97-15	P032-97	Dr. Richard Hebda	Establishment and Monitoring of Plots in the Garry Oak Ecosystem Restoration and Monitoring Program	13 Mar 97	17 Nov 97	31 Dec 97	12 Feb 98	
97-16	P003-97	Rhonda Milliken	Migration Monitoring of Neotropical Migrant Birds	13 Mar 97	17 Nov 97	31 Oct 97	9 Jan 98	
97-17	P038-97	Mike Dunn	Video Production of Canadian Wildlife Service 50th Anniversary - Rocky Point on Site Shoot	13 Mar 97	17 Nov 97	23 Mar 97		9 Mar 98
97-18	P039-97	Pak Tajundin Komar	Population/Quantitative Genetics of Garry Oak	16 Apr 97	17 Nov 97	31 Oct 97		6 Jan 98
97-19	P040-97	Tom Rutherford	Workshop '97 - Salmon - A Part of Our Lives	09 May 97	17 Nov 97	18 May 97		4 May 98
97-20	P041-97	R. Hebda / M. Ryan	Instructions in Field Methods in Restoration	19 Jun 97	17 Nov 97	31 Aug 97	12 Feb 98	
97-21	P042-97	Christine Roberts	Effects of <i>Ariolimax columbianus</i> on Comm. Stru. Fungus	11 Sep 97	17 Nov 97	31 Dec 97	6 Jan 98	
97-22	P043-97	Mike Pearson	Inventory Habitat and Use by Salish Suckers	11 Sep 97	17 Nov 97	31 Oct 97	9 Jan 98	
97-23	P021-97	Brown/Mehrotra	Biology and Other Science Research Projects	15 Oct 97	17 Nov 97	31 Dec 97	4 May 98	
97-24	P022-97	Catrin Brown	Rocky Point Forest Canopy Research Station Project	13 Mar 97	17 Nov 97	31 Dec 97	4 May 98	



## **APPENDIX 1**

**Cumulative Bibliography of  
Environmental Science Reports on DND Lands  
Placed in the Pacific Forestry Centre Library**

**Cumulative List of  
Environmental Science Reports on DND Lands  
in Pacific Forestry Centre Library**

**Reports for Projects Prior to 1995**

1. Crippen Consultants. 1981. Engineering Feasibility and Environmental impact study for a proposed highway Bypass Route of Nanaimo, May 1981. Crippen Consultants, North Vancouver, B.C. for Ministry of Transport and Highways. 11 sections + app.
2. Juan de Fuca Environmental Consultants. 1990. Nanaimo Inner Route: Recreation and Landscape Assessments Constraints Report - Initial Identification of Park, Recreation and Landscape Contrants, March 1990. Jaun de Fuca Environmental Consultants, Victoria, B.C. Draft 26p. + app.
3. Edwards, W.C. 1990. Assessment of Impact of Highway Relocation near Nanaimo on Ambient Air Quality, July 1990. B.H. Levelton & Associates Ltd. Vancouver, B.C. Prepared for Graeme & Murray Consultants Ltd. Victoria. 15 p. + app.
4. Blood, Donald A. 1991. Island Highway Planning and Preliminary Design Project: Wildlife resource Assessment, February 5, 1991. D. Blood and Associates Ltd., Nanaimo, B.C. Prepared for Crippen consultants Ltd. and B.C. Ministry of Transport and Highways. 95p.
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May 1998

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**Annual Workshop  
Environmental Science Advisory Committee**

**January 29, 1998**

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**Department of National Defence - CFB Esquimalt**  
**Environmental Science Advisory Committee**

**ANNUAL WORKSHOP**  
**AGENDA**

8:15 a.m., January 29, 1998

Mews Conference Centre, Building 22,  
Royal Roads University,  
Colwood, B.C.

8:00 - 8:15                      Registration

8:15                              Welcome

8:30 - 10:00                  Presentations:

1. Michael Shepard for Rhonda Millikin - Permit No. P003-97  
Migration Monitoring of Neotropical Birds
2. Al Mitchell - Permit No. P005-97 - Sustainable Development of  
Natural Sources of Taxol
3. Richard Ring - Permit No. P006-97 - Community Ecology of the  
Canopy- Forest Floor Insect/Arthropod Fauna from an Old  
Growth Forest
4. Christian Engelstoft - Permit No. P024-96 - Sharp-tailed Snake  
Inventory
5. Allan Hawryzki - Permit No. P017-96 - Demographic Study of  
Allium amplexans
6. Mike Dunn - Permit No. P023-96 - Installation and  
Maintenance of Microclimate Station

10:00 - 10:15                  Break



10:15 - 12:00

Presentations:

1. Michael Hulme - Permit No. P030-96 - Management of Spruce Weevil - *Pissodes stobi*
2. Doris Rohlfs - Permit No. P031-96 - Infestation of Garry Oak Acorns by the Filbert Weevil and Filbert Worm
3. George Edwards/Mike Meagher - Permit No. P035-96 - Genetic Variation in Garry Oak
4. Richard Hebda - Permit No. P032-96 - Garry Oak Ecosystem Resoration
5. Christine Roberts - The Effects of *Ariolimax columbianus* on Community Structure of Fungus

12:00 - 1:15

Lunch

1:15 - 4:30

EMAN Workshop

4:30

Wrap up

## **APPENDIX 3**

### **Final Reports for Projects Completed in 1997**

**Permit No.:** PO36-97

**Title:** Correlation Between Nitrogen of litter/Soil and Mass of Collembola

**Author:** Jennifer Eakins/Joe Wessel

**Organization:** University of Victoria, Biology Department

**Location:** Rocky Point

**Start Date:** February 15, 1997

**Completion Date:** February 28, 1997

**Project Overview:**

The field study was conducted to investigate the correlation between soil organic nitrogen percentage and average body mass of mycophagus Collembola (Isotomidae) in the soil of an undisturbed site with a disturbed site. The concentration of nitrogen was correlated with the mass of collembola at these sites.

Sampling of soil and litter was carried out at 2 sites - one disturbed and one undisturbed. At each site samples were collected from 6 points. Each sample consisted of less than 1.3 l of soil/litter, i.e. 15 cm diameter by 7.5 cm depth. Observations were also made on the litter and canopy. The soil samples were analyzed for nitrogen concentration and collembolan content.

**Objectives:**

The project was used as a field project for Biology 412 (entomology) at the University of Victoria. The objective was to see if there is a correlation between soil organic nitrogen percentage in the soil and average body mass of mycophagus collembola on the two sites.

**Accomplishments to Date:**

Six soil and litter samples were collected from each of two sites - one a disturbed site (recently cleared) and an undisturbed site (125 year old Douglas-fir stand). Each sample was divided into two components - one for extraction of collembola, and one for organic nitrogen analysis. Analysis of the data showed that the undisturbed site had a greater mean soil organic nitrogen percentage than the disturbed site. The mean masses of Isotomidae in the two sites were not significantly different, showing no direct correlation between soil organic nitrogen percentage and collembola body mass. As the study was very limited no specific conclusions were formed. Further field studies were recommended to quantify the effects of habitat characteristics on collembolan mass and population size.

**Permit No.:** PO38-97

**Title:** Video Production of Canadian Wildlife Service 50<sup>th</sup> Anniversary Rocky Point on Site Shoot

**Author:** Michael Dunn

**Organization:** Pacific Wildlife Research Centre

**Location:** Rocky Point - Church Hill Forest Canopy Research Station

**Start Date:** March 15, 1997

**Completion Date:** March 16, 1997

**Project Overview:**

1997 was the 50<sup>th</sup> anniversary of the Canadian Wildlife Service and to help celebrate this event, the Media Resources Department of Capilano College were asked to develop a commemorative video. The theme of the video was CWS people and their sense of purpose through this 50 year period. The student film crew visited CWS work sites to record interviews and get some site video shots. The migration monitoring station at Rocky Point was viewed as being an ideal site location for one of these on-site shoots. Biologists were interviewed on site and portions of the interviews were used to produce a 15-20 minute video on the CWS which would be distributed to interested parties from schools, other agencies or community groups.

**Objectives:**

To interview CWS biologists doing what they like to do in the field setting and to use portions of these interviews to produce a 15 to 20 minute video.

**Accomplishments to Date:**

As CWS is celebrating its 50th Anniversary as the federal wildlife agency, a commemorative video was commissioned through the Capilano College Media Resources program. A student- led video production crew was assigned the project and they spent three months gathering information and shooting video of a selection of people and venues that would epitomize CWS present and future. Location shots were taken and interviews conducted at the Rocky Point Migration Monitoring Station. Segments of this shoot were used in the final production of " People, Partnerships and Protection." The video was featured at the 50th Anniversary celebrations in Ottawa, November 1, 1997 to great reviews of senior management.

<b>Permit No.</b>	P039-97
<b>Title</b>	Preliminary Study of Flowering Behaviour of Garry Oak ( <i>Quercus garryana</i> , Dougl. ex. Hook)
<b>Project Leader</b>	Tajudin Edy Komar
<b>Organization</b>	Department of Forest Science, UBC # 260-2357 Main Mall Vancouver BC .V6T 1Z4
<b>Locations</b>	Albert Head, Mary Hill Battery (Permit includes CFAD Rocky Point)
<b>Start Date</b>	April 14, 1997
<b>Completion Date</b>	August 31, 1997

### **Project Overview**

A preliminary observation of flowering behaviour of Garry oak (*Quercus garryana*, Dougl. ex. Hook) for further investigation on the effective population size.

### **Objectives**

- To provide information for further investigation on the effective population size of Garry oak using morphological variables (flowering behaviour).
- To investigate whether Garry oak is self-incompatible or self-compatible.
- To survey the population size and distribution.

### **Methods**

At this time, the observation on flowering behaviour was carried out by putting pollination bags on some trees in Albert Head and Mary Hill Battery. About 25 trees in total from both locations were chosen, from which small branches were selected and covered with pollination bags in later April/early May 1997. Mid to late August the bags were removed and the number of acorns from each bagged branches were counted/monitored.

During the period at which the catkins (male flower) were emerging, the variation in individual producing catkins was also observed. 1-2 months later when the early developed acorns were visible, the variation of individual producing acorn was also observed.

To survey population and its distribution, several areas within Mary Hill, Albert Head and Rocky Point were visited

## **Accomplishment/Results**

1. There were a lot of variation in term of the production of catkins from tree to tree, from branches to branches and the size of the tree.
2. The individuals which produced a large number of catkins do not necessarily produce large number of acorns. It is suspected that the flowering synchrony between male and female flower (either the timing between pollination and receptivity or the number of pistils produced) is the main cause of this occurrence. Other environmental condition is also important to consider.
3. Self-pollination trial showed that some of self-pollinated acorns developed into full size. However, it is too early to say that Garry oak is self-compatible. Larger size experiment should be carried out to prove this.
4. Small trees with diameter approximately 20 cm, even smaller, produced large number of catkins similar to that of larger trees. Small trees were also found to produce acorns, however, they were mostly aborted or failed to develop into full or normal size. This was observed in Albert Head location.

**Permit No.:** PO40-97

**Title:** Workshop '97 - Salmon - A part of Our Lives

**Project Contact:** Tom Rutherford  
(250) - 363 - 0233

**Organization:** Fisheries and Oceans Canada/Amalgamated  
Conservation Society

**Location:** Royal Roads University

**Start Date:** May 16, 1997

**Completion Date:** May 18, 1997

**Project Overview:**

DFO Community Involvement Division co-sponsors a workshop for volunteers on a biennial basis and the 1997 version was co-hosted by the Amalgamated Conservation Society at Royal Roads University in the Victoria area. These workshops offer participants a chance to improve their technical skills and network with like minded volunteers from throughout B.C. and the Yukon.

**Objectives:**

The project was used as a field project for Biology 412 (entomology) at the University of Victoria. The objective was to see if there is a correlation between soil organic nitrogen percentage in the soil and average body mass of mycophagus collembola on the two sites.

**Accomplishments to Date:**

- Over 25 workshops delivered over a 3 day period, most were given at least 2 or 3 times, allowing participants to design their schedule so as to include all the workshops of specific interest to them.
- Workshop topics included a range of outdoor and classroom activities including estuary evaluation and sampling techniques, water quality monitoring, stream mapping, fry identification, riparian planting, et., etc.

- The stream, ponds, and estuary at the Royal Roads site were used as outdoor classrooms through the event.
- Children's activities and workshops were held throughout the weekend.
- All meals were provided, and a banquet/dance was held Saturday night.

**Research Activities:**

None

**Extension and Demonstration:**

This was the entire focus of the event, with the target being representatives from the over 400 community groups and 1,000 schools who have entered into partnership with DFO to work towards the conservation and restoration of our salmonid populations and the watersheds that support them.

**Notes:**

- Carrie Mishima, Communication Officer in habitat and Enforcement produced an article in the HEB Highlights about the "Workshop '97".
- The previous DFO CID workshop was held in Williams Lake, the next will be held in Port Moody.



## **Appendix 4**

**Annual reports for Projects Worked on in 1997**

<b>Permit No.</b>	P002-97
<b>Title:</b>	Establishment and monitoring of permanent ecological plot in a Coastal Douglas Fir forest and a Garry-oak woodland at the Rocky Point Department of Defence lands
<b>Project Leader</b>	Trudy Chatwin (250) 751-3150
<b>Organization</b>	Ministry of Environment, Lands and Parks 2080 Labieux Road Nanaimo, B.C. V9T 6J9
<b>Start Date</b>	December 1994
<b>Completion Date</b>	December 1997

### **Location and Study Area Description**

The Coastal Douglas Fir plot (Figures 1 and 2) is located adjacent to Church Hill at Latitude 48°18'50", Longitude 123°32'33" (UTM 10U Easting 4599, Northing 53524) surrounding the Lester B. Pearson/UVIC canopy research site in a productive "old-growth" Douglas-fir-Salal community. This site occurs within the Coastal Douglas Fir Moist Maritime Biogeoclimatic Zone in Site Series 04 (Douglas fir Grand fir - Oregon Grape) (Meidinger and Pojar 1991). Under the Biophysical Classification scheme proposed by Ministry of the Environment both plots are located in the Georgia Basin Ecoregion, Nanaimo Lowlands Ecosection.

The Garry-oak plot (Figures 3 and 4) is located in the vicinity of Fossil Point and Cape Calver at Latitude 48°19'20", Longitude 123°32'33" (UTM 10U Easting 4599, Northing 53524) in polygon 120 in a Garry-oak Brome community.

The climate in the plot study area is characterized by warm, dry summers and mild wet winters. The area lies in the rain shadow of Vancouver Island and the Olympic Mountains. Mean annual temperature ranges from 9.2 to 10.5° C. The monthly average of the daily minimum temperature never falls below 0 degrees C. Mean annual precipitation varies from 647 to 1263 mm.

From our experience at the site, we expect the old-growth Douglas Fir site will have a generally cooler, moister micro-climate due to its position and riparian influence. The Garry-oak site is characterized by bedrock outcrops, a mixture of shallow and deep soils and greater exposure to the wind. It appears to be subject to greater extremes of temperature than the forest plot.

## **Project Overview**

As a signatory to the 1992 UN Convention on Biodiversity, Canada has committed itself to contributing to conserving biological diversity and to global efforts in conserving biological diversity. Article 7 and 12 of the Convention address the need for research and inventory of biodiversity. Canada's Biodiversity Strategy's (November 1994 draft) Goal #2 is "To improve our understanding of ecosystems and increase our resource management capability" and sub-objectives recommend the enhancement of biological inventory efforts especially in threatened ecosystems. As well, Environment Canada under the auspices of EMAN (Ecological Monitoring Assessment Network) has been directed to establish a series of long-term ecological monitoring stations across Canada.

The Smithsonian Man and the Biosphere Program (SI/MAB) focuses on problems associated global forest biodiversity, emphasizing practical applications of research to achieve sustainable resource management. SI/MAB has established a network of over 150 permanent long-term biodiversity monitoring plots in biosphere reserves and other forested areas (mostly tropical) that are rich in forest biodiversity. The plots are established using a consistent protocol.

As Rocky Point Military Reserve lies within the threatened Coastal Douglas Fir biogeoclimatic zone and has excellent examples of representative Douglas-fir and Garry-oak community types it provides an ideal site for the establishment and monitoring of permanent SI/MAB / EMAN ecological monitoring plots. The restricted access to the reserve and the association with other research projects lent additional value to having SI/MAB plots at Rocky Point.

The measurement and monitoring of the two permanent SI/MAB plots is a co-operative effort under the Ecological Monitoring Assessment Network (EMAN) of Environment Canada, the Ministry of Environment, Lands and Parks, the SI/MAB program with fieldwork and funding assistance provided by Canadian Department of Defence, Forestry Canada, Tara Martin and Luke Dielt.

To date we have surveyed and measured and described the Church Hill, Douglas-fir plot and the Calver Point Garry-oak plot according to the SI/MAB protocol. Plot data has been entered into the BIOMON program and stored within the world-wide plot system. Overall tree plot maps, individual quadrat maps, overall tree data and individual quadrat data forms have been compiled. As well, in conjunction with Pearson College students we took measurement to develop a vegetative profile of the Church Hill site. This information should be useful to the bat project and provides a horizontal pictorial representation of the forest structure in the Douglas fir forest. Work is being conducted at this time to redo the profile drawing and accompanying text. A dendrochronological study of the Douglas-firs in the Church Hill site was completed by Dr. Dan Smith and Dave Lewis of the University of Victoria Tree-Ring Laboratory. This report is included as an addendum to the report. Amphibian and snake cover boards have been placed in the Church Hill plot as part of an amphibian and Sharp-tailed Snake monitoring project.

The next steps for the project are to describe the understory vegetation of both plots, describe soil, measure Coarse Woody Debris, and start a lichen litterfall biomass investigation. I would like to further analyse wildlife tree data as the BIOMON program has not emphasized this aspect of the data. Climate monitoring equipment has been placed within the canopy of the Church Hill plot. Attention to the operation of equipment and a data collection regime will provide climatic information to go along with the vegetation information.

### **Goals and Objectives of the Work**

1. To establish and monitor 2 permanent 1 hectare plots according to Smithsonian/MAB protocol in a Coastal Douglas Fir old-growth forest at Church Hill and a Garry-oak woodland at Rocky Point.
2. To use the plots and data as a baseline for other forms of research and monitoring as well as to make comparisons with a Canadian and world wide system of SI/MAB plots

The specific objectives of the plot are to :

- inventory woody plants and their distribution
  - record forest structure
  - detect patterns of recruitment, mortality and regeneration of forest trees
  - determine the relative influence of abiotic factors (soil and climate), natural disturbance and human caused disturbance
3. To establish a long-term monitoring protocol that will detect trends, such as patterns of recruitment, mortality, and regeneration of forest trees in the Coastal Douglas Fir ecosystem.

### **ACCOMPLISHMENTS OF THE PROJECT IN 1997**

The 1996 project report provided the results of the Smithsonian Man and Biosphere plot measurements for both the Cape Calver Garry Oak and the Church Hill Douglas-fir Plot. No additional plot measurements were taken in 1997. The plot can be remeasured and monitored in future years.

**Permit No.:** P003-97

**Title:** Migration monitoring of Neotropical Migrant Birds

**Project Leader:** Rhonda L. Millikin, M.Sc., A.P.Bio. 604-940-4669

**Organization:** Canadian Wildlife Service  
5421 Robertson Rd., RR1  
Delta, B.C. V4K 3N2

**Location:** CFAD Rocky Point, Building 100

**Start Date:** Spring (23 April) then again in fall (27 July)

**Completion Date:** Spring (31 May) then again in fall 12 October)

**Project Overview:**

This is part of an International effort to establish a network of long-term migration monitoring stations for landbirds. Rocky is an important stopover site for songbird migrants. We have now sampled 80 species of birds over a 4 year period (1994-1997) using a standard banding technique. This data will provide population trend information and an indication of the importance of the site for "fueling" songbirds during their migration. We are also comparing traditional methods with a nocturnal sampling system that incorporates radar and acoustic technology to monitor songbirds during their night-flight (traditional methods sample only individuals that have stopped over the day).

Objectives: 1. To demonstrate the importance of Rocky Point for Neotropical landbird migrants, using standardised techniques. 2. To monitor population trends of Neotropical landbird migrants. 3. To substantiate population trends measured with diurnal methods and to compare migration at Rocky Point to surrounding habitats, using nocturnal sampling.

### **Accomplishments to Date of the project**

- a. Highlights of findings to date: Patterns of migration are consistent between methods and years for selected species. Reverse migration seems to be associated with a landscape barrier to migration. Some species thought to be rare on Vancouver Island are frequent migrants at Rocky Point (eg, Northern waterthrush).
- b. Research activities: Extended sampling into spring to compare migration behaviour, specifically reverse migration, at Rocky Point with the Olympic Peninsula. Visiting scientists from California, RMC Kingston and Brock University.
- c. Extension and demonstration: Provided coop experience for numerous school groups (high school and college). Worked with Capilano film students to prepare a Canadian Wildlife Service 50<sup>th</sup> anniversary video which highlighted this project. Work with BCSPCA to collaborate with their new centre in Metchosin. Establishment of nonprofit society associated with the migration station to facilitate fund-raising and volunteer coordination.

**Permit No.:** P005-97

**Title:** Sustainable development of natural sources of taxol:  
Ecophysiology of Pacific yew (*Taxus brevifolia*)

**Project Leader:** A.K. Mitchell, Ph.D. (604) 363-0786

**Organization:** Canadian Forest Service  
Pacific Forestry Centre  
506 W. Burnside Rd.  
Victoria, B.C. V8Z 1M5

**Location:** Colwood Supply/Fuel Oil Depot; Royal Roads; Rocky Point

**Start Date:** 1993

**Completion Date:** 1997

### **Project Overview:**

Increasing demand for the promising new anti-cancer agent, taxol, has created concerns about the unsustainable exploitation of natural stands of Pacific yew (*Taxus brevifolia* Nutt.), from which taxol is extracted. This has prompted the development of conservation and cultivation options for the species in an effort to foster sustainable development of the resource.

Survival of natural stands of Pacific yew will depend on the degree to which species survival is at risk in disturbed environments. Whether disturbance results from selective harvesting of yew or from timber harvesting, tolerance to environmental change will be a key to assessing conservation options. By defining the degree to which Pacific yew can acclimate to stresses such as exposure, management guidelines can be refined to ensure conservation of the resource in concert with its utilization.

### **Objectives:**

- 1) To assist in the development of options for the *in situ* and *ex situ* conservation of Pacific yew.
- 2) To provide physiological and morphological indications of the stress tolerance of Pacific yew.

## **Accomplishments to Date**

### **a) Highlights of findings**

Activities in 1997 centered around detecting mechanisms by which environmental stresses are mitigated in foliage of Pacific yews. Measurements were made of foliar physiology and morphology on Pacific yews growing in natural stands at three locations on DND lands (Colwood Fuel Depot, Royal Roads, Rocky Point). Data analysis and report preparation is in progress.

Pacific yew had many mechanisms that enabled them to survive and grow in shady understorey environments. Pacific yews maintained a positive balance between the carbon spent in growth and that accrued in photosynthesis, in part, by adjustments in foliar form (specific leaf area) and the maintenance of many age classes of leaves. Physiological adjustments were also detected in photosynthesis at low light levels and in chlorophyll fluorescence.

#### ***Foliar morphology:***

The primary foliar adjustment to shady understorey environments was in specific leaf area. Trees growing in shade produced wide, thin leaves with large surface areas that were well suited to capturing light. Trees growing in shade carried between 7 and 14 yearly cohorts of foliage. Maintenance of many age classes of foliage was apparently beneficial for survival in shade. Stomatal density was reduced in response to shade but this may not confer any water stress tolerance because the shade leaves were larger.

#### ***Foliar Physiology:***

Chlorophyll fluorescence measurements showed that foliage grown in shade had high photochemical efficiencies which, in part, enabled the high rates of photosynthesis in low-light environments. Preliminary measurements of photosynthesis in different aged foliage showed similar characteristics but fluctuations in the ambient light environment made comparisons difficult and will require further investigations before conclusions can be drawn (see Research Activities 1997). Based on foliar nitrogen (N) concentrations, male and female trees did not differ in their capacities for photosynthesis. Foliar N concentrations of approximately 1.2% were sufficient to support the foliar adjustments observed in response to shade.

### **b) Research Activities 1997**

#### ***Plot maintenance***

Plot maintenance at the three study sites (Rocky Point, Royal Roads, and Colwood Fuel Depot) consisted of ensuring that neutron probe soil moisture tubes were free of water and debris and re-installing protective plugs and covers to tubes that had been disturbed. Increment cores were taken as a measure of tree growth and were analysed using a digital dendrochronometer.

#### ***Morphological measurements***

Branches were sampled for determination of shoot growth demography. Shoots were divided into age-class cohorts and the number of age-classes and current-year and non-current year shoots were counted for each sample branch. Data analyses in progress.



### ***Physiological measurements***

Preliminary measurements of light harvesting and photosynthesis in different age-classes of foliage were completed. Male and two female trees at Rocky Point were sampled and current-year, 1-year, 2-year, 3-year and 4-year-old foliage were analyzed using a portable infra-red gas analysis system (ADC-LCA2, Hoddesdon, England). Leaf areas (one side) of sample shoots were measured in the lab using a Delta-T system (Decagon Devices, Pullman WA) and Chlorophyll Fluorescence was measured using a CF-1000 (P.K. Morgan, Andover, MA).

Samples were taken and foliar nitrogen concentrations of current-year and 1-year-old shoots were determined on all sample trees (18 trees).

### ***Data Analysis***

Data analysis is in progress using ANOVA and regression techniques.

### **c) Extension and Demonstration:**

Results will be communicated through Progress Reports and by publication of pertinent results in scientific journals as well as oral presentations at conferences and workshops and to the public. The following are evidence of extension and demonstration:

### ***Publications (Scientific Journals; refereed):***

Mitchell, A.K. 1997. Rooting cuttings of Pacific yew (*Taxus brevifolia*) from Vancouver Island locations. Northwest Science 71: 56-63.

Mitchell, A.K. R.W. Duncan, T.A. Bown and V.G. Marshall. 1997. Origin and distribution of the yew big bud mite (*Cecidophyopsis psilaspis*) in British Columbia. Can. Ent. 129:745-755

Mitchell, A.K. 1997. Shade tolerance in Pacific yew (*Taxus brevifolia*: foliar acclimation to exposure. Tree physiology (accepted)

Hogg, K.E., A.K. Mitchell and M. Clayton. 1996. Confirmation of cosexuality in Pacific yew (*Taxus brevifolia* Nutt.). The Great Basin Naturalist 56(4): 377-378

### ***Publications (Information Reports; refereed):***

Duncan, R.W., T.A. Bown, V.G. Marshall and A.K. Mitchell. 1997. Yew big bud mite. Forest Pest Leaflet 79. Pacific Forestry Centre. ISBN 0-662-25727-8. 4 pp.

Mitchell, A.K. 1992. The yews and taxol: a bibliography (1970-1991). Forestry Canada, Pacific Forestry Centre, Inf. Rept. BC-X 338. 31 pp.

**Conferences:**

Mitchell, A.K. 1994. Acclimation to stress in Pacific yew. North American Forest Biology Workshop, June 14-16, 1994. Baton Rouge, Louisiana. p. 52.

Mitchell, A.K. and T. Bown. 1994. Values of Department of National Defense (DND) land on South Vancouver Island: Pacific yew. In: Department of National Defense lands on Southeastern Vancouver Island: Initial evaluation of knowledge and notes from a workshop February 23, 1993. Prepared by: M. Lashmar. Canadian Wildlife Service, Delta B.C., April 1, 1994. pp. 71-73.

**Seminars:**

A.K. Mitchell. 1997. Origin and distribution of the yew big bud mite. Victoria Men's Garden Society, Victoria, B.C. October 1, 1997.

A.K. Mitchell. 1994. Pacific yew and taxol. Native plant festival, Royal B.C. Museum Showcase. Victoria, B.C. March 27, 1994.

**Permit No.:** P006-97

**Title:** Community ecology of the canopy-forest floor insect/arthropod fauna from an old-growth forest.

**Project Leader:** Dr. N.N. Winchester, Department of Biology  
University of Victoria  
P.O. Box 3020  
Victoria BC V8W 3N5  
Ph. 721-7099 Fax: 721-7120 Email [tundrast@uvvm.uvic.ca](mailto:tundrast@uvvm.uvic.ca)

**Location:** Rocky Point and Rocky Point Pearson College Canopy Station

**Start Date:** June 1994

**Completion Date:** Ongoing

**Project Overview:**

Community structure of forest canopy and ground arthropods in the coastal ancient forests on Vancouver Island is virtually unknown and information concerning responses of these communities to forest management practices is lacking. Conservation of biological diversity is a major environmental issue and this study area is a high priority area in terms of biodiversity research, conservation area planning and land use planning. The reasons for maintaining biodiversity have been clearly identified and results from my six years of study in the Carmanah Valley and four years of study at the Rocky Point canopy station support the theory that a unique ancient forest insect community exists, with several new species that are specific to microhabitats within these forest systems. In addition, the canopy fauna seems to contain an unique set of individuals that have evolved to form a separate arboreal community. The study at the DND site continues to offer an opportunity to explore trends in canopy arthropod communities and apply this information across a wide geographic region that includes different ancient forest mosaics. These canopy studies represent the only long term Northern temperate old-growth forest research on arthropods and will be used to form an integral part of an international network on global canopy studies.

**Objectives:**

I propose to document the community composition of the canopy and ground insect/arthropod fauna in this ancient forest, correlate this with biogeoclimatic zone, microclimate conditions and compare this community with 3 other canopy projects. These results will then be used to isolate factors that structure these communities across a wide geographic area (e.g. global canopy network). This project will involve

systematists from across North America and I will concentrate on community composition structure and patterns in order to record changes that occur due to shifts in environmental gradients. A large part of this project will be dedicated to resolving taxonomic problems with the aim of cataloguing and describing the unique and previously undescribed species that make up biologically distinct communities (eg canopy fauna). The influence of environmental factors on insect/arthropod distributions, host-plant interactions and survivorship will be examined in the field to elucidate variables that contribute to the observed community structure.

#### **Accomplishments to Date:**

##### **a) Highlights:**

Analysis of results is **dependent on identifications to species** in the target taxa groups. To date this data is only available for the Asilidae. A summary of these results can be found in the following: Cannings, R., Green, G., Winchester, N. 1995. Selected invertebrate inventory. In Baseline Inventories of Rare Species and Ecosystems of Department of National Defense Properties of Southern Vancouver Island. (Ed.) K.H. Morgan. Canadian Wildlife Service, Environment Canada. pp. 120. Identifications for the Arachnida, Sphecidae, Staphylinidae, and Curculionidae are expected to occur over the next 8 months.

##### **b) Research Activities:**

Trap coarse sorting where successfully completed and target taxa from the samples are currently being mounted for identification. The total samples sorted from each component of the research program are:

- 1) Malaise traps: 432 (all sorted)
- 2) Pan traps: 384 (40 sorted)
- 3) Pitfall traps: 144 (not sorted)
- 4) Beetle traps: 144 (all sorted)
- 5) Branch clipping: 120 (all sorted)

Target taxa processed from these traps included the Asilidae (robber flies). Identifications were completed by Rob Cannings (RBCM). These specimens are currently being catalogued and stored. The Symphyta (sawflies) were sorted from the Malaise traps and sent to Dr. H. Goulet (BRD) where they are currently being identified. The Arachnids (spiders) from the branch clipping program have been sorted and sent to D. Buckle in Saskatoon where they are currently being identified. The Aculeate wasps and spiders have been sorted from all Malaise traps and are currently being mounted. For identification. In addition, over 60,000 specimens from a variety of arthropod orders have been sorted from the Malaise traps. The Coleoptera fauna from the beetle interception traps have been sorted, labeled and integrated into the old-growth forest collection at PFC (Pacific Forest Centre). These specimens formed the database of a highly successful directed research project that was completed by Mr. Tim Boulton as part of his BSc. degree.

- c) A paper on the robber flies of Rocky Point is in prep, authors are R.A. Cannings and N. N. Winchester.
- d) A paper on the Arachnids of Rocky Point is currently being prepared by N. N. Winchester. To date, the number of 72 species have been identified.

e) Extension and Demonstration

Field research concentrated solely on the extension and demonstration of arthropod biodiversity. This aspect of the research program was facilitated by conducting tours at the Rocky Point research site. In conjunction with Environment Canada (see Dr. M. Dunn) I am also spending time getting the microclimate station up and running.

- 1) Presented eleven papers on aspects of the canopy projects at a number of Universities and at 4 scientific meetings.
- 2) Completed interviews (publications) and filming with:
  - Mark Moffett; National Geographic, Vol 191, No. 1, January 1997. Tree Giants of North America..
  - Gary Braasch, Journalist; BBC Wildlife, Vol. 14, No.8, August 1996. The High Life.
  - Douglas Cowell, Journalist, Canadian Wildlife, July/August 1996. A Green New World.
  - Douglas Cowell, Journalist, Canadian Federation Naturalist Magazine for children, Going Buggy in the trees. (Note, at present I do not have a complete citation for this, only a photocopy of the article.)
  - National Film Board of Canada. Completed a 3 day film shoot of the canopy research program and facility at Rocky Point. Expected release of this film, September, 1997.
  - Ring, R.A. and N.N. Winchester, 1996. Coastal Temperate Rainforest Canopy Access Systems in British Columbia, Canada. Selybyana, Vol. 17, 1: 22-26.
- 3) Completed a 3 day extension and demonstration set of field trips organized with the Society of Conservation Biology. In total 14 international visitors where given tours into the canopy at Rocky Point.
- 4) Working on completing a canopy web page that will be launched out of the University of Victoria. The Rocky Point canopy work is included in the site. Completion date is expected in early 1998.

**Permit Number:** P010-97

**Title:** Bat use of Man-made Structures on DND Lands

**Author:** David Nagorsen (250) 387-2933  
e-mail: dnagorsen@RBML01.rbcm.gov.bc.ca

**Organization:** Royal British Columbia Museum  
PO Box 9815 Stn Prov Govt  
Victoria V8W 9W2

**Location:** Maryhill battery (primary study site), and Rocky Point.

**Start Date:** 1 January 1997

**Completion Date:** 31 December 1997

**Project Overview:**

In 1993, a nursery colony of Townsend's big-eared bat (*Plecotus townsendii*) was found in the Command Post at Maryhill. A rare bat on the provincial Blue List, only four other nursery colonies are known for this species in BC. All are unprotected roosts in buildings. The three tunnels associated with gun emplacements at Maryhill are potential hibernacula for Townsend's big-eared bat. A survey of other man-made structures on DND properties in 1995 revealed that the Maryhill structures supported the only significant bat colony roosting in buildings. To improve temperature regimes, increase accessibility for bats, and prevent human disturbance/vandalism the steel doors of the Maryhill structures (tunnels #1 and 2, command post, building #1020) were modified into "bat gates" with secure locks. Tunnel #3 was left unaltered as a control. The Maryhill site is now the only protected roost of Townsend's big-eared bat in BC and it offers an ideal research setting to study the roosting requirements and general biology of a rare bat at the northern periphery of its range in Garry Oak -Douglas-fir habitat. In May 1996, Optic Stow Away (Hoskins Scientific) data loggers were placed in the 3 tunnels, command post, and building #1020 to record continuous temperatures throughout the year. A recorder is also set outside to record ambient temperatures.

**Objectives (1997):**

1. Inventory the command post bimonthly from May to October to determine population, seasonal pattern, and parturition date for the nursery colony.
2. Collect faecal pellets from floor of nursery colony to assess potential for diet study.
3. Inventory tunnels monthly throughout the winter to determine the use of tunnels for roosting and hibernation.

4. Download temperature/humidity loggers every 6 months.
5. Continue to advise DND on bat conservation issues and protection of the Maryhill colony.

### **Accomplishments 1997**

1. Vandalism continued to be a problem at the site. The bat gate on tunnel #1 was cut open with a hack saw in April. The surface door to building #1020 was also lifted and a temperature logger was stolen from the site. I worked with DND staff including the military police to redesign the bat gate and investigate potential vandals.
2. I advised DND on the timing for constructing a communications tower near the command post on Maryhill.
3. Single, torpid Townsend's big-eared bats were observed in tunnel #1 January- May but no bats were found roosting in this tunnel during the day from May-December. No bats were found in tunnel #2 in any month. It is not clear why Townsend's big-eared bat has not accepted this tunnel for hibernation but preliminary analysis of temperature data suggest that mean monthly temperatures in tunnel #2 are several degrees warmer than tunnel #1.
4. Bats used building #1020 as summer night roost and occasionally as a summer day roost for solitary males. Single bats were found hibernating in this building in April.
5. Bats roosted in the command post from 11 April to early October. The nursery colony reached a maximum population of 20-25 adults by early July; parturition (births) occurred between 12 July-12 August.
6. A large sample of faecal pellets deposited July-September were collected from the floor of the command post. I also collected about 30 samples of insect fragments (moth wings, insect heads etc.) from the floor. Samples (faecal pellets, insect fragments) from 1996 and 1997 have been sent to Dr. Mark Brigham at the University of Regina for analysis.
7. Temperature readings from loggers were downloaded and imported into Microsoft Excel. Continuous temperature profiles exist now from May 1996 through December 1997.
8. Temperature loggers were installed in a nursery colony of Townsend's big-eared bat in the attic of a barn at Minnekahda Park (GVRD) near Pitt Meadows. This site will yield comparative data on roosting temperatures from a second coastal population.

### **Acknowledgements:**

Alterations to the building structures were funded by DND. I thank Michael Dunn, Canadian Wildlife Service for funding data loggers and locks. My research was supported by the Royal British Columbia Museum and the BC Ministry of Environment Lands, and Parks.

**Permit No.** P017-97

**Title:** Demographic Study of *Allium amplexans* Torr.  
(Slimleaf Onion)

**Project Leader:** Allan R. Hawryzki, B.Sc.  
(250) 753-3245 Local 2315

**Organization:** Malaspina University-College  
900 5th Street  
Nanaimo, B.C. V9T 3E2

**Location:** CFMETR (Nanoose) Site

**Start Date:** May 1, 1997

**Completion Date:** November 30, 1997

### **Project Overview:**

Long term study to monitor changes in birth, growth, and death rates of individuals and "in summary" population trends of the rare and endangered native onion species *Allium amplexans* Torr.

### **Objectives:**

To better understand the population dynamics of this rare species and therefore the proportional significance of demographic, environmental and stochastic events towards these changes. Information incorporating such information as population distribution, breeding biology and microhabitat preferences will be used to establish a predictive model of future population viability.

### **Accomplishments of the Project**

#### **a) Highlights of findings to Date**

1. Three new sites of *A. amplexans* have been found in this region during 1997. Two are in the immediate Nanaimo area and the third on Texada Island. Although an optimistic finding, especially considering the eight new locations discovered in previous years, as mentioned in last year's report over 3 times as many historical populations have not been relocated.



2. All plants sampled from the 2 new sites in the Nanaimo area are triploid. Triploids are thought (?) to be apomictic.
3. Additional breeding work during 1997 on plants from a population south of Nanaimo verified 1996 research that nonpollinated flowers did not produce seed. Therefore the plants **do not** appear to be apomictic. Perhaps the stimulation by pollen grains triggers the development of the seed but does not contribute chromosomally to it?
4. The 1997 data (Table 1) indicates that a total of 603 bulbs produced flowers (mature plants); a total decline of 25% since the 1995 census. These population totals can be somewhat deceiving since they do not account for what is actually happening regarding stages/ages of individual bulbs. i.e. The proportion of immature individuals (not yet producing flowers) vs those which are most likely the most advanced (have the largest numbers of flowers per inflorescence).

Table 1. Number of mature plants within each population counted from 1995 to 1997.

Year	Population #1	Population #2	Population #3	Population #4	Population #5	Total Number
1995	22	219	206	306	48	801
1996	6	343	89	233	5	676
1997	3	192	41	325	42	603

5. A comparison of populations 2 and 4 between 1995 and 1996 (Table 2) indicates that while only 25% of reproductive I's disappeared (being temporarily placed within column 4, row 3) 75% of reproductive IV's disappeared (column 7, row 3). The reason these individuals have been placed within the vegetative stage rather than a death column is due to the fact that until the 1997 analysis is complete it is not known if these "older" individuals have indeed died or simply gone into a temporary resting stage. Other *Allium* species are known often to skip a year's flowering. Therefore, total counts of mature (flowering ) individuals can be somewhat misleading as to the general health of each population due to the proportions of different individual life stages within them. A population with a higher proportion of advanced or older individuals would probably experience a higher rate of individual disappearances (deaths) than one where most of the individuals were younger.

**Table 2. Transition Matrix of *A. amplexans* emphasizing differences in life stages based upon flower numbers per inflorescence (Populations 2 & 4 at CFMETR, 1995/96). Numbers indicate percentages of individual bulbs which stayed in same, advanced, or regressed one or more life stages.**

				FROM:			
TO:	Seedling	Juvenile	Vegetative	Reprod. I (1-5 fl's)	Reprod. II (6-10 fl's)	Reprod. III (11-15 fl's)	Reprod. IV (16-20 fl's)
Seedling	0	0	0	0	0	0	0
Juvenile	0	.47	0	0	0	0	0
Vegetative	0	.47	.09	.25	.57	.53	.75
Rep. I	0	.06	.13	.25	.09	.11	0
Rep. II	0	0	.50	.50	.30	.26	.25
Rep. III	0	0	.28	0	.05	.11	0
Rep. IV	0	0	0	0	0	0	0

## b) Research Activities

Research activities at the CFMETR site during 1997 were restricted to counting total numbers of breeding plants, monitoring their life stages within permanent plots and observing biotic and abiotic microhabitat characteristics of each population.

Breeding work was carried out on another populations south of Nanaimo.

Information from the 1997 dataset is now being incorporated into a Lefkovich matrix model in order to analyze changes in the population swtructure for the second transition (from 1996 to 1997).

## c) Extension and Demonstration

None

**Permit Number:** PO18-97  
**Title:** Purple Martin Nestbox Program  
**Project Leader:** Darren R. Copley, B.Sc.  
657 Beaver Lake Road  
Victoria, B.C. V8Z 5N9  
(250) 479-6622  
**Location:** Colwood Supply/ Fuel Oil Depot  
**Start Date:** March 1, 1997  
**Completion Date:** October 1, 1997

**Project Overview:**

This site is one of only six Purple Martin colonies in the entire province and it is the largest of the six. This large swallow is on British Columbia's Red List and presently nests only in human-made nestboxes which must be maintained and monitored throughout the year.

**Objectives:**

To increase the population of breeding birds to a size that will provide scout birds to start up other local colonies. This will make the Purple Martin less vulnerable if we can spread the population around to many different sites on Vancouver Island. Also with a larger, more stable population, we can start some research pertaining to life history, migration patterns, etc.

**Accomplishments to Date/of the Project:**

*a) Highlights of findings to Date/Project:*

Western Purple Martins are adaptable to human disturbance and can co-exist with humans in high-activity areas. This includes the movement of nestboxes a short distance.

Accurate population estimates can be attained only by physically opening and checking for active nestboxes, as well as using the natural mobbing tendency of Martins to count adults in the air.

*b) Research Activities:*

This year the nestlings at Esquimalt, along with the nestlings at all of the other BC colonies, were colour-banded. At Esquimalt, 16 nests contained young the right age to be banded. Eight nests contained young that fledged or were too young to band (we were unable to check and confirm some other nests here so there may be more nests than these), making a total of 24 nests. We banded 47 young and one adult female. The one adult female that we caught was sitting on young too small to band.

*c) Extension and Demonstration:*

None.

**Permit No.:** PO21-97

**Title:** Lester B. Pearson College of the Pacific - Biology and Other Science Research Projects

**Author:** Catrin Brown and Narendra Mehrotra

**Organization:** Lester B. Pearson College of the Pacific

**Location:** Rocky Point

**Start Date:** October 15, 1997

**Completion Date:** December 31, 1997

**Project Overview:**

The Rocky Point Forest Canopy Research Station facility is located on Department of National Defence lands at CFAD Rocky Point. Students from Lester B. Pearson College of the Pacific accessed the canopy station site and collected various data. They then prepared a report on the results of their project.

**Objectives:**

The objective was to provide the students with an opportunity to collect real data from an ecosystem and to work on that data as part of their training.

**Accomplishments to Date:**

During 1997 only one report was produced from data collected at the Rocky Point Forest Canopy Research Station facility. The abstract of this report is as follows:

**The Distribution of Four Types of Mosses at the Canopy Level**

By Jody Szkorupa, Lester B. Pearson College of the Pacific

The forest canopy research is a new area of study. The research station at Rocky Point on Southern Vancouver Island enables the research into this unique and endangered ecosystem. The stations are at different heights and a total of four Douglas-fir trees are available for use.

In terms of the study of mosses, two trees at different levels on each were studied. Four different types of mosses were identified at the research station: Isothecium myosuroides, Dendroalsia abeitina, Eurynchium praelongum, and Pseudotaxiphyllum elegans. The size of the moss beds were measured by the use of quadrats in centimetre squares. The percentage cover of these mosses were compared in terms of height as well as a comparison between the mosses of the two trees studied. In addition, several factors were observed at each of these stations: light, bark texture, angle of branch, precipitation, exposure, competition and man-made factors, and height.

It was discovered that the previous observations at each station had an effect on which types of mosses grew where. Isothecium tended to grow in well illuminated, flat surfaced areas at lower heights. Eurynchium moss grew in similar conditions to Isothecium, but covered approximately 30% less total area than the Isothecium specie. At the lower level, level B, is where Pseudotaxiphyllum and Dendroalsia grew. Level B had less light, more grooves in the bark and less exposure. Thus, the latter two mosses tend to grow in a darker, less exposed area. Overall, Level A had nearly six times more moss growth per area than that of level B. Isothecium was by far the dominant moss specie.

With the observations and results combined, it was made evident that these moss specie are sensitive to factors influencing their habitat. Background research of these mosses allowed for a reinforced conclusion to the obtained results.

**Permit No.:** PO22-97

**Title:** Lester B. Pearson College of the Pacific - Rocky Point Forest Canopy Research Station Report

**Author:** Catrin Brown

**Organization:** Lester B. Pearson College of the Pacific

**Location:** Rocky Point

**Start Date:** January 1, 1997

**Completion Date:** December 31, 1997

**Project Overview:**

The Rocky Point Forest Canopy Research Station facility is located on Department of National Defence lands at CFAD Rocky Point. A committee was set up to oversee the operation of the facility with Lester B. Pearson College of the Pacific being the head of the committee. The college owns and maintains the facility. Researchers who wished to use the facility made arrangements with the college. The college was responsible for the safety, maintenance and operation of the facility.

**Objectives:**

The objectives were to ensure that the facility was maintained in a safe operating condition, the facility was available to any researcher who wanted to use it, and the use of the facility was tracked.

**Accomplishments to Date:**

During 1997 the Rocky Point Forest Canopy Research Station facility was used as follows:

Three afternoon visits were made by groups of 14 students from Lester B. Pearson College of the Pacific in March. The students were acquainted with the use of the system and carried out some routine safety checks.

No research work was done during the year.

A safety report by Argonaut Access was completed in December.

**Permit No.:** PO23-97

**Title:** Microclimate Monitoring Station

**Author:** Michael Dunn/Neville Winchester

**Organization:** Pacific Wildlife Research Centre  
University of Victoria, Biology

**Location:** Rocky Point - Church Hill Forest Canopy Research Station

**Start Date:** April 1, 1997

**Completion Date:** December 31, 1997

**Project Overview:**

The instrument array for the microclimate station was installed in 1996 on one of the trees (Tree #1) that form part of the Forest Canopy Research Station. The microclimate station was designed to operate in association with the Forest Canopy Research Station and the Smithsonian Institute and Man and the Biosphere Study plot in the Coastal Douglas-fir sub-zone. The instrument array includes temperature, humidity and insulation sensors deployed from the forest canopy to below the soil surface. An automated, self tripping rain gauge was also installed. An In Situ data logger was installed at the base of the tree. Problems with sensors and the data logger prevented the station from becoming fully operational.

Trouble shooting was to be carried out during the year to make the station fully operational. Regular visits were to be made on an 18 day cycle to collect the data. The raw data custodian and data analysis are to be negotiated once the station is fully operational.

**Objectives:**

To provide long term, reliable climate data for the forest canopy and soils in support of the Forest Biodiversity Permanent Plot work and the Forest Canopy Research work.

**Accomplishments to Date:**

There is not much to report on the station for this year. After initial installation of the station sensors within the Canopy Research station, there have been ongoing problems with some of the sensors and with the consistent downloading of the datalogger. As a result, a continuous record of temperature information has not been possible. The station will remain in place and a mutually agreeable process developed to maintain and download the data developed over the next year.

**Permit No.:** P024-97

**Title:** Sharp-tailed Snake Inventory on the Gulf Islands and the Southeastern Vancouver Island, March - November 1997.

**Project Leader:** Christian Engelstoft (250) 652 9770  
Alula Biological Consulting  
1967 Nicholas Road  
Saanichton, B.C. V8M 1X8

**Location:** Mary Hill, Rocky Point, and Church Hill.

**Start Date:** March 1997

**Completion Date:** 15 November 1997

**Project Overview:**

This was the second year of a proposed three year project studying the Sharp-tailed Snakes. The focus during 1997 was on developing a tracking method based on the harmonic-direction finder system, and conducting a 4 searches in areas considered potential Sharp-tailed Snake habitat.

**Objectives:**

Increase understanding of sharp-tailed snake biology  
Increase understanding of the distribution of the sharp-tailed snake

**Accomplishments To Date:**

**a) Highlight of findings in 1997 in areas around the DND properties.**

- Found two Sharp-tailed Snakes at the know site outside DND land

**b) Highlight of findings in 1997 in general for the project.**

- Continued to develop our understanding of Sharp-tailed Snake's habitat requirements.
  1. Small secluded south facing talus slopes seems to be important habitat.
  2. Decaying logs also appear to be a critical habitat requirement
- Tracked a snake for two month using the harmonic direction finder method.
- Found a possible location of a hibernacular. (Did not verify in order not to destroy the site.)
- Extended the known fall activity from October 9 to November 2.
- Found a new location inhabited by Sharp-tailed Snake on Saltspring Island.



### **c) Research Activities.**

The two methods utilized in this project were time-constrained searches (TCS) and establishment of artificial cover object (ACO) plots. The TCS method was used to search different potential Sharp-tailed Snake habitats throughout the study area. Two Sharp-tailed Snakes were found just outside the boundary of the DND property using the TCS. A few searches were conducted on the DND property without result. The ACO method was used in areas where Sharp-tailed Snakes had been found, as a way of surveying that area repeatedly with little habitat modification. A total of 32 individual snakes were found on Saltspring and North Pender Islands with the ACO method. The ACOs on the DND property were visited twice during the 1997 field season. The following species were encountered under ACO's or during TCS's: Northern Alligator Lizard (*Elgaria coerulea*), Northwestern Garter Snake (*Thamnophis ordinoides*), Western Red-backed Salamander (*Plethodon vehiculum*), Rough-skinned Newt (*Taricha granulosa*), Pacific Treefrog (*Hyla regilla*) and Red-legged Frog (*Rana aurora*).

On Pender Island, we successfully tracked a Sharp-tailed Snake from 11 of September to the 8 of November. The snake stayed within an area of approximately 114 m<sup>2</sup> (19 x6m). The snake was never seen on the surface during this period except during the first night of release. The snake was mainly located in/under well-decayed logs and a few times under rocks. Decaying logs therefore seem to be an important habitat requirement for the species.

### **d) Extension and Demonstration**

Gave talks to the following groups

- 1) Trail and Nature Club, Saltspring Island
- 2) The Mayne Island Nature Club
- 3) Biodiversity and Conservation Biology Course (ES 318, Instructor Dr. Eastman)

**Permit Number:** P030-97

**Title:** Management of spruce weevil, Pissodes strobi

**Project Leader:** Dr. Michael Hulme (250) 363-0600

**Organization:** Canadian Forest Service  
Pacific Forestry Centre  
506 West Burnside Road, Victoria

**Location:** Nanoose TX and CFMETR

**Start Date:** April 1 1997

**Completion Date:** Continuing

#### **Project Overview:**

No satisfactory way is known to manage spruce weevil (*Pissodes strobi*) the most damaging plantation pest of spruce throughout the province. In 1989 a small area of spruce was planted at Nanoose TX and CFMETR with the objective of using these trees to study management techniques for the spruce weevil. The trees have now grown to a point where heavy weevil attack and damage has occurred naturally. The time is now ideal to begin the insect work. We plan two activities. One is to collect the weevils for laboratory studies in Victoria. The second is to release an insect parasite (parasitoid), *Eubazus semirugosus*, well known to attack only *Pissodes* species of weevils. The two DND sites are particularly well suited to this work because they are isolated from other spruces making it difficult for spruce-dwelling insects to move in and out, which would complicate our observations.

#### **Objectives:**

To collect *Pissodes strobi* for study in Victoria, and to test a promising new method of managing the pest.

**Accomplishments to Date:****a) Highlights of findings to Date:**

The leaders of many trees have been killed as a result of attack by *Pissodes strobi*. All indications are that the damage will intensify as more trees are attacked. The *Pissodes strobi* population appears to be extremely healthy and in a vigorous stage of expansion. Parasitoids that attack only *Pissodes* weevil pests have successfully accepted *Pissodes strobi*. The adult parasitoid introduced into sleeve cages surrounding ovipositing weevils at the tops of trees, have successfully laid eggs through the bark of the tree into the eggs of the weevil and the progeny has developed to completion.

**b) Research Activities:**

These were limited to enclosing weevils and parasitoids in sleeve cages at the top of spruce trees, and assessing the egg-laying capabilities of the weevil and parasitoid.

**c) Extension and Demonstration:**

None

**Permit No.:** P031-97

**Title:** Study of acorn feeding insects on Garry oaks in the southeastern Vancouver Island area

**Project Leader:** Doris Rohlfis (250) 363-0778

**Organization:** Natural Resources Canada  
Canadian Forest Service  
Pacific Forestry Centre  
506 West Burnside Road  
Victoria, BC V8Z 1M5

**Location:** Mary Hill Battery and Rocky Point

**Start Date:** June 1996

**Completion Date:** December 31, 1998

### **Project Overview:**

Garry oak (*Quercus garryana*) Dougl. is the only oak native to British Columbia (Farrar, 1995), and is one of the more distinct and stately trees growing in the Greater Victoria area. Because the Garry oak is a unique species and has a high concentration of rare plant species associated with it there is interest in the insects that infest and damage acorns. These two acorn boring insects, both native to North America are the filbert weevil (*Curculio occidentis* (Casey)) and the filbertworm (*Cydia latiferreana* (Walsingham) formerly *Melissopus latiferreanus* (Walsingham)) (Passon, 1964; AliNiazee, 1980). This project focuses on these two acorn feeding insects.

### **Objectives:**

The overall goal of this study is to determine the extent of damage caused by the two acorn infesting insects and suggest possible ways to reduce the amount of this damage.

The study has six specific objectives:

1. Determine the proportion of Garry oak acorns infested by the filbert weevil and the filbertworm at 10 locations in the Greater Victoria area
2. Determine:
  - a) the life history of the more damaging insect
  - b) identify parasitoids, if any, of this pest and
  - c) the role of the parasitoids in regulating its host population.
3. Determine the proportion of infested acorns that can germinate into viable seedlings.
4. Construct a presence/absence damage rating scale that can be used to determine the amount of damage the acorn crop may sustain
5. Determine the distribution of both insects within the Garry oak canopy
6. Determine the life history of the less damaging insect attacking Garry oak acorns.

## Accomplishments to Date:

### a) Highlights of findings to Date

#### 1. Number of acorns collected

Table 1. Number of acorns collected per location by the 4 collection methods.

Type of Collection	Mary Hill	Rocky Point
pole pruner	348	384
strata sample	0	180
mass collection	~300	~500
seed traps	106 <sup>a</sup> , 13 <sup>b</sup>	159 <sup>a</sup> , 61 <sup>b</sup>

a = aborted acorns

b = mature acorns

#### 2. Infestation Rates

Table 2. Infestation rates by the filbert weevil and the filbertworm.

Location	Number of acorns collected	Number of acorns infested	Total percent infested	% Infestation by		
				filbert weevil	filbert worm	both
Mary Hill Battery	348	109	31.3 %	16.7	12.9	1.7
Rocky Point	384	88	22.9 %	20.3	2.1	0.5
Total	732	197	26.9%	18.6	7.2	1.1

#### 3. Damage Estimation

A sample of 1,347 acorns were chosen randomly from a sample of approximately 5,000 acorns and measured for both weight and length. Then the acorns were dissected and classified into four groups; healthy, light damage, moderate damage and severe damage, based on the amount of insect feeding and damage to the acorn kernel. No significant difference was found however, between the light and moderate damage classes and for this reason the damage categories light and moderate were combined. The number of acorns measured for each group (healthy, light/moderate damage, and severe damage) was 610, 388, and 349 acorns respectively.

Using the length, width and damage class data from the 1,347 acorns, a multiple regression model was developed that incorporated the length and weight as independent variables and damage rating as the dependent variable. The data was fit to the following model:

$$Y = a + b_1x_1 + b_2x_2$$

where:

Y= damage rating

a= 1.969472

b1= -0.458178

b2= 0.122227

x1= weight

x2= length

overall equation:  $Y = 1.969472 - 0.458178(\text{weight}) + 0.122227(\text{length})$

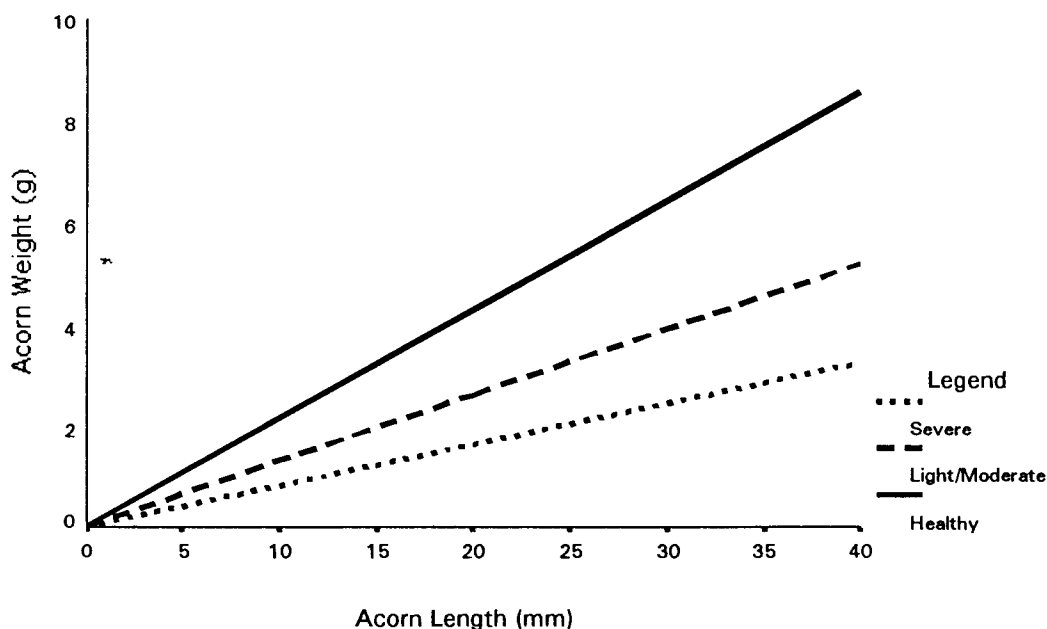


Figure 1. Relationship between healthy acorns, light/moderately insect damaged acorns and severely insect damaged acorns.

$Y = 1.969472 - 0.458178(\text{weight}) + 0.122227(\text{length})$  (healthy  $r^2 = 0.94$ ,  $n = 610$ ; light/moderate damage  $r^2 = 0.92$ ,  $n = 388$ ; severe damage  $r^2 = 0.89$ ,  $n = 349$ ).

A second random sample of acorns were drawn (from the same sample as the acorns from which the model was determined) and weighed and length measured but not cut open. The weight and length values were applied to the regression equation and the acorns were categorized into one of the three damage categories using the equation. Approximately 150 acorns were classified into each of the three categories. Ninety acorns were chosen randomly from each of the three categories and planted in styrofoam germination tubes. The acorns will be kept at ambient temperature inside the header house at PFC and checked weekly for germination. Germination date will be recorded and seedling height will be measured at the end of the growing season. Seedling progress will be followed for 1 year.

#### 4. Presence-Absence Model

A presence-absence model is a method of density estimation that requires counting only a fraction of the individuals in a population. It is assumed that the mean density of individuals can be estimated from the observed proportion of samples containing one or more individuals (Gerrard and Chiang 1970). The data was fit to a model to show the relationship between the percent filbert weevil infestation of acorns and the actual number of insects inside of the acorn.

In practice, the researcher would in the field randomly pick 10 acorns from a sample tree and score each of the 10 acorns as being infested or not without dissecting the acorn (using the criteria of being infested if the acorn contains at least one oviposition or emergence hole) the number of oviposition or emergence holes per acorn is not important. The proportion of infested acorns (i.e. 7 of 10 = 0.7) would be applied to the model indicating the potential insect density on the tree. The reliability of the presence-absence model will have to be verified in the 1998 sampling season.

The sampling data was fit into the following model (Gerrard and Chiang 1970, Nachman 1984):

$$\ln(m) = a + b \ln[-\ln(po)]$$

where:

$\ln$  = natural log

$b = 0.8056$

$a = -0.1932002$

$m$  = mean number of filbert weevil larvae per acorn

$po$  = proportion of acorns uninfested

overall equation:  $\ln(m) = -0.1932002 + 0.8056 \ln[-\ln(po)]$

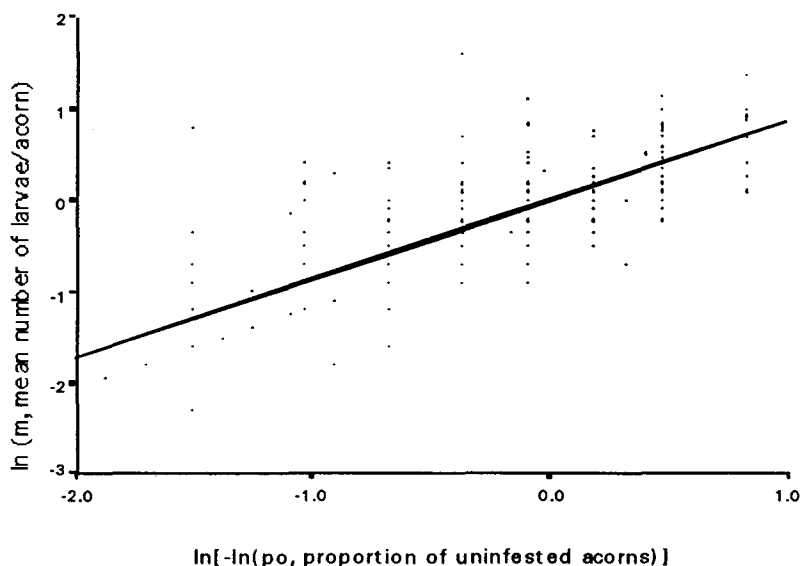


Figure 2. Relationship between the mean number of larvae per acorn ( $m$ ) and the proportion of acorns uninfested ( $po$ ) by the filbert weevil (*Curculio occidentis*).

$\ln(m) = -0.1932002 + 0.8056 \ln[-\ln(po)]$  ( $r^2 = 0.70$ )

## **b) Research Activities**

### **1. Sample Collection**

Research activities at Mary Hill Battery and Rocky Point included acorn collection by the following three methods: 1) pole pruner 2) seedtraps and 3) mass collection of acorns from the ground.

Fifteen sample trees were chosen at both Mary Hill and Rocky Point. The 15 sample trees were grouped into five groups of three trees each and acorns were collected using a pole pruner from one group of three trees once a week at both locations. The 5 groups of trees were rotated through for 15 weeks (June 23 - September 30 1997), with each group being sampled 3 times. The result was 30 acorns per tree being collected (in some cases, less than 30 acorns were collected per tree because of low acorn production). A pole pruner was also used to collect acorns from 9 strata levels of two trees (only 2 trees at Rocky Point has a large enough acorn crop for this type of collection). Acorns were collected from 3 levels of the tree (top, middle, and bottom) and from three directions (south, northwest and northeast) for a total of 9 strata sections per sample tree, and 10 acorns per section.

Seed traps were used to collect acorns at Rocky Point and Mary Hill Battery. Seed traps are constructed with a wire basket and a plastic insert with a fiberglass bag. Each trap has a collecting surface area of 0.25 m<sup>2</sup>. The traps were staked into place with a six foot metal stake. Three traps were placed under each of 12 sample trees both at Mary Hill and Rocky Point. Collections were made on September 16 and 23 1997.

Mass collection of acorns were made from the ground October 6 1997. The collection was conducted with the purpose of accumulating a large number of larvae so that a laboratory colony of insects may be started to study life histories of the insects.

### **2. Laboratory Activities**

Laboratory activities included dissection of acorns to determine the percent of acorns infested by the filbert weevil and filbertworm. Type of insect injury, number and type of insect larvae within each acorn, and damage class was also recorded.

Life history determination included setting up larvae in plastic ice-cream buckets full of sand to allow the insects to overwinter, and emerge as adults. Life history observations will begin in the spring. Determination of the number of instars of the larvae will be by head capsule measurements. The head capsules of all the larvae that were preserved in 70% EtOH from the summer dissections in 1997 will be measured using a microscope with attached micocaliper (Microcode II, Boeckeler Instruments).

Statistical analysis was done on the program SPSS.

## **c) Extension and Demonstration**

- Presented research at the University of British Columbia Graduate Student seminar, November 1996
- Brief summary of research presented at the annual meeting of the Environmental Science Advisory Committee on January 31, 1997



## References:

AliNiazee, M.T. 1980. Insect and mite pests of filberts. Oregon Agricultural Experiment Station Bulletin, 643. pp. 2-6.

Farrar, J.L. 1995. Trees in Canada. Fitzhenry & Whiteside Limited, Canadian Forest Service, Natural Resources Canada. pp. 264-265.

Gerrard, D.J. and H.C. Chiang. 1970. Density estimation of corn rootworm egg populations based upon frequency of occurrence. Ecology. 51(2). 237-245.

Nachman, G. 1984. Estimates of mean population density and spatial distribution on *Tetranychus urticae* (Acarina: Tetranychidae) and *Phytoseiulus persimilis* (Acarina: Phytoseiidae) based upon the proportion of empty sampling units. Journal of Applied Ecology. 21: 903-913.

Passon, D.E. Controlling the filbert moth. Proc. Oreg. Wash. Nut Growers Soc. 50: 29-30.

**Permit No.** PO32-97

**Title:** Establishment of a long term natural area restoration and monitoring program at Rocky Point and Mary Hill

**Project Leader:** Richard Hebda, Ph.D. (250) 472-4569

**Organization:** Restoration of Natural Systems Program  
c/o School of Environmental Studies  
University of Victoria  
P.O. Box 1700  
Victoria, B.C. V8W 2Y2

**Location:** Mary Hill Battery and CFAD Rocky Point

**Start Date:** April 1, 1997

**Completion Date:** December 31, 1997

**Project Overview:**

To carry out establishment and monitoring of plots in the Garry oak ecosystem restoration and monitoring program.

**Objectives:**

1. Establish and characterize monitoring plots for plant species in Garry oak meadow vegetation at DND properties on south Vancouver Island.
2. Develop and implement experimental design for exotic species removal in Garry oak meadow vegetation
3. Remove major exotic species and monitor the effects of the removal.

**Accomplishments:**

*a) Highlights of findings*

1. Continued monitoring by students revealed increased species diversity from 1996 to 1997 in dry Mary Hill sites where broom was removed. Newly recognized grasses species largely contributed to the new records.
2. Rapid growth of broom seedlings reaching 20% cover occurred by December in the dry site Mary Hill broom removal plot. In contrast much less regrowth of broom occurred in the deep soil slope plots and at Rocky Point.

3. Though broom removal on dry sites is easier, keeping the broom off in following years may be more of a challenge than in the heavily infested, grassy sites.
4. Large scale broom removal may be very effective for at Rocky Point where rare species grow in grassy habitats and the broom infestation is patchy.

### **Activities:**

#### *Research:*

Restoration of Natural Systems students and staff visited monitoring sites several times during the year and collected plant species cover data. Specifically site visits were made in the summer by the ER312a field course and in the late fall by other students.

Limited broom removal was attempted in the summer visit , but the seedlings were too small for effective removal. Further limited removal occurred in the fall but broom remains in the study plots, Further removal is planned for late winter under a new permit.

#### *Extension*

R. Hebda presented a poster in this Project at the national EMAN (Environmental Monitoring and Assessment Network) meetings in Saskatoon, February 1997.

The ER312a (Field Methods) course spent one day at Mary Hill learning vegetation assessment techniques.

The moss identification manual developed by Mike Ryan in 1996 was field tested, and eventually expanded to cover forest habitats with support from the Canadian Wildlife Service/ Environment Canada. A final version is planned for completion in Spring 1998.

Permit renewal will be requested for 1998.

**Permit No.:** PO35-97

**Title:** Genetic Diversity in Garry Oak

**Project Leaders:** M.D. Meagher, Ph.D., R.P.F.  
D.G. Edwards, Ph.D., R.P.Biol.

**Organization:** MDM Forgene/FTB Forest Tree Beginnings

**Location:** CFMETR/Mary Hill Battery

**Start Date:** November 1996

**Completion Date:** December 31, 1998

### **Project Overview:**

Garry oak is British Columbia's only native oak, but nothing is known about its genetic variation. The results of this research may help authorities at all levels assess the need to preserve local populations in view of the patterns and degree of genetic variation found. By this means seed (acorn) transfer guidelines may be developed to determine how best to conserve the species in areas in which it has become threatened.

### **Objectives:**

To determine the patterns and degree of genetic variation in Garry oak (*Quercus garryana*) indigenous to British Columbia.

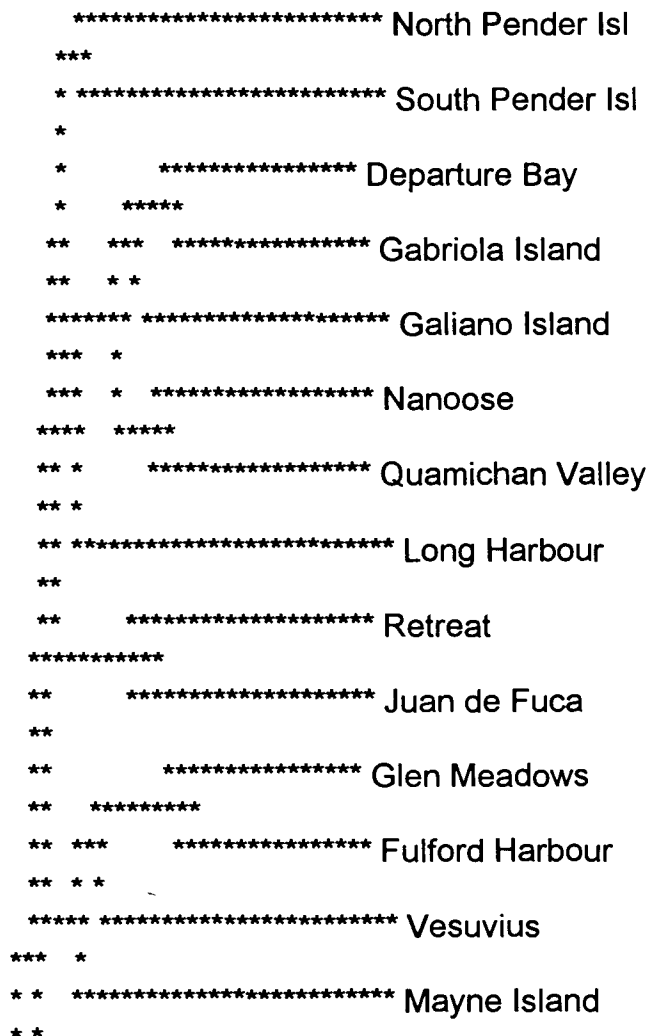
### **Accomplishments to Date:**

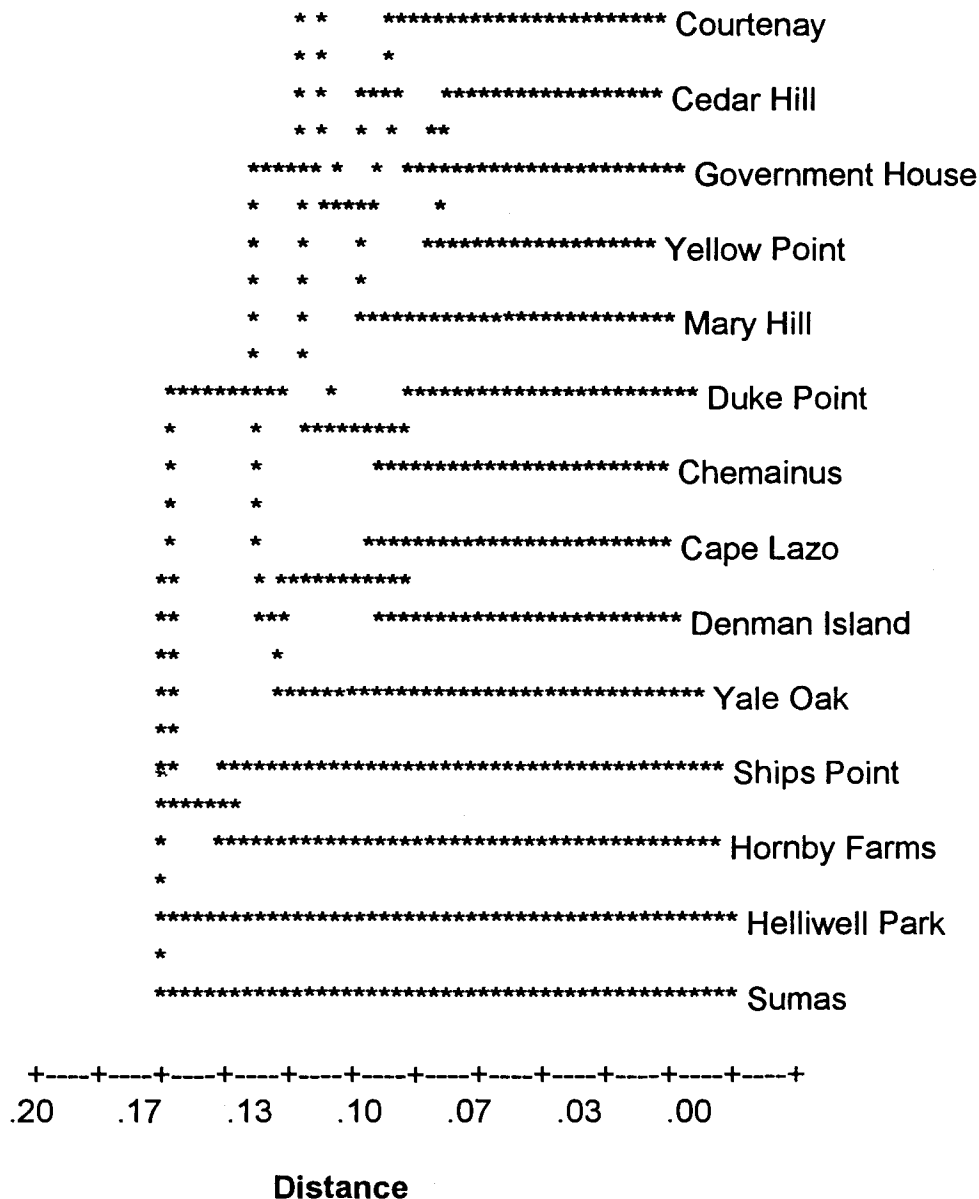
#### **a) Highlights of findings to date;**

Samples of dormant vegetative buds were collected from 31 Garry oak trees at CFMETR and 32 trees at Mary Hill Battery in December 1996, as well as from approximately 30 trees in each of 26 other locations (in November-February 1997) within the natural range of the species in British Columbia (Figure 1). At each site, 6-10 buds, scattered around the lower crowns, were removed from each tree. Materials from all locations were refrigerated (0-1°C) until laboratory work, comprising dissection of bud primordia, followed by extraction and analysis of enzymes by electrophoretic methodology, began in April 1997.

Isozyme patterns were analysed for “genetic distances” and a genetic tree was developed to show how individual geographic sources were related to one another based on similarities within these patterns (Figure 2). No strong pattern of geographic affinities was revealed. For example, the Sumas and Yale materials showed stronger similarities to materials from Denman and Hornby Islands, than to those from Galiano and Mayne Islands. The Nanoose (CFMETR) oaks showed some similarity to those from Departure Bay and Gabriola Island, while the Mary Hill Battery samples showed affinities with the Nanaimo/Chemainus area, i.e. Duke Point, Yellow Point and Chemainus oaks. It is conjectured that this lack of clustering may relate to the method by which acorns are distributed, i.e. by birds, which has produced a large degree of mixing of genetic materials. These relationships require further study.

**Figure 2. Garry oak Genetic Distances**





## b) Research Activities

In the southern part of Vancouver Island, a light-to-medium Garry oak acorn crop developed in 1997 - some trees bore many acorns, while most trees bore none - and collections were made from approximately 30 individual trees at two of the previous bud-collection locations (golf courses in the greater Victoria area), but not from CFMETR and Mary Hill Battery where terrain conditions would have made acorn collection difficult; acorn collection at these two sites will be feasible when acorn production is substantial on most trees, possibly in 1998. The acorns collected to date have been sown in a common garden nursery facility on the Saanich Peninsula so that differences in growth - bud burst/set, height/diameter, dry

matter production - among seedlings representing individual parent trees can be assessed under uniform environmental conditions. These assessments will begin in the summer of 1998.

Funding was secured to permit additional dormant-bud sampling to be undertaken in that portion of the natural range of Garry oak outside BC, that is in Washington, Oregon and California; the species can be found as far south as central California. This will be completed in January 1998, and laboratory isozyme extraction and analysis will begin in March/April 1998.

**c) Extension and Demonstration;**

A report on the project (bud collection and preliminary laboratory work) was presented at a meeting of the DND Scientific Advisory Committee held at the University of Victoria, Royal Roads campus, in January 1997. The authors have joined the Garry Oak Meadow Preservation Society (GOMPS) of Greater Victoria, and although no formal or informal presentation has yet been made, the Society has been made aware of the research.

**Permit #:** P037-97

**Title:** Amphibian survey with special emphasis on the Oregon spotted frog (*Rana pretiosa*). Selected wetland sites: Fraser River Lowlands and corridors to the Interior Plateau.

**Project Leader:** Russell Dean Haycock, R.P.Bio., R.E.H.O.  
(604) 948-9812  
hyla@bc.sympatico.ca

**Organization:** Hyla Environmental Services  
1680-56th Street  
Delta, BC V4L 2L6

**Location:** Eleven sites within DNDNRB (Aldergrove) out of ninety-seven sites throughout total area surveyed.

**Start Date:** March 01, 1997

**Completion Date:** May 30, 1997

**Project Overview:**

Survey of wetland habitat for the potentially extirpated Oregon spotted frog (*Rana pretiosa*). This project was an inventory only with 59% of sites surveyed by a local naturalist under separate contract with the Ministry of Environment, Lands, and Parks.

**Objectives:**

Locate specimens thought to be *Rana pretiosa* and have species verified through protein analysis.

**Accomplishments of the Project**

***a) Highlights of findings***

1. Verification of the frog species=*Rana pretiosa* - Oregon spotted frog, was confirmed by Dr. David Green (McGill University, Redpath Museum, Montreal, Que).

***b) Research Activities***

Research activities at the DNDNRB site during 1997 were restricted to an inventory of wetlands for eggs, larvae, juvenile and adult Oregon spotted frogs.



**Permit No.:** PO41-97

**Title:** Instruction in field methods in Restoration

**Project Leader:** Richard Hebda, Ph.D. (250) 472-4569

**Organization:** Restoration of Natural Systems Program  
c/o School of Environmental Studies  
University of Victoria  
P.O. Box 1700  
Victoria, B.C. V8W 2Y2

**Location:** Royal Roads DND property

**Start Date:** July 1, 1997

**Completion Date:** August 31, 1997

**Project Overview:**

Use of Royal Roads DND lands to instruct University of Victoria Restoration of Natural Systems students in advanced field methods.

Objectives: To have students visit selected sites and learn:

1. Terrestrial Ecosystem mapping
2. Slope stability analysis
3. Air photo interpretation
4. Coarse woody debris assessment
5. Fish habitat assessment

**Accomplishments:**

**Activities:**

From July 8-11, 1997 the ER312B (Field Studies 2) class of the Restoration of Natural Systems Program, University of Victoria, visited several ecosystem types at the Royal Roads site to learn field techniques in restoration. Richard Hebda and Mike Ryan, with the help of teaching assistant Kendrick Brown instructed 17 students of varied backgrounds.

Students learned:

1. slope assessment procedures in the gravel pit off Metchosin Rd.
2. recognition and description of successional communities in the gravel pit and adjacent areas
3. terrestrial ecosystem description and mapping in old-growth Douglas-fir stands and in Garry oak communities
4. how to estimate woody debris in old-growth and second growth stands on DND lands and on the Royal Roads campus
5. fish habitat assessment near the mouth of Cottonwood Creek with the help of Fisheries Branch, Ministry of Environment Lands and Parks staff (Tracy Michalski and George Reid).

Students developed restoration/reclamation prescriptions for the gravel pit as part of their evaluation. Selected copies of the field data and mapping exercises have been made available to Royal Roads staff for reference and updating of their species list. Tentatively we plan to offer the course using in part the DND Royal Roads grounds in 1998.

***Research:***

Nil

***Extension:***

Teaching ER312b

**Permit No.** P042-97

**Title:** The effects of *Ariolimax columbianus* on community structure of fungi.

**Project Leader:** Christine Roberts B.Sc., M.S.  
(250) 360 1793

**Organization:** University of Victoria  
Victoria, B.C. V8w 2Y2

**Location:** Rocky Point

**Start Date:** September 1, 1997

**Completion Date:** December 31, 1997

**Project Overview:**

The study investigates the interrelationships between fungivorous invertebrates and fungal community structure, with differing forest floor features. The emphasis is on the role of the banana slug *Ariolimax columbianus* as a potential vector and aid to establishment of fungal spores.

**Objectives:**

Research the potential of banana slugs as vectors and aid to establishment of several mycorrhizal and some saprophytic fungi which commonly display slug damage. Assess effect of forest floor features on slug habits and fungal community structure. Determine interrelationships.

**Accomplishments of the project**

**a) Summary of findings to date**

1. During this first season of the project data on the species eaten by *Ariolimax columbianus* were collected, and slugs examined for intact spores passed through the gut. Banana slugs had sampled 40% of all fungal species recorded and eaten a meal from 18% of all sporocarps recorded. They consume a quarter to a third of the crop of preferred species resulting in estimated losses of the spore yield of 15% to 30%. All of the medium to large sized species of *Russula* were eaten avidly and were the most frequently attacked mushrooms.

2. There was a strong positive correlation between sporocarp size and slug feeding damage.
3. Densities of *Ariolimax columbianus* seemed higher where there were fruitings of larger *Russula* species and appeared to be lowest amongst stands of cedar, which are endomycorrhizal and do not support the fleshy sporocarps of many of the slugs' preferred fungi. Data on slug densities will be collected in 1998 to check these observations.
4. Intact spores including the occasional germinating spore were found in the fecal strings of *A. columbianus* of all of the commonly eaten *Russulaceae*, also of *Armillaria ostoyea*, *Thelephora terrestris*, the genera *Suillus*, *Gomphideus*, *Cortinarius*, and unidentified basidiospores and ascospores.
5. Taxa slugs avoid or rarely sample include most of the genera *Inocybe*, *Hebeloma crustuliniformis*, the genera *Telamonia*, *Laccaria*, *Collybia*, *Marasmius*, *Xeromphalina*, *Phellodon*, *Clavulina*, and *Psuedohydnum*. The former two contain toxins and large metuloid or encrusted cystidia, the latter group are often tough, waterlogged or bitter.
6. The sesquiterpenes responsible for the acrid flavours of some *Russula* species and which prevent some mammals from eating them (including humans), had no effect on *A. columbianus*, which relished both mild and acrid species.
7. During the course of data collection, a mushroom identified as *Tricholoma apium*, a rare species, has been found on the site, and several of the *Russula* species have so far only been identified to subsection, some may be undescribed species.

## **b) Research Activities**

Research at Rocky Point in 1997 centered upon collecting these preliminary data, identifying suitable sites for plots on which to collect slug and sporocarp density data. Also collection of samples of both fungi and slugs, slugs were subsequently returned alive and unharmed.

## **c) Extension and Demonstration**

None

**Permit No.:** P043-97

**Title:** Habitat Inventory and Use by Salish Sucker  
(Catostomus sp.)

**Project Leader:** Mike Pearson, M.Sc.  
(604)732-9399 mpearson@portal.ca

**Organization:** British Columbia Conservation Foundation  
206, 17654 - 56A Avenue  
Surrey, B.C. V3S 1G3

**Location:** NRS Aldergrove

**Start Date:** September 1, 1997

**Completion Date:** October 31, 1997

#### **Project Overview:**

Part of a larger project to study the distribution and use of habitat of the endangered Salish sucker and Nooksack dace conducted during the summer and fall of 1997.

#### **Objectives:**

The long term objective is to develop a Restoration and Management Plan for the these species involving landowners, municipal governments, stream stewardship groups, Ministry of Environment, Lands and Parks (MoELP), and the Institute for Resources and Environment at UBC. To that end we have applied through the Fisheries Research Branch of MoELP to the Habitat Conservation Trust Fund (sponsors of the present project) for 3.5 years of funding. A copy of that proposal is appended.

#### **a) Highlights of findings to Date**

Due to scheduling constraints and uncooperative weather we were only able to do some preliminary fish sampling at NRS Aldergrove this year. We did catch several young-of-the-year Salish suckers in the Salmon River behind a condemned farm house on the property and just downstream of the 272<sup>nd</sup> Street bridge (map 1; table 1). This finding is quite significant as recruitment of young into the populations is suspected as a major limiting factor for Salish suckers (Prof. J.D. McPhail pers. comm.).

## **Research Activities**

I am in the process of completing a review of all available information on Salish sucker and Nooksack dace which includes a summary of all catch data since 1990. It will appear as a MoELP technical circular and I will forward a copy of it when it becomes available. I am also interested in pursuing further research at NRS Aldergrove as the admittedly sparse data suggests that it is one of the more productive remaining Salish sucker habitats.

Specifically I am interested in:

- completing a reach scale survey of the Salmon River, Bertrand Creek tributary and Tyre Creek on DND lands
- additional presence/absence fish sampling
- location of important spawning and rearing habitats
- research into seasonal habitat use

## **Extension and Demonstration**

None.