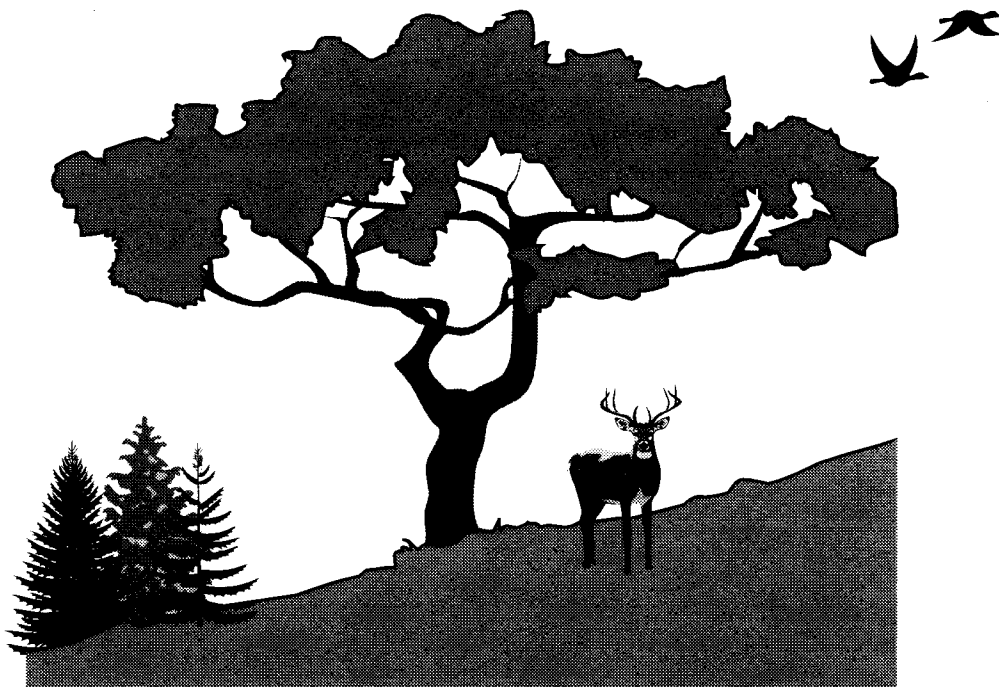


Department of National Defence— CFB Esquimalt
Environmental Science Advisory Committee

REPORT

1998 Annual Report

Prepared for the Committee by
Arthur Robinson
J.A. Trofymow
May, 1999



Natural Resources
Canada

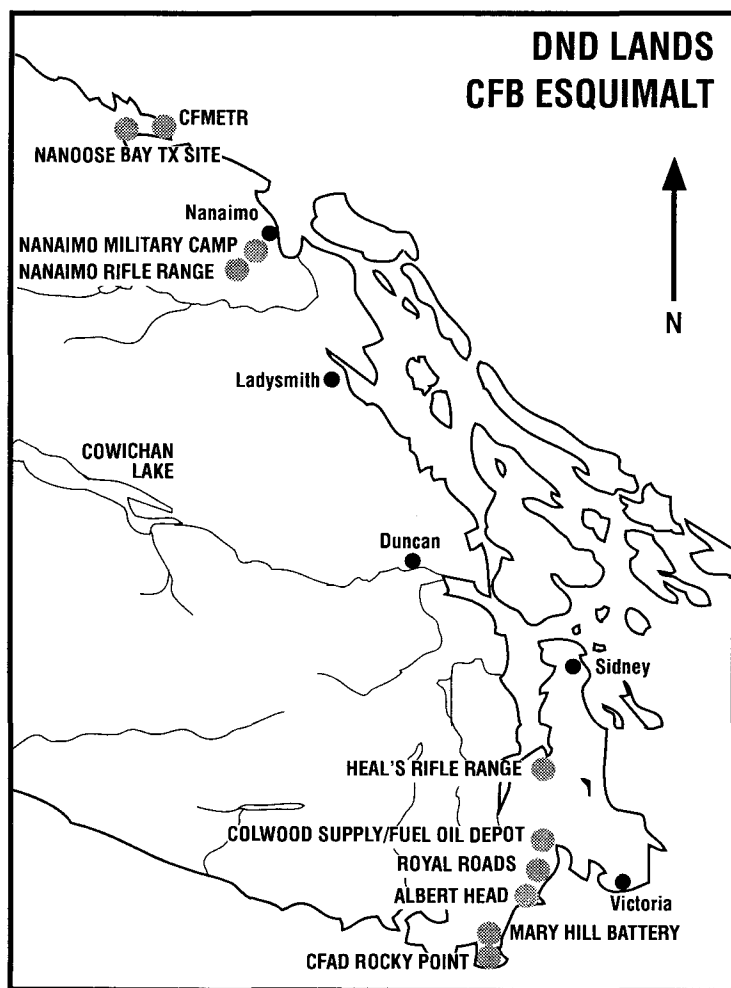
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Canada

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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**Prepared for the Committee by
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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 Defense
- * Canadian Wildlife Service
- * University of Victoria
- * Lester B. Pearson College of the Pacific
- * Canadian Forest Service
- * B.C. Ministry of Forests
- * Royal Roads University

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

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DND Environmental Science Advisory Committee - CFB Esquimalt

1998 Annual Report

1. Summary

The DND Environmental Science Advisory Committee was established in 1994 as a multiagency 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 1998 a total of 26 proposals were received and 26 permits were issued. The committee met four times during the year to review proposals and project status.

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 interested agencies and all project proponents who had done research on DND lands during the year and was held at Royal Roads University in Victoria. Researchers presented ten papers. The workshop was attended by 28 representatives from various organizations and backgrounds.

With completion in late 1997 of the initial phase of the GIS database compilation for DND properties, data was distributed to member agencies and a workshop was held to review and revise conservation management zones as mapped for four properties.

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 1998 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 multiagency committee to oversee research being carried out at Rocky Point. The DND Environmental Science Advisory Committee (ESAC) - CFB Esquimalt was established in 1994 under a letter of understanding (LOU) as a technical advisory committee reporting to the joint Department of National Defense/Canadian Forest Service Forest Resource Management Committee. Soon after the committee was formed it became apparent that the committee's mandate for only the one property (Rocky Point) 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. The first five-year term of the committee's LOU came to an end in December 1998. Early in 1999 the committee will be reviewing its terms of reference and prepare a new LOU.

A. Organization and Terms of Reference - ESAC is a multiagency committee composed of representatives from the Department of National Defence, Canadian Forest Service, Canadian Wildlife Service, the B.C. Ministry of Forests, University of Victoria, Royal Roads University and Lester B. Pearson College of the Pacific 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 are to review and evaluate research proposals for projects on DND lands, advise DND on the proposals and other research issues, to track the projects and permits, and to report on them.

The committee facilitated the establishment and reviews projects for the Forest Canopy Station owned and maintained by the Lester B. Pearson College of the Pacific. The College built this facility 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.

In 1998 Lester Pearson College relinquished ownership of the Forest Canopy Station to DND withdrew as a member agency of the committee.

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 interested agencies and all project proponents who have done research on DND lands during the year. Further details on the 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 completed. These reports are compiled and published by ESAC in an annual report. Further details on the research reports for permitted projects completed in 1998 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 and Activities on DND Esquimalt Properties During 1998

This past year, 1998, was the fourth full year of activity for ESAC, which received a total of 26 proposals during the year 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 track the status of the various proposals that were received. Of the 26 proposals received, 26 were approved and received permits. The status of these 26 approved proposals is shown in Table 2. Researchers submitted written annual reports (Appendix 3) on activity for 20 continuing projects and a final reports (Appendix 4) for 6 completed projects.

A. ESAC Workshop - In January of 1999 at Royal Roads University, Victoria, the ESAC sponsored a workshop, providing an opportunity for the investigators to present the results of their studies. Twenty eight individuals attended the workshop (Appendix 2). Ten presentations were made and final and annual reports from these presentations are included in Appendix 3 and 4.

B. Forest Canopy Research Station Activities - During 1998 Lester B. Pearson College of the Pacific relinquished ownership of the Forest Canopy Station to DND. The University of Victoria assumed responsibility for the facility and reorganized the Forest Canopy Research Station Operating Committee. The FCRSOC is committed to increase use of the facility by more actively promoting it to the scientific community. Early in 1999 a new terms of reference for the committee will be prepared and operating procedures reviewed.

The Canopy station was accessed on 3 occasions during the 1998, by Lester B. Pearson College students with an average of 12 people per occasion. Two visits were also made by University of Victoria personnel in December to repair the microclimatic station.

This facility consists of four old growth trees that have been fitted with platforms in the canopy and ladders leading from the platforms higher into the canopy. Tree No. 1 is isolated from the other three trees by about 75 meters. A boardwalk made of "Superwood" (made from recycled plastic bags) connects the four trees on the ground. Trees No. 2, 3, and 4 are situated close to each other and are connected by "Burma" rope bridges. Access to the canopy of Tree No. 1 is by means of a bosun chair and a hand operated winch attached to a nearby smaller tree. The person in the bosun chair is winched up to the platform. From there access to the upper part of the tree is by ladders attached to the trunk. Access to the canopy of the other three trees is by means of a winch that hauls the person up to the platform of Tree No. 4. From this

platform access to the other two trees is by means of "Burma" rope bridges. In addition, another "burma" bridge connects Tree No. 4 to another large tree about 25 meters away.

In 1996 a microclimate monitoring station was installed on Tree No. 4. Various sensors were set up on the tree ranging from the forest floor to the upper branches to monitor the microclimate within the canopy and the forest floor. An automatic rain gauge was also set up in a nearby clearing. The data was relayed to and stored in a data logger at the base of the tree. Unfortunately, due to technical difficulties and equipment failure the system never operated properly and a climate record was not recorded. In early 1999 the station will undergo an overhaul and will be brought up to a proper operating condition.

C. Geographic Information System Database Compilation and Conversion-
Over the last five 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 was not possible due to technical difficulties. Instead, in 1998 CD-ROM copies of the data were made and delivered to DND and CWS. It is anticipated that each year, pending funding, map coverages and point data will be reviewed for accuracy, databases updated and new versions of the database distributed. DND has provided funding to conduct an update in early 1999. The thematic layers in the DND GIS database will be updated, spatial and attribute errors corrected, and new information will be added to the database for the following properties – Albert Head, CFAD Rocky Point, CFMETR, Colwood Supply/Fuel Oil Depot, Dockyard, Heals Rifle Range, Mary Hill Battery, Masset, Matsqui TX Site, Naden, Nanaimo Rifle Range, NRS Aldergrove, and Richmond Armory.

D. Conservation Management Planning Workshop - A Conservation Management Planning Workshop was at Royal Roads University held in March, 1998. Fourteen people from DND, CFS, Canadian Wildlife Service, Capital Regional District, Royal Roads University and other agencies met to review the conservation management zones proposed by Madrone Consultants Ltd. in its two reports (Reports 11 and 14 in Appendix 1).

The workshop focused on four (Albert Head, Mary Hill, Rocky Point and Royal Roads). Thematic maps were prepared from the new GIS database for each of the four properties for use during the workshop to review conservation management plans. The conservation management zones as recommended by Madrone Consultants were reviewed and changes to the boundaries were suggested. The conservation management recommendations for each property were discussed and a consensus was reached on the recommendations for each property.

5. Outlook for 1999

The committee will continue its activities in 1999 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 will set 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, and the updating of the data) will be carried out early in 1999. The updated 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.

Table 1: Research Project Proposals for DND Properties 1998

<i>Prop #</i>	<i>Agency</i>	<i>Project Title</i>	<i>Applicant</i>	<i>Contact</i>	<i>Project Description</i>	<i>Location</i>
98-01	BC Enviro	Western Screech-owls of Southern Vancouver Island	Laura Darling	Ken M.	Conducting standard call playback survey to inventory the owls, and subsequently attempting to capture owls in mist nets for banding and blood sampling for DNA analysis. Study to be conducted throughout Vancouver Island and some locations on mainland.	CFMETR
98-02	CFS	Successional Forests Research Workshop Field Trip	Arthur Robinson	Arthur R.	Participants of a Successional Forest Research Workshop will visit three sites at Rocky Point - Gary Oak stand, Pacific Yew project and the Forest Research Canopy Station. Proponents of research projects at these sites will be on hand to answer questions about their projects.	RP, RPPCCS
98-03	Malaspina U	Demographic Study of <i>Allium ampletens</i>	Allan Hawryzki	Andy M.	Long term study to monitor changes in population numbers and structure of <i>Allium ampletens</i> (slimleaf onion) using stage-based matrix model. Adults of five populations on site will be counted and the stage structure of individuals will be examined.	CFMETR
98-04	PWC	Migration Monitoring of Neotropical Migrant Birds	Rhonda Millikin	Ken M.	Migration monitoring of neotropical migrant birds will be carried out in Spring and Fall by means of visual census surveys, mistnetting surveys and radar monitoring surveys. This includes radar and acoustic recordings of nocturnal flights of land birds, species that migrate at night.	RP

<i>Prop #</i>	<i>Agency</i>	<i>Project Title</i>	<i>Applicant</i>	<i>Contact</i>	<i>Project Description</i>	<i>Location</i>
98-05	VNHS	VNHS Greenways Inventory Project	Victoria Natural History Society (A. Embleton)	Jody W.	This project, to inventory remaining greenspaces in the capital improvement district and the biological values on them, is sponsored by the Provincial Capital Commission and the Real Estate Foundation. Its purpose is to identify sites that should be preserved in their natural condition to protect habitats, species and aesthetic values.	CFOD
98-06	CFS	Survey and Limited Collection of Hardwood Decay Pyrenomycetes (fungi)	Brenda Callan	Arthur R.	To collect and identify rare and unusual wood decay fungi which grow on dead, fallen, undisturbed aspen, alder, maple, oak and arbutus.	RP
98-07	CFS	Management of Spruce Weevil, <i>Pissodes strobi</i>	Michael Hulme	Tony T.	Observe the development and behaviour of the parasite exposed to <i>Pissodes strobi</i> naturally occurring on the spruce trees and remove insect samples for examination.	CFMETR, NTX
98-08	CFS	Study of acorn feeding insects on Garry Oak in the southeastern Vancouver Island area	Imre Otvos / Doris Rohlf	Tony T.	To determine the extent of damage to Garry Oak acorns caused by the filbert weevil and the filbert worm and determine infestation rates of the two insects.	MHB, RP
98-09	CFS	Sustainable development of natural sources of taxol: Ecophysiology of Pacific yew	Al Mitchell	Tony T.	A study of the physiological responses of Pacific Yew to seasonal changes in water, light, temperature and humidity for the purpose of developing conservation options. This year's work involves preliminary statistical analysis of data and some additional field measurements as required.	RP, RR, CFOD
98-10	BCMOEL	Survey for Spotted Frog, <i>Rana pretiosa</i>	Laura Friis	Ken M.	Survey wetlands for presence of <i>Rana pretiosa</i> . Confirm presence of sites identified in 1997.	Aldergrove

<i>Prop #</i>	<i>Agency</i>	<i>Project Title</i>	<i>Applicant</i>	<i>Contact</i>	<i>Project Description</i>	<i>Location</i>
98-11	CFS	North American Forest Biology Workshop/Western Forest Genetics Assoc.	Al Mitchell	Tony T.	To introduce delegates from all over North America to local ecosystems, environmental issues and forest practices. Specific locations to be visited include the Garry Oak ecosystem and the Douglas-fir ecosystem.	RP, RPPCCS
98-12	CFS	Genetic variation in Garry oak and Arbutus	Edwards/Meagher	Tony T.	Estimate genetic variation in Garry oak and Arbutus toward advising on biodiversity and gene conservation.	CFMETR, MHB
98-13	UVIC	Est. and Monitoring of plots in the Garry oak ecosystem restoration and monitoring program	Richard Hebda	Andy M.	Establish and monitor plots in Garry Oak ecosystem; remove broom, gorse, blackberries from plots	MHB, RP
98-14	VNHS	Purple Martin Nestbox Program	Darren Copley	Ken M.	To maintain and monitor the nestboxes of Purple Martin colony throughout the year. Some leg-banding may be done this year.	CFOD
98-15	RR	Establishment of EMAN long-term Ecological Monitoring Plots at Royal Roads	Dushenko/Addison	Bill D.	Maintain plots to monitor long-term biodiversity and ecological changes at property in relation to natural and anthropogenic impacts.	RR
98-16	BCMOEL	Rare plant communities on the DND properties.	Adolf Ceska	Andy M.	Develop an inventory of rare plant communities; catalog them using the CDC methodology; and develop management guidelines.	AH,MHB,CFMETR, RP,RR

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<i>Prop #</i>	<i>Agency</i>	<i>Project Title</i>	<i>Applicant</i>	<i>Contact</i>	<i>Project Description</i>	<i>Location</i>
98-17	UVIC	Instruction in Field Methods for Restoration	Richard Hebda	Ken M.	Field work for course in Ecosystem Restoration Program at UVic. Establish temporary vegetation plots, use airphotos to map, look for wildlife signs, measure slopes-examine stability	RR
98-18	Alula/MELP	Sharp-tailed snake (<i>Contia tenuis</i>) Inventory	Engelstoft / Chatwin	Andy M.	To identify new sites inhabited by the Sharp-tailed snake, further the understanding of habitat requirements and increase understanding of the distribution.	MHB, RP
98-19	UBC	Vertical Profiling of Air Pollutants by Tethered Balloon	Dr. Ian McKendry	Jody W.	To monitor the vertical structure of the lower atmosphere during smog episodes and in particular the processes of vertical mixing of pollutants that occur during night time.	Aldergrove
98-20	UVIC	Marbled Murrelet Habitat Assessment in the Coastal Douglas-fir Zone	Holm/Burger	Ken M.	To determine the presence/absence as well as occupation of Marbled Murrelets within old growth stands of CDF.	MHB, RP
98-21	UVIC	Community Ecology of the Canopy Forest Floor Insect/Anthropod Fauna from an Old Growth Forest	Neville Winchester	Richard R.	This is a continuation of the project studying the community composition of the canopy and ground insect/anthropod fauna in an old growth forest. This year's activities focus on observation of anthropod seedling activities and extension and demonstration activities.	RP, RPPC
98-22	UVIC	Interactions between the banana slug, <i>Ariolimax columbianus</i> and Fungi of B. C. coastal forests	Christine Roberts	Jody W.	This is a continuation of the project studying the interactions between the banana slug and fungi. This year's activities will focus on testing slugs for food preference and testing slug feces for mycorrhizal formation on seedlings of Douglas-fir.	RR, RP

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<i>Prop #</i>	<i>Agency</i>	<i>Project Title</i>	<i>Applicant</i>	<i>Contact</i>	<i>Project Description</i>	<i>Location</i>
98-23	CFS	Ecology, Biology and Management of Exotics-Scotch Broom and Gorse	Raj Prasad	Arthur R.	To determine the impact of broom on Douglas-fir seedlings, to provide a better understanding of the ecology of the two species and to formulate recommendations for the suppression of broom and gorse.	HRR
98-24	UVIC	Field Trip for Environmental Studies	Donald Eastman	Tony T.	To increase student awareness of the value of Rocky Point ecologically and increase student awareness of the type of ecological research and management at the site.	RPPCCS
98-25	RRU	Nanaimo First Nations Non-Timber Forest Products Integrated Management Project	Signy Fredrickson	Art R.	This project will establish plots to determine what products exist and what the potentials are for management and use of these products.	NRR
98-26	RBCM	Bat Use of Man-Made Structures on DND Lands	David Nagorsen	Andy M.	To modify structures to prevent human disturbance and improve structures for roosting of Townsend's Big Eared Bats. Monitor population and field studies of bat colonies.	MHB, RP

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Table 2: 1998 Permit Summary
DND Environmental Science Advisory Committee - CFB Esquimalt

<i>Prop #</i>	<i>Permit #</i>	<i>Applicant</i>	<i>Phone #</i>	<i>Project Title</i>	<i>Contact</i>	<i>Approved</i>	<i>Expiry Date</i>
98-01	P044-98	Laura Darling	(250) 387-9762	Western Screech-owls of Southern Vancouver Island	Ken M.	02 Feb 98	31 Dec 98
98-02	P045-98	Arthur Robinson	(250) 363-0729	Successional Forests Research Workshop Field Trip	Arthur R.	02 Feb 98	20 Feb 98
98-03	P017-98	Allan Hawryzki	(250) 753-3245 Loc 3215	Demographic Study of <i>Allium ampletens</i>	Andy M.	20 Apr 98	30 Nov 98
98-04	P003-98	Rhonda Millikin	(604) 940-4669	Migration Monitoring of Neotropical Migrant Birds	Ken M.	11 Mar 98	31 Dec 98
98-05	P046-98	Victoria Natural History Society (A. Embleton)	(250) 595-6812	VNHS Greenways Inventory Project	Jody W.	11 Mar 98	31 Oct 98
98-06	P047-98	Brenda Callan	(250) 363-0744	Survey and Limited Collection of Hardwood Decay <i>Pyrenomyces</i> (fungi)	Arthur R.	22 Apr 98	19 Apr 98
98-07	P030-98	Michael Hulme	(250) 363-0600	Management of Spruce Weevil, <i>Pissodes strobi</i>	Tony T.	20 Apr 98	31 Dec 98
98-08	P031-98	Imre Otvos / Doris Rohlf's	(250) 363-0778	Study of acorn feeding insects on Garry Oak in the southeastern Vancouver Island area	Tony T.	20 Apr 98	31 Dec 98
98-09	P005-98	Al Mitchell	(250) 363-0786	Sustainable development of natural sources of taxol: Ecophysiology of Pacific yew	Tony T.	20 Apr 98	31 Dec 98
98-10	P037-98	Laura Friis	(250) 387-9755	Survey for Spotted Frog, <i>Rana pretiosa</i>	Ken M.	20 Apr 98	30 Oct 98
98-11	P048-98	Al Mitchell	(250) 363-0786	North American Forest Biology Workshop/Western Forest Genetics Assoc.	Tony T.	20 Apr 98	23 Jun 98

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<i>Prop #</i>	<i>Permit #</i>	<i>Applicant</i>	<i>Phone #</i>	<i>Project Title</i>	<i>Contact</i>	<i>Approved</i>	<i>Expiry Date</i>
98-12	P035-98	Edwards/Meagher	(250) 477-4757	Genetic variation in Garry oak and Arbutus	Tony T.	20 Apr 98	31 Dec 98
98-13	P032-98	Richard Hebda	(250) 472-4569	Est. and Monitoring of plots in the Garry oak ecosystem restoration and monitoring program	Andy M.	20 Apr 98	31 Dec 98
98-14	P018-98	Darren Copley	(250) 479-6622	Purple Martin Nestbox Program	Ken M.	20 Apr 98	01 Oct 98
98-15	P034-98	Dushenko/Addison	(250) 391-2580	Establishment of EMAN long-term Ecological Monitoring Plots at Royal Roads	Bill D.	20 Apr 98	31 Dec 98
98-16	P050-98	Adolf Ceska	(250) 356-7855	Rare plant communities on the DND properties.	Andy M.	10 Sep 98	31 Dec 98
98-17	P041-98	Richard Hebda	(250) 472-4569	Instruction in Field Methods for Restoration	Ken M.	10 Jun 98	31 Aug 98
98-18	P024-98	Engelstoft / Chatwin	(250) 652-9770	Sharp-tailed snake (<i>Contia tenuis</i>) Inventory	Andy M.	07 May 98	15 Nov 98
98-19	P049-98	Dr. Ian McKendry	(604) 822-4929	Vertical Profiling of Air Pollutants by Tethered Balloon	Jody W.	10 Jun 98	31 Aug 98
98-20	P051-98	Holm/Burger	(250) 477-8596	Marbled Murrelet Habitat Assessment in the Coastal Douglas-fir Zone	Ken M.	10 Jun 98	31 Jul 98
98-21	P006-98	Neville Winchester	(250) 721-7099	Community Ecology of the Canopy Forest Floor Insect/Anthropod Fauna from an Old Growth Forest	Richard R.	10 Jun 98	31 Dec 98
98-22	P042-98	Christine Roberts	(250) 360-1793	Interactions between the banana slug, <i>Ariolimax columbianus</i> and Fungi of B. C. coastal forests	Jody W.	10 Jun 98	31 Dec 98
98-23	P052-98	Raj Prasad	(250) 363-0600	Ecology, Biology and Management of Exotics-Scotch Broom and Gorse	Arthur R.	31 Jul 98	30 Nov 98

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<i>Prop #</i>	<i>Permit #</i>	<i>Applicant</i>	<i>Phone #</i>	<i>Project Title</i>	<i>Contact</i>	<i>Approved</i>	<i>Expiry Date</i>
98-24	P053-98	Donald Eastman	(250) 721-7354	Field Trip for Environmental Studies	Tony T.	21 Sep 98	31 Oct 98
98-25	P054-98	Signy Fredrickson	(250) 226-7063	Nanaimo First Nations Non-Timber Forest Products Integrated Management Project	Art R.	05 Oct 98	31 Dec 98
98-26	P010-98	David Nagorsen	(250) 387-2933	Bat Use of Man-Made Structures on DND Lands	Andy M.	29 Oct 98	31 Dec 98

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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

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2. Juan de Fuca Environmental Consultants. 1990. Nanaimo Inner Route: Recreation and Landscape Assessments Constraints Report - Initial Identification of Park, Recreation and Landscape Constraints, 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.
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11. Radcliffe, Gillian, Glen Porter, and Jan Teversham. 1994. Ecological Assessment of Department of National Defence Properties (CFB Esquimalt) Vancouver Island. Madrone Consultants Ltd. for Department of National Resources and Department of National Defence. 57 p + App.

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13. Knopp, Denis and Larkin, Lee. 1995. An Inventory of the Significant Flora and Fauna of Canadian Forces Base Chilliwack, B.C. B.C.'s Wild Heritage Consultants, Sardis, B.C. 295p.
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15. Bradshaw, Paul A. 1995. The Physical Nature of Vertical Forest Habitat and its Importance in Shaping Bat Species Assemblages. Unpublished manuscript. Department of Biology, University of Regina, Regina, SK.
16. Robinson, Arthur and Trofymow, Tony. 1996. DND Environmental Science Advisory Committee - CFB Esquimalt Annual Report - 1995. Canadian Forest Service, Victoria, B.C. (Includes reports done under Permit Nos. P002-95, P003-95, P004-95, P005-95, P007-95, P007-95, P008-95, P009-95, P010-95, P011-95, P012-95, P013-95, P014-95, P015-95, P016-95, P017-95, and P018-95).

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17. Ferg, D. Vicki. 1996. Training Area Planning System (TAPS) Phase II. An Assessment of Military Training at CFB Esquimalt. DND. CFB Esquimalt. 67p + Annexes.
18. Shepard, Michael G. 1996. Diurnal Raptors on Southern Vancouver Island DND Lands. 306 - 825 Cook St., Victoria, B.C. V8V 3Z1. Unpublished manuscript. 6p.
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21. Knopp, Denis. 1997. Vegetation Classification and Inventory of Significant Flora and Fauna of Naval Radio Section Aldergrove, B.C. B.C.'s Wild Heritage Consultants, Sardis, B.C. 120p.
22. Robinson, Arthur and Trofymow, Tony. 1997. DND Environmental Science Advisory Committee - CFB Esquimalt Annual Report - 1996. Canadian Forest Service, Victoria, B.C. (Includes reports done under Permit Nos. P002-96, P003-96, P005-96, P006-96, P008-96, P009-96, P010-96, P017-96, P018-96, P021-96, P022-96, P023-96, P024-96, P025-96, P026-96, P027-96, P028-96, P029-96, P030-96, P031-96, P032-96, P033-96, P034-96, and P035-96)
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24. Bradshaw, Paul A. 1997. The Physical Nature of Vertical Forest Habitat and its Importance in Shaping Bat Species Assemblages. Department of Biology, University of Regina, Regina, SK. 25p.
25. Levelton Associates Consulting Engineers. 1997. Proposed Septage Facility - Report of Geotechnical Investigation. Rosebank Road, Colwood, BC. 16p.

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26. Hartwig, Carol and Eastman, Don. 1998. Relationships between the Primary Cavity Nester, Pileated Woodpecker, Dryocopus pileatus, and Wildlife Tree Densities and Coarse Woody Debris in Coastal Western Hemlock Biogeoclimatic Zone on Vancouver Island. Completion Report for Contributions. Graduate Project at the University of Victoria, Victoria, B.C. March 31, 1998. 30 p.

27. Haycock, Russ. 1998. Amphibian Survey With Special Emphasis on the Oregon Spotted Frog Rana pretiosa - Selected Wetland Sites: Fraser River Lowlands and Corridors to the Interior Plateau. Hyla Environmental Services, 1680 - 56th Street, Suite 458, Delta, B.C. Prepared for Wildlife Branch, B.C. Ministry of Environment. 230p.
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29. Robinson, Arthur, J.A. Trofymow. 1998. Department of National Defence Environmental Science Advisory Committee - CFB Esquimalt Annual Report - 1997. Canadian Forest Service, Victoria, B.C. 69 p. (Includes reports done under Permit Nos. P002-97, P003-97, P005-97, P006-97, P010-97, P017-97, P018-97, P021-97, P022-97, P023-97, P024-97, P030-97, P031-97, P032-97, P035-97, P036-97, P037-97, P038-97, P039-97, P040-97, P041-97, P042-97, and P043-97).
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Reports For Projects in 1998

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33. Pearson, Mike. 1998. A Review of the Distribution, Status, and Biology of the Endangered Salish Sucker (Catostomus sp.) and Nooksack Dace (Rhinichthys sp.). Province of British Columbia, Ministry of Fisheries. 24p.
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P038-97, P039-97, P040-97, P041-97, P042-97, and P043-97). 69p.

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37. Burger, Alan E., Katy Holm, Anna Young and Stephen Young. 1999. Assessment of Nesting Habitat for Marbled Murrelets in the Coastal Douglas-fir Zone on SE Vancouver Island in 1998. Department of Biology, University of Victoria, Victoria, B.C. 32p. + appendices and map.
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April 1999

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APPENDIX 2

ESAC Committee Members, Participants in ESAC Workshop, and ESAC Workshop Agenda

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**Annual Workshop
Environmental Science Advisory Committee**

January 29, 1999

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Norm Mogensen	Victoria Natural History Society	477-9114
D. Smith	Department of National Defence	363-4914
W. Ewen	Royal Roads	385-9013
Christian Engelstoft	Alulia Biological Consulting	652-9770
W. Easton	Canadian Wildlife Service	(604) 940-4673
Andy MacKinnon	Ministry of Forests	387-6536
Richard A. Ring	University of Victoria	721-7102
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O. Ceska		477-1211
M. Furuhash	Royal Roads University	478-1974
Anna Young	University of Victoria	721-7211
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Heather O'Leary	Canadian Forest Service	363-6036
Angela West	Canadian Forest Service	363-0729
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Norm Healey	Royal Roads University	391-2588
Tom Gray	Canadian Forest Service	363-6030
Richard Hebda	B.C. Royal Museum/University of Vic.	387-5493
Mike Hulme	Canadian Forest Service	363-0733
Trudy Chatwin	Ministry of Environment	751-3150
Jody Watson	Department of National Defence	363-5063

Department of National Defence - CFB Esquimalt
Environmental Science Advisory Committee
ANNUAL WORKSHOP
AGENDA

8:15 a.m., January 29, 1999

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

8:00 - 8:15 Registration

8:15 - 8:30 Welcome

8:30 - 10:00 Presentations

1. Michael Shepard for Rhonda Millikin - Permit No. P003-98 - Migration Monitoring of Neotropical Birds
2. Brenda Callan - Permit No. P047-98 - Survey and Limited Collection of Hardwood Decay Pyrenomycetes (Fungi)
3. Richard Ring - Permit No. P006-98 - Community Ecology of the Canopy-Forest Floor Insect/Arthropod Fauna from an Old Growth Forest
4. Bill Dushenko - Permit No. P034-98 - Establishment of EMAN Long-term Ecological Monitoring Plots at Royal Roads
5. Christian Engelstoft - Permit No. P024-98 - Sharp-tailed Snake Inventory
6. Allan Hawryzki - Permit No. P017-98- Demographic Study of *Allium ampletens*

10:00 - 10:15 Break

10:15 - 12:00 Presentations

7. Anna Young for Dr. Burger - Permit No. P051-98 - Marbled Murrelet Habitat Assessment in the Coastal Douglas-fir Zone
8. Michael Hulme - Permit P030-98 - Management of Spruce Weevil - *Pissodes stobi*
9. George Edwards/Mike Meagher - Permit No. P035-98 - Genetic Variation in Garry Oak and Arbutus
10. Richard Hebda - Permit No. P032-98 - Garry Oak Ecosystem Restoration and Monitoring Program
11. Norm Mogenson/Tony Embleton - Permit No. P046-98 - VNHS Greenways Inventory Project

12:00 - 1:15 Lunch

1:15 - 2:00 Wrap up

Appendix 3

Annual Reports for Projects Worked on in 1998

Permit No.: P003-98

Title: Monitoring of Neotropical Migratory Birds

Project Contact: Wendy Easton
(604) 940-4673

Organization: Canadian Wildlife Service
Pacific Wildlife Research Centre
5421 Robertson Road, RR#1
Delta, BC V4K 3N2

Location: CFAD Rocky Point, Victoria

Start Date: April 1, 1999

Completion Date: October 31, 1999

Project Overview:

Large-scale population declines in forest songbirds, particularly neotropical migrants, have been documented by scientists in North America. Many of these bird species are not adequately monitored in Canada by traditional surveys such as the Breeding Bird Survey and Christmas Bird Counts. Breeding bird and migration monitoring at Rocky Point targets a large number of songbird species that utilize Garry Oak Meadow and Coastal Douglas-fir ecosystems of Rocky Point for breeding or critical stopovers during migration. To detect changes in the numbers and distribution of songbirds at Rocky Point, the site must be monitored annually for 5-20 years.

Objectives:

To monitor the use of habitat at Rocky Point by breeding and migrating songbirds. To detect changes in population trends of birds breeding and stopping over at Rocky Point.

Accomplishments to Date:

We have observed 228 bird species at Rocky Point (Table 1). Of the 297 landbird species found in all of Canada, almost half of the species (n=141) have been observed at Rocky Point from 1994 -1998 using standard survey techniques. Most of the landbirds surveyed at Rocky Point (n=101) are considered target species for migration monitoring and are recognized nationally as species with a medium to high priority for conservation (Table 2) . Long-term trends in their populations are currently being analyzed. **Table 1.** All bird species (n=228) surveyed at Rocky Point.

Table 1. All bird species (n=228) surveyed at Rocky Point.

Red-throated Loon	Oldsquaw	Black Turnstone
Pacific Loon	Bufflehead	Surfbird
Common Loon	Common Goldeneye	Red Knot
Pied-billed Grebe	Barrow's Goldeneye	Sanderling
Horned Grebe	Hooded Merganser	Semipalmated
Red-necked Grebe	Red-breasted	Sandpiper
Eared Grebe	Merganser	Western Sandpiper
Western Grebe	Common Merganser	Little Stint
Northern Fulmar	Osprey	Least Sandpiper
Sooty Shearwater	Bald Eagle	Baird's Sandpiper
Fork-tailed Storm- Petrel	Northern Harrier	Pectoral Sandpiper
Brown Pelican	Sharp-shinned Hawk	Rock Sandpiper
Brandt's Cormorant	Cooper's Hawk	Dunlin
Double-crested	Northern Goshawk	Stilt Sandpiper
Cormorant	Broad-winged Hawk	Short-billed Dowitcher
Pelagic Cormorant	Swainson's Hawk	Long-billed Dowitcher
Great Blue Heron	Red-tailed Hawk	Common Snipe
Green Heron	Rough-legged Hawk	Red-necked
Turkey Vulture	Golden Eagle	Phalarope
Greater White-fronted	American Kestrel	Red Phalarope
Goose	Merlin	Pomarine Jaeger
Snow Goose	Gyr Falcon	Parasitic Jaeger
Canada Goose	Peregrine Falcon	Heermann's Gull
Brant	Blue Grouse	Mew Gull
Mute Swan	Ruffed Grouse	California Gull
Tundra Swan	California Quail	Glaucous-winged Gull
Wood Duck	Virginia Rail	Western Gull
Gadwall	Sora	Thayer's Gull
American Wigeon	American Coot	Herring Gull
Mallard	Sandhill Crane	Bonaparte's Gull
Blue-winged Teal	Black-bellied Plover	Little Gull
Northern Shoveler	Pacific Golden-Plover	Caspian Tern
Northern Pintail	Semipalmated Plover	Common Tern
Green-winged Teal	Killdeer	Forster's Tern
Canvasback	Black Oystercatcher	Common Murre
Ring-necked Duck	Greater Yellowlegs	Pigeon Guillemot
Greater Scaup	Lesser Yellowlegs	Marbled Murrelet
Lesser Scaup	Solitary Sandpiper	Ancient Murrelet
Harlequin Duck	Wandering Tattler	Cassin's Auklet
Surf Scoter	Spotted Sandpiper	Rhinoceros Auklet
White-winged Scoter	Upland Sandpiper	Rock Dove
Black Scoter	Whimbrel	Band-tailed Pigeon
	Ruddy Turnstone	Mourning Dove

Barn Owl
Western Screech-Owl
Great Horned Owl
Northern Pygmy-owl
Barred Owl
Long-eared Owl
Northern Saw-whet
Owl
Common Nighthawk
Black Swallow
Vaux's Swallow
Calliope Hummingbird
Rufous Hummingbird
Belted Kingfisher
Red-breasted
Sapsucker
Downy Woodpecker
Hairy Woodpecker
Northern Flicker
Pileated Woodpecker
Olive-sided
Flycatcher
Western Wood-
Pewee
Willow Flycatcher
Hammond's
Flycatcher
Dusky Flycatcher
Pacific-slope
Flycatcher
Say's Phoebe
Western Kingbird
Northern Shrike
Cassin's Vireo
Hutton's Vireo
Warbling Vireo
Steller's Jay
Blue Jay
Clark's Nutcracker
Northwestern Crow
Common Raven
Horned Lark
Pug-nose Martin

Tree Swallow
Violet-green Swallow
Northern Rough-
winged Swallow
Bank Swallow
Cliff Swallow
Barn Swallow
Chestnut-backed
Chickadee
Bushtit
Red-breasted
Nuthatch
Brown Creeper
Bewick's Wren
House Wren
Winter Wren
Marsh Wren
Golden-crowned
Kinglet
Ruby-crowned Kinglet
Western Bluebird
Townsend's Solitaire
Swainson's Thrush
Hermit Thrush
American Robin
Varied Thrush
European Starling
American Pipit
Cedar Wren
Orange-crowned
Warbler
Nashville Warbler
Yellow Warbler
Yellow-rumped
Warbler
Black-throated Gray
Warbler
Townsend's Warbler
Palm Warbler
Black-and-white
Warbler
Northern Waterthrush
Mourning Warbler

MacGillivray's
Warbler
Common Yellowthroat
Wilson's Warbler
Western Tanager
Black-headed
Grosbeak
Blue-bunting
Spotted Towhee
Chipping Sparrow
Savannah Sparrow
Fox Sparrow
Song Sparrow
Lincoln's Sparrow
Swamp Sparrow
White-crowned
Sparrow
White-throated
Sparrow
Golden-crowned
Sparrow
Dark-eyed Junco
Lapland Longspur
Bullock's Oriole
Yellow-headed
Blackbird
Red-winged Blackbird
Western Meadowlark
Brewer's Blackbird
Brown-headed
Cowbird
Bobolink
Purple Finch
House Finch
Red Crossbill
White-winged
Crossbill
Pine Siskin
American Goldfinch
Evening Grosbeak
House Sparrow

Table 2. BC landbirds monitored at Rocky Point. Category titles in bold delineate target species that are not adequately monitored by the Breeding Bird Survey (BBS). Species in italics are recognized nationally as medium to high priority for conservation.

A. Species with <50% of North American (Canada & U.S. only) breeding range covered by BBS, and <60% of their winter range in U.S. and Canada.

<i>American Pipit</i>	<i>Savannah Sparrow</i>
<i>Lincoln's Sparrow</i>	<i>Swainson's Thrush</i>
<i>Northern Waterthrush</i>	<i>Wilson's Warbler</i>
<i>Orange-crowned Warbler</i>	

B. Species with <50% of North American breeding range covered by BBS, but 60% of winter range in U.S. and Canada.

<i>Dark-eyed Junco</i>	<i>Swamp Sparrow</i>
<i>Fox Sparrow</i>	<i>Varied Thrush</i>
<i>Golden-crowned Sparrow</i>	<i>White-crowned Sparrow</i>
<i>Yellow-rumped Warbler (Myrtle)</i>	<i>White-throated Sparrow</i>
<i>Northern Shrike</i>	<i>White-winged Crossbill</i>
<i>Ruby-crowned Kinglet</i>	<i>Palm Warbler</i>

C. Species with <60% of their Canadian and Alaskan breeding range (but 50% of North American range) covered by BBS, and <60% of their winter range in U.S. and Canada.

<i>Bank Swallow</i>	<i>Olive-sided Flycatcher</i>
<i>Barn Swallow</i>	<i>Red Crossbill</i>
<i>Black Swift</i>	<i>Rufous Hummingbird</i>
<i>Black and White Warbler</i>	<i>Say's Phoebe</i>
<i>Black-throated Gray Warbler</i>	<i>Solitary Vireo</i>
<i>Chestnut-backed Chickadee</i>	<i>Townsend's Warbler</i>
<i>Chipping Sparrow</i>	<i>Tree Swallow</i>
<i>Cliff Swallow</i>	<i>Vaux's Swift</i>
<i>Common Nighthawk</i>	<i>Violet-green Swallow</i>
<i>Common Yellowthroat</i>	<i>Warbling Vireo</i>
<i>Dusky Flycatcher</i>	<i>Western Tanager</i>
<i>Hammond's Flycatcher</i>	<i>Western Wood-Pewee</i>
<i>Hutton's Vireo</i>	<i>Yellow Warbler</i>
<i>MacGillivray's Warbler</i>	<i>Yellow-headed Blackbird</i>
<i>Mourning Warbler</i>	

D. Species with <60% of their Canadian and Alaskan breeding range (but >50% of North American range) covered by BBS, but >60% of their winter range in U.S. and Canada (includes some irruptive species and irregular migrants).

American Robin
Brewer's Blackbird
Brown Creeper
Cedar Waxwing
Downy Woodpecker

European Starling
Golden-crowned Kinglet
Hairy Woodpecker
Hermit Thrush
Horned Lark

Marsh Wren
Northern Flicker
Pine Siskin
Purple Finch
Red-breasted Nuthatch
Red-breasted Sapsucker
Red-winged Blackbird
Song Sparrow
Townsend's Solitaire
Winter Wren

E. Species with >60% of both their Canadian and North American breeding range covered by BBS, and <60% of their winter range in U.S. and Canada.

Band-tailed Pigeon
Black-headed Grosbeak
Bobolink
Calliope Hummingbird
House Wren
Hutton's Vireo
Lazuli Bunting

Nashville Warbler

Northern Oriole
Northern Rough-winged Swallow
Purple Martin

Western Bluebird
Western Flycatcher
Western Kingbird
Willow Flycatcher

F. Species with >60% of both their Canadian and North American breeding range covered by BBS, and >60% of their winter range in U.S. and Canada

American Goldfinch
Bewick's Wren
Blue Jay
Brown-headed Cowbird

Evening Grosbeak
House Finch
Spotted Towhee
Western Meadowlark

Research Activities:

None.

Extension and Demonstration:

None.

Permit Number: P005-98

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

Author: A.K. Mitchell, Ph.D. (250) 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: 1999

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 to date:

Activities in 1998 centered around data analysis and interpretation.. Measurements of environmental factors and of foliar physiology were collated from observations taken over 3 years on Pacific yews growing in natural stands at three locations on DND lands (Colwood Fuel Depot, Royal Roads, Rocky Point). Highlights of results are summarized below under research activities.

b) Research Activities

Tree growth

Sample trees were of varying diameters (cm DBH), ages and growth rates (mm diameter) (Table 1). Missing increment core data were the result of trees having multiple stems. Male and female trees were not significantly different ($t \leq 0.05$) with respect to any of the above characteristics. Tree DBH varied between 30.7 and 4.0cm, ages between 117 and 26, and growth increments between 3.9 and 0.2 mm/year. Foliar nitrogen concentrations (%N) were not significantly different between male and female trees ($t \leq 0.05$) and varied between 1.2 and 0.9%N (Table 1). As a result, data from male and female trees were combined for analysis of foliar physiological characteristics. Foliar N concentrations in current-year (1996, 1.13%N) and one-year-old foliage (1995, 1.10%N) were not significantly different ($t \leq 0.05$).

Table 1: Diameter at breast height (cm DBH), age at breast height, growth increments (mm), and foliar nitrogen concentrations (%N96, current-year; %N95, 1-year-old) of male and female sample trees . Means of male and female comparisons followed by the same letter are not significantly different ($t \leq 0.05$)

Sex	Tree	DBH	Age	1994	1995	1996	%N95	%N96	
Male	Average		12.8a	65a	0.84a	0.67a	0.95a	1.23a	1.13a
Female	Average	11.1a	63a	1.52a	1.30a	1.49a	1.14a	1.07a	

Seasonal variation

Environmental conditions

Seasonal variations in light (photosynthetically active radiation, PAR), were less pronounced than in vapour pressure difference (VPD) or temperature ($^{\circ}\text{C}$) (Figure 1). Maximum light intensities were $1100 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PAR but were more frequently were in the range of 160 to $480 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PAR and this was characteristic of the understory environment in which the trees were growing (Figure 1A). Light intensities on any one sampling date were also quite variable (\pm s.e.), indicating the occurrence of sunflecks in the understory.

Temperature was very consistent throughout the spring and summer, ranging from 15 to 25°C (Figure 1B) and 0.3°C was the lowest and 31.4°C the highest temperature on which data were collected. This was characteristic of the west coast marine environment in which the trees grew.

Seasonal variation in VPD followed a similar pattern to temperature (Figure 1B). The maximum VPD reached was 2.56 KPa and the minimum, 0.08 KPa. As a result of shading from the overstory, high VPD did not consistently occur at the same time as high light or temperature.

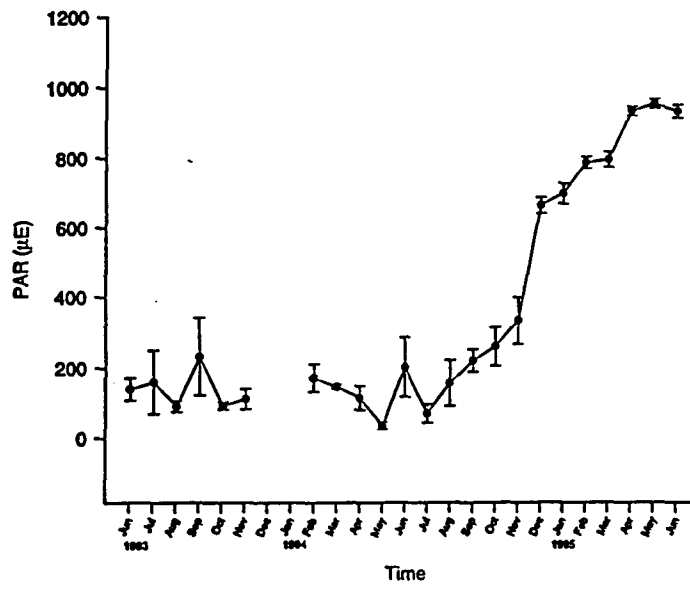
Water relations

Soil moisture and tree water stress followed a similar seasonal pattern to temperature and VPD (Figure 1C). Soil moisture fell as low as 5.8% volumetric water content in summer and this was accompanied by xylem water potentials (mid-day average) as low as approximately -2.8 MPa. During periods when soil moisture was at or near saturation (maximum = 26.7% volumetric water content), xylem water potentials were between -1.0 and -1.5 MPa.

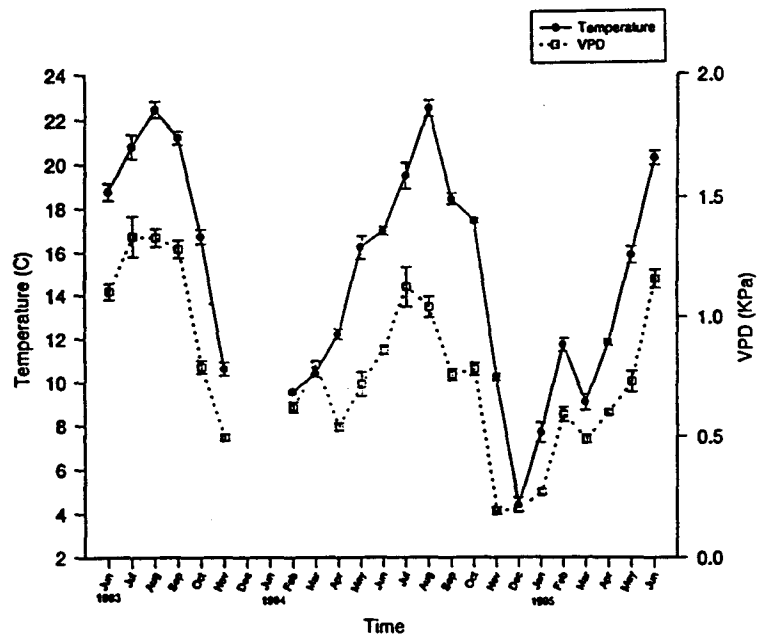
Figure 1: Seasonal changes in environmental conditions under which photochemical efficiency and photosynthesis were measured. (A) light ($\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ PAR, photosynthetically active radiation), (B) temperature ($^{\circ}\text{C}$), vapor pressure difference (VPD, KPa), and (C) soil moisture (% volumetric water content, 0-50 cm) and midday xylem water potential (Mpa) of Pacific yew growing in the understory of natural stands ($n=18$, \pm 1 s.e.).

Figure 1:

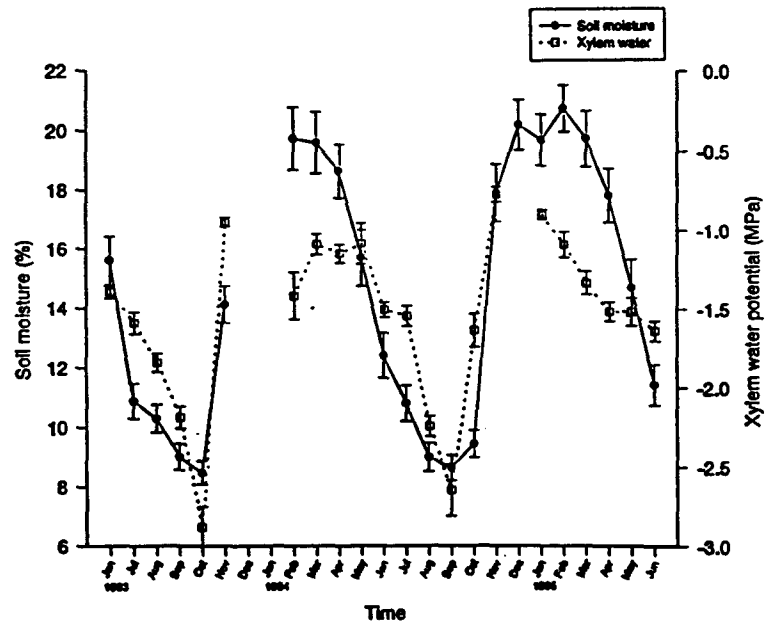
A)



B)



C)



Light capture and use

Throughout the sampling period, photochemical efficiency of PS II (Fv/Fm) tended to be higher in one-year-old than current-year foliage (Figure 2A). The lowest Fv/Fm observed was in current-year foliage in June, at which time shoots were elongating and foliage was developing. Low Fv/Fm were also found in September 1994 and October 1993, times when soil and tree water deficits were at their maxima.

Photosynthesis

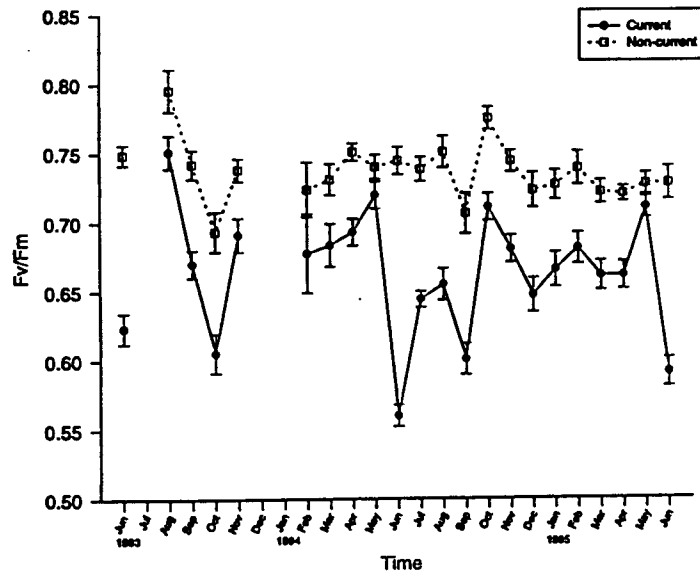
Photosynthesis rates (A, $\mu\text{mol CO}_2 \cdot \text{m}^{-2} \cdot \text{s}^{-1}$) were similar in current-year and one-year-old foliage except during the period of shoot and foliage expansion in June and July when rates were lower in current-year than one-year-old foliage (Figure 2B). In general, rates of photosynthesis were low, between 1.0 and 2.0 $\mu\text{mol CO}_2 \cdot \text{m}^{-2} \cdot \text{s}^{-1}$ and wide variation in rates was indicative of the range of ambient light intensities under which individual shoots were measured. During the period of greatest soil and tree water deficits (August to October), photosynthesis rates were not lower than during the fall and winter months when soil and tree water deficits were minimal. The highest rates of photosynthesis occurred in spring (April to June) during which time the most favorable combination of light, temperature and VPD occurred.

Stomatal conductance (GWV; $\text{mol H}_2\text{O m}^{-2} \cdot \text{s}^{-1}$) followed the same seasonal pattern as photosynthesis, in that current-year and one-year-old foliage were similar (Figure 2C). Very high stomatal conductances were measured in November and December of 1995 and this may have been an artifact of low temperature and its effects on humidity measurements.

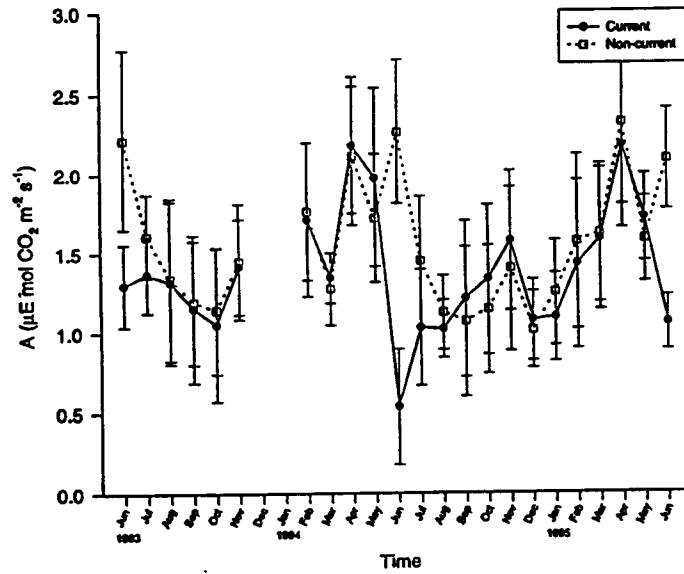
Figure 2: Seasonal changes in carbon acquisition in current-year (●) and one-year-old (□) Pacific yew foliage. Responses of (A) photochemical efficiency (Fv/Fm; n=18), (B) photosynthesis (A; $\mu\text{mol} \cdot \text{CO}_2 \text{ m}^{-2} \cdot \text{s}^{-1}$; n=9), and (C) stomatal conductance (GWV; $\text{mol H}_2\text{O m}^{-2} \cdot \text{s}^{-1}$; n=9) of Pacific yew foliage growing in the understory of natural stands (± 1 s.e.).

Figure 2:

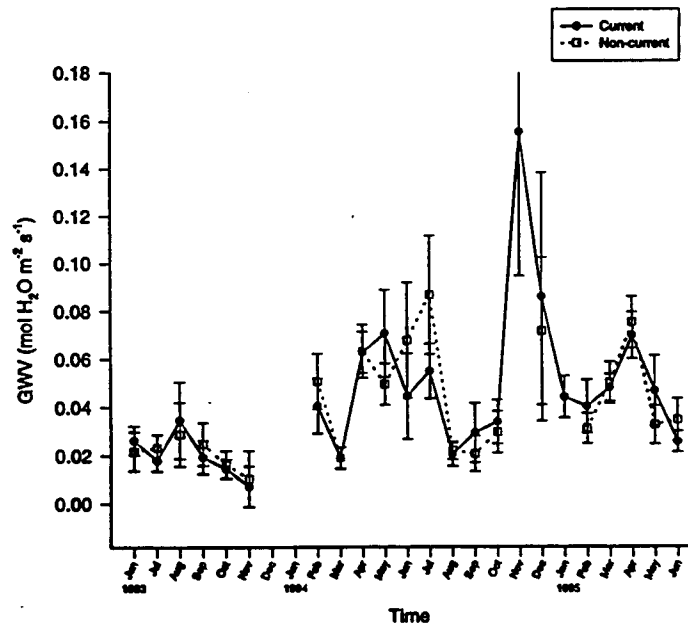
A)



B)



C)



c) Extension and Demonstration:

Tours:

Pacific yew and taxol: field tour. North American Forest Biology and Western Forest Genetics Association Joint Meeting. Victoria, B.C., June 23, 1998. (50 delegates)

Pacific yew and taxol field tour. Structure, processes and diversity in successional forests of coastal British Columbia Workshop. Rocky Point, B.C. February 20, 1998. (50 delegates)

Popular articles:

Getting to know yew. Information Forestry. Canadian Forest Service, Pacific and Yukon Region, Pacific Forestry Centre. ISSN 0706-9413. December 1997. p. 4.

Working out the bugs in yew research. Information Forestry. Canadian Forest Service, Pacific and Yukon Region, Pacific Forestry Centre. ISSN 0706-9413. February 1994. p. 3.

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 18:740-757.

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 Number: P006-95

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

Author: Dr. N.N. Winchester, Department of Biology,
University of Victoria, P.O. Box 3020, Victoria V8W 3N5
Ph: (250) 721-7099 Fax: (250) 721-7120
Email: 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. This year we completed the species identifications for the arachnids. This information was presented as part of a keynote address at the 2nd International Canopy meetings, held in Sarasota, Florida in November, 1998

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)

As per last year we are continuing with the sorting and mounting of the material from the traps. The group closest to completion are the staphylinids, which will be shipped for identification in early March 1999.

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 Aculeate wasps 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 ancient 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 still in prep, authors are R.A. Cannings and N. N. Winchester.

d) Extension and Demonstration

Once again, this year, the field component of the study 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. The microclimate station is currently operational and data is being downloaded and collected by participants at the University of Victoria.

1) Presented 6 papers on aspects of the canopy projects scientific meetings.

2) **Extension this year:**

⇒ Completed an interview with CBC mid-day.

⇒ Completed a film sequence with Discovery.com

⇒ Completed a 45 minute radio talk show, with AM 900

Extensions from previous years

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 were 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. This web page is now up and operational.

Permit No: P010-98

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

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

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

Location: Mary Hill Battery (primary study site).

Start Date: 1 January 1997

Completion Date: 31 December 1998

Project Overview:

In 1993, a nursery colony of Townsend's big-eared bat (*Corynorhinus 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. My research is an long term study designed to monitor bat use and roosting requirements in the Maryhill structures.

Objectives (1998):

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 1998

1) I advised DND on the timing for constructing a communications tower near the command post on Maryhill. The tower was constructed from January to March 1998.

3) Single, torpid Townsend's big-eared bats were observed in tunnel #1 January- March but no bats were found roosting in this tunnel during the day from May-December. Single, torpid Townsend's big-eared bats were observed in tunnel #2 January, May, and December. In previous years no bats were found hibernating in tunnel #2 in any month. In November, a single torpid Big Brown bat (*Eptesicus fuscus*) was found in torpor in tunnel #2. This is the first time I have observed another bat species roosting in the structures at Maryhill.

2) 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 January, March, and May.

3) Townsend's big-eared bats (6 individuals) appeared at the command post by 8 May and the colony reached about 18 animals in June. However, from July to early August the colony disappeared from the command post. By late August the colony returned with about 15 bats observed in the building. No evidence of vandalism and I can not explain the disappearance of this colony in July and August from the command post. In other years the nursery colony persisted throughout the entire summer.

4). A large sample of faecal pellets deposited in summer were collected from the floor of the command post. I also collected about 20 samples of insect fragments (moth wings, insect heads etc.) from the floor. Samples (faecal pellets, insect fragments) were sent to Dr. Mark Brigham at the University of Regina for analysis.

5). Temperature readings from loggers were downloaded and imported into Microsoft Excel. I now have continuous temperature profiles from May 1996 through December 1998.

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 Number: P017-98

Title: Demographic Study of *Allium amplexans* Torr.

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

Organization: Malaspina University-College
900 5th Street
Nanaimo, B.C. V9R 5S5

Location: CFMETR (Nanoose) Site

Start Date: April 1, 1995

Completion Date: Continuing

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.

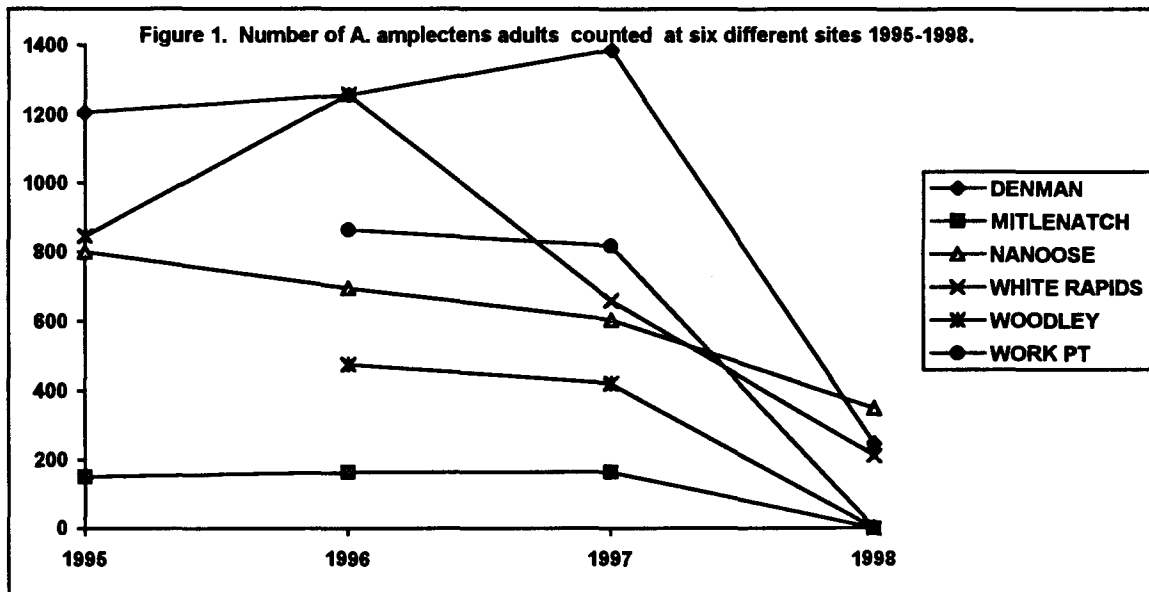
Accomplishments to Date:

a) Highlights of findings to Date:

1. Most populations are tightly compacted within small geographic areas. This is substantially due to the clonal nature of this species.

2. Population numbers of adult (flower producing) plants can vary substantially from year to year. This variation was observed, not only for the CFMETR site, but also for several others (Table & Figure 1).
3. This yearly variation is due to a number of different variables.
4. Internal demographics such as percentages of plants failing to flower for one or more years and proportions of plants within each life stage can have a significant effect on total numbers (details in 1997 report).
5. Total March and April precipitation in 1998 seemed to act as a limiting factor contributing to significant decreases in total numbers observed (Table 1).
6. Populations visited had a source of spring water runoff or evidence of such (i.e. damp habitat species/Mimulus sp.) within the immediate vicinity.

Table 1. Number of <i>Allium amplexans</i> adults (flowering scapes) counted 1995-1998 at six different sites and total March/April precipitation data from South Nanoose site.				
LOCATIONS	1995	1996	1997	1998
DENMAN ISLAND Boyle Point Prov. Park/Eagle Rocks	1207	1256	1386	247
MITLENATCH ISLAND Northwest Bay	151	164	163	0?
VANCOUVER ISLAND				
Ladysmith: Woodley Ridge	NA	475	420	0?
Nanaimo: White Rapids Road (Harewood Plains)	846	1259	658	211
Nanoose: (CFMETR) (Populations 1-5)	801	695	603	347
Victoria: Work Point (Population 2)	NA	864	816	1?
TOTAL PRECIPITATION (MARCH/APRIL AT SOUTH NANOOSE WEATHER ST'N)	218.4	167.8	268.6	96.3



MANAGEMENT RECOMMENDATIONS:

1. Because of the ephemeral nature of this species (both within and between years) populations should not be considered extirpated until at least 2 yearly follow-up inventories are made.
2. A GPS database for known extant locations is extremely important. Inadvertent destruction of known populations can take place due to an imprecise database.
3. Changes in the hydrology of known sites should not be conducted or done with great care. The loss of a source of spring runoff will probably doom the population to extinction. This is especially important because of the lack of geographic dispersion of most populations.

b) Research Activities:

Research activities at the CFMETR site during 1998 were the same as during the previous year or counting total numbers of plants, monitoring their life stages within permanent plots and observing biotic and abiotic microhabitat characteristics of each of 5 populations.

c) Extension and Demonstration:

Gave talks to the following groups

1. EMAN Workshop, Victoria
2. Nanaimo Field Naturalist Club, Nanaimo
3. Taxonomy and Biodiversity 457 Course, Malaspina University-College, Nanaimo

Permit Number: PO18-98

Title: Purple Martin Nestbox Program

Project Leader: Darren R. Copley, B.Sc.
657 Beaver Lake Road, Victoria, B.C.
V8Z 5N9, (604) 479-6622

Location: Colwood Supply/ Fuel Oil Depot

Start Date: April 25, 1998

Completion Date: October 1, 1998

Project Overview:

This site is one of only 10 Purple Martin colonies in the entire province. It is the third largest. 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, especially protected areas. With a larger, 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 a high traffic area.

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. There were close to 50 returning birds this year.

b) Research Activities:

Nestlings were banded this year and this previous, however not under this permit. There were 8 returning birds that were banded as young in 1997. For information on this please contact Cam Finlay at 479-9833. Our work consisted of cleaning-out and maintaining the nestboxes, as well as monitoring of the population for any possible disturbances to a successful breeding season.

c) Extension and Demonstration: None.

Permit No.: P024-98

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

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

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

Start Date: March 1998

Completion Date: 31 March 1999

Project Overview:

Final year of the project.

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 areas around the DND properties.

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

B) Highlight of findings from 1996-98 in general for the project.

Developed an understanding of Sharp-tailed Snake's habitat requirements. Small secluded south facing talus slopes surrounded by trees. Decaying logs also appear to be a critical habitat requirement. Developed an understanding of Sharp-tailed Snake seasonal activity:

1. Found active from February 18 to November 2
2. Spring peak in April - May and a smaller fall peak in September - October, timing depending on weather.
3. Activity in the summer seems to occur after larger rain events.

Tracked two Sharp-tailed Snake using the harmonic direction finder method that provided data on micro-habitat use and movement distances. Growth rate seems to vary with age. Found a new location inhabited by Sharp-tailed Snake on Saltspring Island and South Pender Island.

C) Research Activities.

The methods used were time-constrained searches (TCS), placement of artificial cover object (ACO), and tracking individuals using the Harmonic Direction Finder technique. 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. 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 because this method allowed repeated searches with little habitat modification. A total of 16 individual snakes were found on Saltspring and a total of 24 individuals on North Pender Islands. The individuals were identified by their pigmentation pattern on the throat and the area by the vent and obvious scars. The ACO sites on DND property were checked three times during the 1997 and 1998 field season. The following species were encountered under ACO's or during TCS's on DND land: 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 two Sharp-tailed Snake in the period from September 1997 to the April 1998. Snake #3 was released in September and last detected in Apr. 1998. It stayed within an area of approximately 180 m². The snake was never seen on the surface during this period except during the first night of release. Snake #3 was mainly located in/under well-decayed logs and a few times under rocks. The other snake (#21) was released in March 1998 and located 5 times until April under rocks and down wood debris. This snake traveled 93 m from release site to area where it was last found. The average longest distance traveled of snakes found under ACO's was 25 m. Decaying logs and rock therefore seem to be an important habitat requirement for the species.

The repeated measurement of snout vent length of individuals allowed us to calculate growth rate over one year. One snake grew from April to October 60 mm resulting in a growth rate of 80 mm/yr. assuming no growth in winter. Snakes under 200 mm, we calculated a growth rate of 22.4 mm/year (SD=7.0 mm, n=2). For snakes greater than 200 mm the growth rate was 7.2 mm/yr. (SD=3.7 mm, n=8).

Permit Number: P030-98

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 were designed for this work 10 years ago because they are isolated from other spruce sites making it less likely that spruce-dwelling insects will move in and out of the plantations, which would complicate our assessment of parasitoid and weevil activity.

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:

Natural feeding and oviposition by *Pissodes strobi* has led to the destruction of many tree leaders in the plantations. Each year a higher proportion of the leaders are attacked and killed as the weevil population naturally increases. As usual with this insect the spread of damage is not uniform but shows a clumped

distribution. Damage is expected to further increase as more trees are attacked, because the weevil population still appears to be in a vigorous stage of expansion. Parasitoids that attack only *Pissodes* weevil pests have been introduced into the *Pissodes strobi* population. The parasitoids have not yet been allowed to search for their host throughout the plantation but continue to be confined in cages with ovipositing weevils at the tops of trees. The adult parasitoids have again successfully laid eggs through the bark of the tree into the eggs of the weevil and the parasitoid 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.: P032-98

Title: Establishment and Monitoring of Plots in the Garry Oak Ecosystem Restoration and Monitoring Program

Project Contact: Richard Hebda
(250) 472-4569

Organization: Restoration Program, Environmental Studies
University of Victoria
P.O. Box 1700
Victoria, B.C. V8W 2Y2

Location: Mary Hill Battery, CFAD Rocky Point (Victoria)

Start Date: April 20, 1998

Completion Date: December 31, 1998

Project Overview:

Monitoring plots were established in Garry Oak stands on two sites at Mary Hill and Rocky Point. The plots contained broom as a major component. The treatment plots were treated by having the broom removed in 1997. The plots were revisited this year and percent coverage of plant species on these plots was documented.

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 to Date:

Activity at the site consisted of 2 parts. On May 5, 1998 students of University of Victoria course ER312A: Field study in Ecological Restoration I collected plant species cover data in the upper three plots (#1,2,3) just below the old bunkers. This is the third year data were collected at the site. Students tested a preliminary draft of a guide to grasses and grass-like plants of southern Vancouver Island. The most notable feature at the time of the visit was the widespread death due to drought of large broom (*Cytisus scoparius*) plants on shallow rocky soils at the site. At the time of the visit flowers and leaves both were turning brown and drying. Students removed erect young seedling plants from the broom-removal plot (#1) on the highest ledge. Seedlings which had not grown a vertical stem at this time were not removed.

In the fall, Anne Stewart, a Biology Co-op student began a long term study of Mary Hill and Rocky Point sites as part of a B.Sc. thesis project at the University of Victoria. Preliminary visits were made to the sites in preparation for planning a regular schedule of visits and plant species data collection in 1999. Inspection of the lower plots at Mary Hill (#4, 5, & 6) and to the sites at Rocky Point revealed that the regrowth of broom in grass-dominated plots remained limited. In plot # 6 at Mary Hill, which had less original grass cover, some broom and especially many black berries (*Rubus procerus*) had begun to reinvade or regrow at the site.

Anne Stewart will visit Mary Hill and Rocky Point sites to collect field data on a regular basis in 1999.

Research Activities:

None

Permit Number: PO35-98

Title: Genetic Diversity in Garry Oak

Authors: M.D. Meagher, Ph.D., R.P.F. (250) 727-7675
D.G. Edwards, Ph.D., R.P.Biol. (250) 477-4757

Organization: MDM Forgene/FTB Forest Tree Beginnings

Location: CFMETR/Mary Hill Battery

Start Date: November 1996

Completion Date: Continuing

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;

Analyses of bud samples collected in 1996 at Mary Hill and CFMETR, and 26 other B.C. locations, revealed patterns of genetic similarity based on isozyme patterns. Although the overall pattern among all populations sampled was of affinity among neighbouring populations, neither of the DND populations was related most closely to its immediate neighbours. CFMETR was most similar to Quamichan Lake, Duncan, (revised from the previous report that indicated closeness to Departure Bay and Gabriola Island), while Mary Hill was closest to the populations from Courtenay, Yellow Point and Victoria. In 1998, sampling was extended into the United States.

b) Research Activities

Collections of winter buds were made from 14 locations between Redding (California) and Bellingham (Washington). Isozyme patterns have been elucidated and data are being analyzed. Results from those collections are being incorporated into analyses based on all materials, that is, including the 28 B.C. collections. DNA analyses, interrupted early in 1998 due to the recall of the Ph.D. student (U.B.C.) caused by the Asian financial crisis, have been renewed. Results are anticipated during 1999. Presentations will be made in scientific articles and at the proposed conference on Garry Oak at the University of Victoria in May, 1999.

c) Extension and Demonstration;

Technology transfer included presentations to:

- a) the third DND Environmental Science Advisory Committee Annual Review;
- b) the Garry Oak Meadow Preservation Society, Victoria;
- c) the Workshop on Structure, Processes and Diversity of Successional Forests of coastal B.C., Victoria;
- d) to Biology students at North Island College, Courtenay;
- e) to the joint meeting of the North American Forest Biology Association and the Western Forest Genetics Association, Victoria.

Permit No.: P037-98

Title: Survey for Spotted Frog, *Rana pretiosa*

Project Contact: Laura Friis
(250) 387-9755

Organization: Wildlife Branch, B.C. Ministry of Environment
P.O. Box 9374 STN PROV GOV
Victoria, B.C. V8W 9M4

Location: NRS Aldergrove, Aldergrove

Start Date: April 5, 1998

Completion Date: October 31, 1998

Project Overview:

This project is a survey of wetlands for the presence of the Oregon Spotted Frog *Rana pretiosa* which is a Red-listed species. This will include the wetlands where its presence was identified in 1997 and other wetlands. An inventory for this species was conducted in 1996-97 and 1997-98 by Russell Haycock and Denis Knopp.

Objectives:

To survey potential and confirmed sites for this species and to confirm the presence of the species on the confirmed site.

Accomplishments to Date:

Activity this year (1998) was restricted to occasional surveys to look for egg masses of this species. (Russell Haycock will report on this himself). Otherwise, the project was inactive.

Proposed future work: A status report for COSEWIC is being prepared by Russell Haycock. This species has been assigned a provincial rank of S1 (critically imperiled because of extreme rarity) and a global ranking of G2G3 (numbers have declined drastically throughout the range; the species continues to be threatened by introduced Bullfrogs, introduced predatory fish, and loss and degradation of wetlands).

We hope to initiate a research project through the University of British Columbia for the next field season. This species will be a high priority for future attention.

Research Activities:

None

Permit No.: P041-98

Title: Instruction in Field methods for Restoration

Project Contact: Richard Hebda
(250) 472-4569

Organization: Restoration Program, Environmental Studies
University of Victoria
P.O. Box 1700
Victoria, B.C. V8W 2Y2

Location: Royal Roads, Victoria

Start Date: July 1, 1998

Completion Date: August 31, 1998

Project Overview:

Use of Royal roads DND lands to instruct University of Victoria Restoration of natural Systems students in advanced field techniques.

Objectives:

To use the varied landscape of the Royal Roads grounds to teach field methods for restoration.

Accomplishments to Date:

The ER 312B: Field study in Ecological Restoration II class visited the DND Royal Roads gravel pit site on two days in July 1999. The class consisted of 17 students. Students were instructed in methods of slope stability analysis and rudimentary stratigraphy, and carried out slope stability assessments using standard provincial forms. Students also examined the different plant communities in the gravel pit and learned how to describe them and rank them with respect to successional status and disturbance agent. Students took field notes and these were marked as part of the course assessment.

Research Activities:

None

Permit No. P042-98

Title: Interactions between the banana slug, *Ariolimax columbianus* on the fungi of B.C. coastal forests.

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

Organization: University of Victoria, Victoria B.C. V8W 2Y2

Location: Rocky Point and Royal Roads

Start Date: June 9, 1998

Completion Date: December 31, 1998

Project Overview:

The study investigates the interrelationships between native slugs and fungi, with particular interest in *Russulas*. 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 members of the genus *Russula*. Identify species of *Russula* on the DND properties. Make preliminary observations regarding the slug-fungi interactions when *Russula* species are not available, as happened this year.

Accomplishments of the Project

a) Summary of findings to date

1. General observations.

The very dry summer and late rainfall this year contracted the fruiting season drastically. During three trips this fall, extensive searching only turned up a few sporocarps of *Russula olivacea* and *Russula xerampolina*. The areas that had fruited so profusely in 1997, mainly the north facing slopes above the entrance road parallel to Pedder Bay, produced *Suillus tomentosus*, *Gomphidius oregonens* and *G. subroseus* in small fruitings but no *Russulas*. I had hoped to collect specimens of *R. gracilis* c.f. and *R. atropurpurea* c.f. which had fruited in the area mentioned above, to use in spore inoculation trials.

The numbers of slugs of any species was considerably lower than in 1997, although small amounts of slug damage were occasionally observed on those few fungi appearing. These observations were too few to draw any conclusions as to food preferences this year. The faecal strings of slugs collected were found to contain mostly algal films from rotting wood, wood and plant debris, rather than fungal tissue. In coastal forests of the Port Renfrew area, in the absence of abundant *Russulas*, Chanterelles were found eaten to stumps by slugs. Last year

Chanterelles were rarely damaged when Russulas and other fungi were around. Although again, observations were too few to be able to draw conclusions, this suggests that slug damage to a particular species of fungi is dependent upon the availability or otherwise of preferred species.

Recent visits to local forested areas in the vicinity of Victoria and Sooke have been notable for the very sparse banana slug population this year, leading me to assume that the dry weather earlier reduced the population considerably.

2. Inoculation trials to test for viability of spores after passing through the gut of a native slug.

Using *Russula* collections from coastal regions and higher elevations north of the Rocky Point area, inoculations were made onto Douglas-fir seedlings grown from local seedlots. The caps of sporocarps were cut into equal sized pieces of approximately 1.5cc volume, and the gill tissue separated from the trama. The trama was dried for later DNA analyses which can be compared to the DNA from any mycorrhizae arising from the treatment to the seedling to check that the inoculum, rather than contaminating spores, formed the mycorrhizae. The gill tissue of half of the pieces was placed directly in the vicinity of the root tips in both container-grown and bag grown seedlings. The gills from the remainder were fed to either *A. columbianus* or another native slug, *Prophyaon vanattae*, and the faecal strings following feeding collected, checked for spores and used to inoculate seedlings as above. Uninoculated controls were also set aside with each treated pair. The results should be available by summer of 1999.

3. One of the sporocarps of *R. olivacea* was collected with a bunch of mycorrhizal root tips attached to its base. These were photographed and described morphologically and will undergo a DNA analysis to see if they are indeed *R. olivacea*. The identification of mycorrhizal tips to species or even genus is often very difficult without such occasional linkages as this being found.

4. Other fungal observations.

We looked this year for sporocarps of *Tricholoma apium*, reported last year, but did not find any fruiting in the same area. We did find a species of *Hebeloma*, tentatively identified as *H. syriense*, growing around the skeleton of a deer. This species is associated with corpses and was found in an area of old growth in the vicinity of where *T. apium* was found last year.

- b) Research Activities

Research at Rocky Point and Royal Roads in 1998 was limited by weather conditions and much of the collecting I had intended to do on the site was not possible due to failure of the fungi of interest to appear in adequate supplies. Consequently, coastal forests in Port Renfrew, Clayquot Sound and Port Hardy were sampled instead.

- c) Extension and Demonstration

None.

Permit Number: PO44-98

Title: Western Screech-owls of Southern Vancouver Island

Author: Laura Darling, Wildlife Research Biologist
(250)387-9762
email: ldarling@fwhdept.env.gov.bc.ca

Organization: Wildlife Branch, BC Environment
PO BOX 9374 STN PROV GOV
Victoria, BC V8W 9M4

Location: CFMETR

Start Date: 01 Feb 1998

Completion Date: 31 Dec 1999

Project Overview:

Presently BC Environment recognises two subspecies of the Western Screech-owl on Vancouver Island. *Otus kennicottii saturatus* is found in forested landscapes of the drier southeastern portion of the island, principally Coastal Douglas-fir, and is "blue-listed" in B.C. based on reduced numbers and threats of habitat loss to its persistence. *O.k. kennicottii* is found throughout the rest of the island and the lower mainland, and is not listed provincially. However, there is some doubt about the validity of the subspecies designations of this owl, and blood samples for DNA analysis will provide some insight into this issue. If the *saturatus* subspecies is found to be significantly different genetically from the *kennicottii* subspecies, and if studies of distribution and inventory (historical and concurrent) confirm reduced numbers, then special management prescriptions will need to be used to prevent further endangerment of the subspecies and to conserve the subspecies. If DNA analysis finds no significant genetic difference, BC Environment must decide whether ecological differences warrant further special management for the subpopulation and whether we can avoid inappropriate and costly forest management prescriptions being applied.

Objectives:

to determine through mitochondrial DNA control region sequencing whether significant differences exist between *O.k. saturatus* and *O.k. kennicottii*; (2) Determine presence of Western Screech-owls throughout the distribution of *O.k. saturatus*; (3) Determine broad scale habitat selection by Western Screech-owls on southern Vancouver Island; and (4) Determine characteristics of habitats and habitat elements known to be used by Western Screech-owls on southern Vancouver Island. With respect to CFMETR in particular, to inventory and determine presence of Western Screech-owls in the area, to describe habitats and habitat elements used, and to capture owls for blood collection for the DNA analysis.

Accomplishments:

CFMETR was visited on several occasions during the winter-spring 1998; four times to conduct night time inventory surveys and twice to attempt to capture owls. Western Screech-owls were determined to be present in the area, and could be considered common at the site. Other owls heard included: Northern Saw-whet Owl and Great Horned Owl. We were unsuccessful in our capture attempts but were able to draw the birds in to the capture site.

Acknowledgments:

Volunteers have contributed significantly to this project in the CFMETR site: thanks to D. Doyle, E. McClaren, R. van den Dreissche, J. Joy and M. Shepard. The research is supported by BC Environment, Wildlife Branch.

Permit Number: P046-98
Title: VNHS Greenways Inventory Project
Project Leader: Norm Mogensen (250) 477 9114
Organization: Victoria Natural History Society (VNHS)
Location: The northerly 18 hectares within Plan 37130
Start Date: Started in April, 1998, but abandoned due to the site's active use as an archery range. Re-started on August 24, 1998
Completion Date: September 9, 1998

Project Overview:

In 1997 the Capital Regional District (CRD) and the Provincial Capital Commission (PCC) released their Regional Green/Blue Spaces Strategy, in which they invited non-profit organizations to collaborate by helping to expand the regional green/blue spaces database, by continuing to advocate for the protection of appropriate regional green/blue spaces, and by continuing to provide public education about green/blue spaces. As this matched well with VNHS' purposes, it launched its Greenways Inventorying Project to pursue these objectives in collaboration with regional and local governments and property owners. This site met the selection criteria for site inventorying, established by VNHS for these purposes.

Objectives:

This site was identified as being of potential regional importance as an undeveloped semi-natural node close to a fast growing urban area. It is connected or close to, and complementary with other protected semi-natural areas and undedicated and unprotected wildlife corridors. The site appeared to have conservation and greenways potential. This project's objective was therefore to inventory ecological and other natural values on the site and assess its conservation potential within a local and regional context.

Accomplishments to Date:

a) Highlights of Findings:

The site contains several eco-systems types of decreasing abundance in this area, and a rich variety of species, within geography that varies from rocky hilltops that slope down to level meadows and some seasonally wet areas. It has a year around stream flowing through it from the west, to its eastern boundary which is the shoreline where Millstream's estuary converges with Esquimalt Harbour. The site is also adjacent to actively used military lands containing a considerable amount of semi-natural habitat, a community recreational facility and a sparsely developed residential neighbourhood.

The site lays within the general corridor zone proposed for the South Coast Marine Access Corridor (a new regional greenway) identified in the CRD/PCC Green/Blue Spaces Strategy document. It would fulfill part of the needs of that greenway, very well. In spite of a number of disturbances on it, the site could be readily restored to something close to its natural state, to serve as a "green" node along the new regional greenway. That node could provide habitat, natural recreational opportunities and solace, close to an urban area intended for early re-development and increased population density.

b) Research Activities: None.

c) Extension and Demonstration:

A spring botany inventory is recommended for this site, as the 1998 inventory was done too late in the season to catch these values.

Permit No.: P050-98

Title: Rare Plant Communities on the DND Properties

Project Contact: Adolf Ceska
(250) 356-7855

Organization: Conservation Data Centre
Ministry of Environment
P.O. Box 9344
Victoria, B.C. V8W 9M1

Location: Albert Head, Mary Hill Battery, CFMETR, CFAD Rocky Point and Royal Roads, (Victoria)

Start Date: April 14, 1998

Completion Date: October 31, 1998

Project Overview:

The project involved a survey of the rare plant communities on DND properties.

Accomplishments to Date:

Report not received

Permit number: PO51 - 98

Title: Marbled Murrelet Habitat Assessment in the Coastal Douglas-fir Zone

Project Leader: Dr. Alan Burger (250) 721-7127

Organization: Biology Department
University of Victoria
PO Box 1700
Victoria, BC V8W 3N5

Location: The eastern end of the CRD, stretching from the Greater Victoria Water District catchment area and DND Rocky Point, throughout the Saanich Peninsula and Saltspring Island.

Start date: 25 May 1998

Completion date: Fall 1999

Project Overview:

This pilot project was the first to look for Marbled Murrelets (*Brachyramphus marmoratus*) in the Coastal Douglas-fir (CDF) biogeoclimatic zone of south-east Vancouver Island. The Marbled Murrelet is a red-listed species in British Columbia and faces threats to its continued survival throughout its range on the Pacific North American coast. Loss of nesting habitat due to logging is the main threat facing the bird in B.C., but other threats include increased nest predation due to forest fragmentation, oil spills and gill net fisheries. Although the CDF zone represents a small portion of the bird's potential breeding range, it is likely to support remnants of the dwindling Georgia Depression breeding population, which is one of the problem areas identified by the Marbled Murrelet Recovery Plan.

Marbled Murrelets remain at sea for most of the year and during the breeding season are extremely secretive and difficult to observe. The birds are unique among seabirds in nesting on suitable limbs of large old-growth coniferous trees, up to 70km inland from the ocean. A single chick is raised during the breeding season, fed several times a day by both parents. The breeding biology of the Marbled Murrelet has in large part been shaped by the risk of nest predation, the major cause of nest failure and the reason for the secrecy surrounding their nesting attempts.

Objectives:

- 1) To establish the extent to which remnant old-growth Coastal Douglas Fir stands support nesting Marbled Murrelets.
- 2) To determine the habitat characteristics of the stands in which murrelets are found and compare those with characteristics in stands without murrelets.

- 3) To compare habitat characteristics of occupied CDF stands with those in CWH zones elsewhere on Vancouver Island and the mainland.
- 4) To map the extent of apparently suitable habitat (based on vegetation characteristics) remaining in the CDF zone.
- 5) To locate nest trees and describe macro- and micro-habitat features of nest stands, trees and sites.

Accomplishments to date:

a) Highlights of findings to date:

- 1) Areas of forest potentially suitable as murrelet nesting habitat were identified using maps and contacts with knowledge of old-growth forest. Once identified, forest stands were ground-checked and trees were assessed for their suitability. 170 forest polygons were visited and about 60 were selected as suitable for murrelet occupancy.
- 2) Forty-one murrelet survey stations were established in and around selected stands and audio-visual surveys were carried out at the stations using standard murrelet survey techniques. Two stations were located at DND Rocky Point in older forest with suitable trees.
- 3) Twenty-four stations recorded murrelets on at least one visit and 11 recorded behaviour indicating suitable nesting habitat nearby. Of the 24 stations, only one was outside the Greater Victoria Water District catchment area, on Saltspring Island. Marbled Murrelets are almost certainly nesting in the catchment area.
- 4) Vegetation surveys were carried out close to survey stations. Analysis indicates that suitable trees for murrelet nesting are present in the CDF zone, with similar densities and characteristics to trees in areas known to contain nesting murrelets elsewhere on Vancouver Island. The small sample of trees climbed all had suitable branches and moss/lichen mats, known to be important for murrelet nesting.
- 5) Potential predators of Marbled Murrelets were found in nearly all dawn surveys suggesting that nest predation is an important limiting factor, which might be affected by logging and other fragmentation that encourages nest predators.

b) Research activities:

Audio-visual surveys at murrelet survey stations are non-invasive. An observer remains at the station for a two hour period around sunrise or sunset when murrelets are most active. Any sighting or hearing of murrelets or potential predators is recorded.

Vegetation surveys are again non-invasive and involve the establishment of a 30 x 30 m temporary quadrat. Characteristics of all trees (greater than 10 cm diameter at breast height) are noted in detail together with percentage cover of other vegetation in the quadrat.

Permit Number: P052-98

Title: Ecology, Biology of Exotic Plants – Scotch Broom and Gorse

Project Leader: Raj Prasad PhD. 250-363-0600

Organization: Canadian Forest Service
506 W. Burnside Rd.
Victoria, BC V82 1M5

Location: Royal Roads and Rocky Point

Start Date: 1998

Completion Date: 2001

Project Overview:

Broom and gorse are two exotic species that are invasive, spread rapidly, and displace local native plants. They also impact negatively on conifer plantations. Studies are needed to better understand their ecology, impact on and displacement of native species, and to formulate appropriate control measures.

Objectives:

- (a) to determine the impact of broom on Douglas-fir seedlings
- (b) to provide a better understanding of the ecology of the two species
- (c) to formulate recommendations for the suppression of broom and gorse

Methodology:

This is a multiyear project with two parts.

The first part will investigate the impact of broom on Douglas-fir seedlings. This summer, ten plots, each measuring 10m by 10m and containing about 10 Douglas-fir seedlings and a cover of broom will be established. Wooden corner posts will mark the corners of each plot. Five plots will be control plots, *i.e.* no treatment, and five will be treatment plots, *i.e.* broom removed manually. The Douglas-fir seedlings will be marked with a numbered stake. Height measurements of the Douglas-fir seedlings will be measured annually. The number of broom plants in each plot will be determined and a measurement made of their height. An analysis of Douglas-fir height growth will be made each year.

The second part, which will begin next year, will investigate the effectiveness of herbicides in controlling sprouting of gorse. Four types of treatments will be compared: a bioherbicide, Vision (Gyphosate), Release (Garlon, Triclopyr) and

control (no treatment). Ten gorse plants will be selected for each treatment. The gorse plant will be cut and the herbicide applied to the cut stump. The stumps will be marked with a numbered stake. The stumps will be checked at the end of the growing season for sprouts and again the following year.

As the second part is to be done in Year 2, all the required MOE approvals will be obtained and a separate Environmental screening done at that time.

Accomplishment to date:

(a) Plots were outlined and areas were marked for monitoring the impacts of these two exotic weeds on conifers. Experiments carried out at other sites demonstrate that Scotch broom competes with Douglas-fir seedlings and reduces the infiltration of light (PAR), height, and volume growth by 50-55%.

(b) Two mycoherbicidal fungi (*Chondrostereum purpureum* and *Fusarium tumidum*) show good potential for checking the growth of Scotch broom and gorse under greenhouse conditions. Plans are underway to extend these experiments to field conditions in the DND sites once resources become available. Plans are also made to integrate the manual cutting, bioherbicidal and herbicidal applications particularly for the control of gorse on DND sites.

(c) Publication: several reports and publications were prepared:

1. D. Peterson and R. Prasad, 1998. The biology of Canadian Weeds. 109. *Cytisus scoparius* (L.) Link. Can. J. Pl. Sci. 78: 497-504.
2. R. Prasad and D. Peterson. 1997. Mechanisms of Invasiveness of Exotic weed, Scotch broom in British Columbia. Proc. Expert Committee on Weeds, Annual meetings 9-12 Dec. 1996, Victoria, BC. pp. 197-198.
3. R. Prasad 1999. Some aspects of the impact and management of the exotic weed, Scotch broom in British Columbia, Canada. Journal of Sustainable Forestry (in press).
4. D. Clements, D. Peterson, and R. Prasad. 1999. The biology of Canadian Weeds. 112. *Ulex europaeus* (L.) Can J. Pl. Sci. (submitted) m.s. 35pp.
5. R. Prasad. 1999. Ecology of Alien Plant Species: Invasiveness of Scotch broom and gorse in Canada. Proc. Intl. Conf. On Exotic Plants. Italy, Oct. 15-18 1999. m.s. 12pp.
6. R. Prasad 1999. Ecology-biology of Scotch broom and gorse in Garry Oak Meadow System. Intl. Symp. Univ. of Victoria, May 5-8, Abst. 2 pages.

APPENDIX 4

Final Reports for Projects Completed in 1998

Permit No. P031-98

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

Author: Doris Rohlf
(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. Since 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, damage and reduce germination potential of the acorns. There are two acorn-boring insects, both native to North America which reduce survival and regeneration capabilities of Garry oak. These are the filbert weevil (*Curculio occidentis* (Casey)) and the filbertworm (*Cydia latiferreana* (Walsingham) formerly *Melissopus latiferreanus* (Walsingham)) (Passon, 1964; AliNiasee, 1980). This project focuses on these two acorn-feeding insects at Mary Hill, Rocky Point and eight other locations in the Greater Victoria area.

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 insect and
c) determine the role of the parasitoids in regulating the pest populations.
- 3) Determine the proportion of infested acorns that can germinate into viable seedlings
- 4) Determine the distribution of the insects within the Garry oak canopy
- 5) Determine the life history of the less damaging insect attacking Garry oak acorns.

Accomplishments - 1998

A) Research Activities

i. Sample Collection

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

Acorns were collected by pole pruner once a week from each location. The 15 sample trees were assigned a number from 1 to 5 with each number being replicated 3 times. One group of 3 trees was sampled each week and 10 acorns were collected from each sample tree. The groups of sample trees were rotated through for 15 weeks (June 22 - September 29 1998), and collecting a maximum of 30 acorns per tree (in some cases, less than 30 acorns were collected per tree because of low acorn production). Acorns were collected by pole pruner for the strata sample collection as well. 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. The strata sampling was conducted once on August 25, 1998.

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 m². The traps were staked into place with a six-foot metal stake. Three traps were placed under each of 12 sample trees at both locations.

Insect emergence traps were used to capture adult filbert weevil. The emergence trap used was a modification of a trap designed by Raney and Eikenbary (1969). Each trap is constructed from four 2"x2" boards fastened into a square for a collecting area of 0.5m². A fine mesh is held into a pyramidal shape with copper welding rods, and a collecting jar is fastened to the top of the rods with a wooden ring and a clamp

One trap was placed under the crown of each of eight sample trees in the first week of April at both Mary Hill and Rocky Point.

ii. Laboratory Activities

Laboratory activities included dissection of weekly collected acorns to determine the percent of acorns infested by the filbert weevil and filbertworm, as well as type of insect injury, and the number and type of insect larvae within each acorn. The location of oviposition holes, eggs, larvae, and emergence holes on the acorn were noted. The position of each damage mark was recorded as apical, middle or distal.

Life history determination included rearing eggs, larvae and adults of the filbert weevil. Filbert weevil eggs and larvae were reared to determine the number of successive instars and duration of each larval instar (as well as length of egg stage). Each egg or larvae was placed individually into a creamer cup containing diet. Eggs and larvae were held at 25°C with a photoperiod of L:D 14:10 and 50% RH. The eggs were observed daily and the time required for each egg to hatch recorded. The number of larval instars was determined using head capsule measurements (Dyar 1947).

Germination Tests

To estimate the amount of damage done to an acorn by insect feeding without dissecting the acorn, a multiple regression equation was developed.

Approximately 1,500 acorns were chosen randomly from a sample of approximately 5,000 acorns and measured for both weight and length. The acorns were dissected and classified into four groups; healthy (no damage), light damage (trace – 20% damage), moderate damage (21% - 50% damage) and severe damage (>50% damage), based on the amount of insect feeding and damage to the acorn kernel.

Using the length, width and damage class data from the acorns, a multiple regression model was developed that incorporated the length and weight as independent variables and damage rating as the dependent variable. No significant difference was found between the light and moderate damage classes and therefore these two classes (light and moderate) were combined to form the new light/moderate damage category.

The model was then applied to a second random sample of acorns (from the same sample as the acorns from which the model was determined) where weights and length were measured but the acorn not cut open. The three damage categories were estimated from the weight and length measurements using the regression equation.

Acorns from the three damage classes were tested for germination potential by using the method used by Bonner (1984) and Bonner and Vozzo (1987). This method is similar to the techniques used for official seed tests for acorns (Association of Official Seed Analysts 1978).

The procedure (Bonner 1984) is simple:

1. Cut acorns in half, discard half with the cup scar
2. Peel the pericarp from the remaining half and place cut side down on a moist blotter paper
3. Incubate at 25°C with 8L : 16D
4. Count germination for up to 28 days. An acorn is scored as germinated if both radicle and shoot exhibit normal growth and morphology.

100 acorns from each of the three damage categories were set up in this manner, and total number germinated recorded.

Statistical analysis was done on the program SPSS.

B) Highlights of findings to Date

Total infestation rates at Mary Hill and Rocky Point were 51.90% and 24.29% respectively (Table 1). Infestation at Rocky Point was the lowest for all ten locations sampled, and fell well below the mean of 51.29%.

Table 1. Infestation Rates by the Filbert weevil and Filbertworm at all locations in 1998

Location	% weevil	% worm	% both	% total infest.
1 Mary Hill	43.81	10.95	2.89	51.90
2 Rocky Point	20.95	3.33	0.00	24.29
3 Officers Mess	38.57	4.29	1.90	40.95
4 High Rock	52.38	14.29	4.76	61.91
5 Beacon Hill	51.43	12.38	0.95	62.86
6 Summit	42.38	18.10	3.81	56.67
7 Playfair	56.67	14.29	4.76	66.19
8 Mt. Tolmie	51.91	21.43	5.71	67.62
9 Christmas Hill	40.00	10.00	3.81	46.19
10 Layritz	31.91	3.81	1.42	34.29
mean				51.29

The mean number of filbert weevil oviposition holes per infested acorn was 1.68, with the mean number of eggs, larvae and emergence holes being 0.83, 0.46 and 0.18 respectively (Table 2). The mean number of filbertworm larvae per acorn was 0.62 and the mean number of filbertworm emergence holes was 0.47.

Table 2. Mean number of weevil oviposition holes, eggs, larvae, and emergence holes and mean number of filbertworm larvae and emergence holes per acorn for all locations in 1998.

Damage	N	Min	Max	Mean	Std. Dev.
Filbert weevil oviposition	1322	0	8	1.68	1.06
Filbert weevil eggs	1322	0	10	.83	1.11
Filbert weevil larvae	1322	0	10	.46	1.05
Filbert weevil emergence	1322	0	4	.18	.54
Filbertworm larvae	243	0	3	.62	.59
Filbertworm emergence	243	0	2	.47	.55

The majority of filbert weevil oviposition holes, larvae and emergence holes were located in the middle portion of the acorn (Table 3). Oviposition holes (4.69%) and larvae (8.06%) were rarely found in the distal end of the acorn. Emergence holes were found more often in the distal end (30.66%) than in the proximal end (26.89%).

Table 3. Location on acorn of weevil oviposition holes, weevil larvae and weevil emergence holes for all locations in 1998.

Acorn Location	Oviposition Holes	Larvae	Emergence Holes
Distal	4.69%	8.06%	30.66%
Middle	75.10%	56.99%	42.45%
Proximal	20.21%	34.95%	26.89%

Acorns were plotted length x width by weight separated by damage class (Figure 1). Healthy acorns have a Rsq of 0.9937, light/moderately damaged acorns a Rsq of 0.9499 and for severely damaged acorns the Rsq is 0.9585

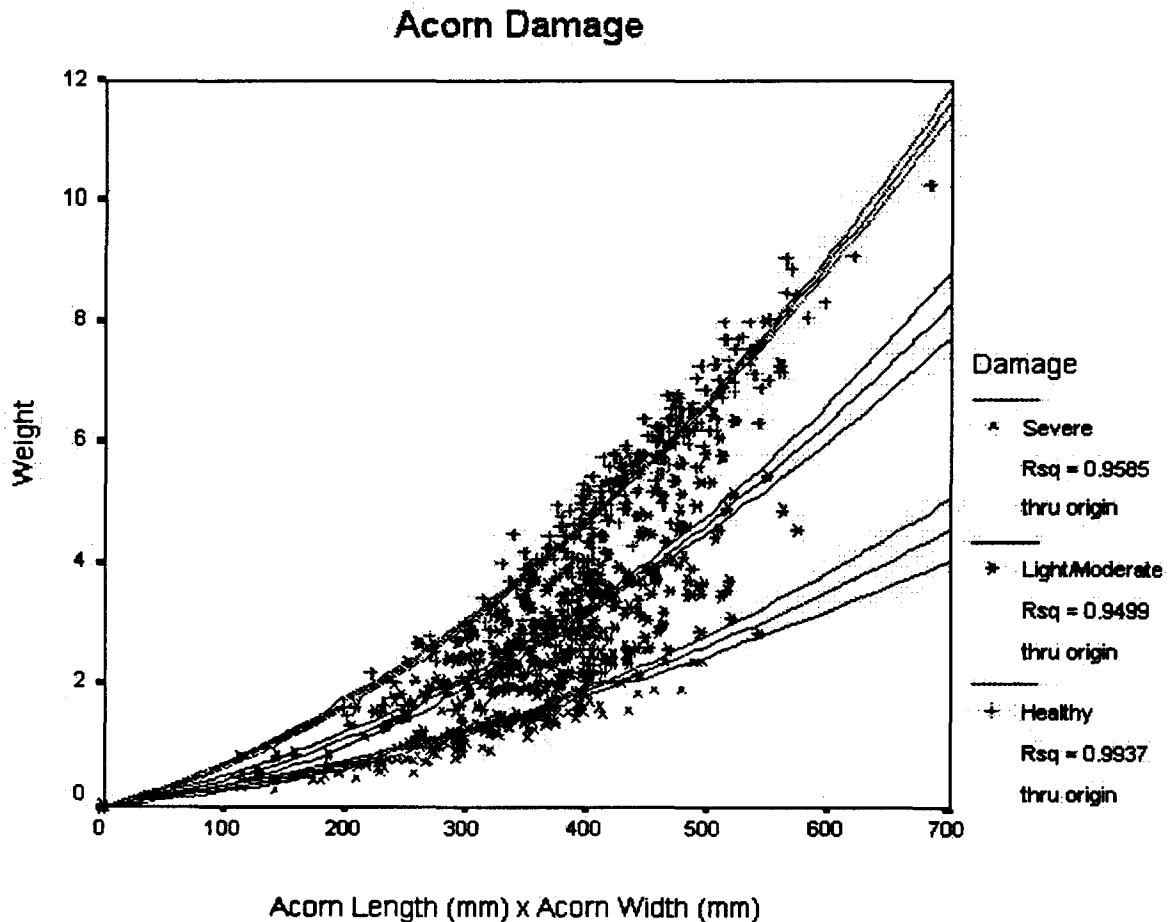


Figure 1. Distribution of healthy, light/moderately damaged acorns and severely damaged acorns.

Acorns from the severe damage category did not germinate (Table 4). In the light/moderate category 23% of acorns germinated and in the healthy category 42% acorns germinated.

Table 4. Number and percent of acorns germinated from the three damage classes for mass collection in 1998

Acorn Class	# of Acorns Set-up	# Germinated	% Germinated
Healthy	100	42	42
Light/Moderate Damage	100	23	23
Severe Damage	100	0	0

Acorn size in 1998 ranged from a maximum length of 35.83 mm to a minimum of 4.17mm. The mean acorn width was 15.58mm with the minimum being 5.73mm and the maximum 15.58mm (Table 5).

Table 5. Mean acorn size for all locations in 1998.

	N	Min (mm)	Max (mm)	Mean (mm)	Std. Dev.
LENGTH	4390	4.17	35.83	17.6057	7.1128
LENGTH	4390	4.17	35.83	17.6057	7.1128
WIDTH	4390	5.73	26.38	15.5852	3.2261
WIDTH	4390	5.73	26.38	15.5852	3.2261

Head capsule width was plotted on a histogram to determine the number of larval instars. In both 1997 and 1998, four peaks were evident in the graph, indicating four larval instars (Figure 2).

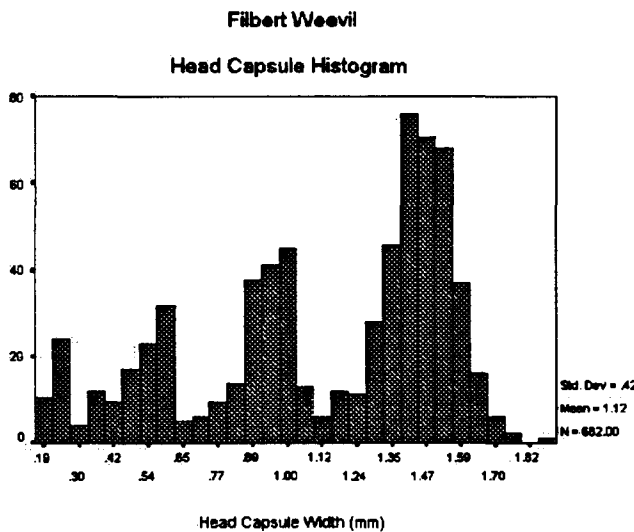


Figure 2. Head capsule distribution of the filbert weevil based on all locations for 1997 and 1998 combined.

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
- Brief summary of research presented at the annual meeting of the Environmental Science Advisory Committee on January 31, 1998

References:

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

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Dyar, H. G. 1947. The number of moults in lepidopteran larvae. Psyche. 5: 420-422.

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

Passon, D.E. 1964. Controlling the filbert moth. Proc. Oreg. Wash. Nut Growers Soc. 50: 29-30. J. Econ. Entomol. 62: 722-723.

Raney, H. G., and Eikenbary, R. D. 1969. A simplified trap for collecting adult pecan weevils. J. Econ. Entomol. 62: 722-723.

Permit No.: PO45-98
Title: Successional Forests Research Workshop Field Trip
Project Contact: Arthur Robinson, (250) - 363-0729
Organization: Canadian Forest Service
Location: Rocky Point
Start Date: February 20, 1998
Completion Date: February 20, 1998

Project Overview:

A Successional Forests Research Workshop was held in Victoria. As part of the workshop a field trip was available for the participants of the workshop. The field trip visited successional forest research sites discussed during the workshop and introduced a number of other research projects within the Gary Oak ecosystem of Southern Vancouver Island. The morning part of the field trip was in the Victoria Watershed North while in the afternoon it was at Rocky Point. At Rocky Point the participants had the opportunity to look at the Gary Oak ecosystem research being carried out there as well as the Pacific Yew research. As the proponents of the research gave a short presentation on their research the trip presented an excellent opportunity for the participants to pose questions about research results and methodology on site.

Objectives:

The objective of the field tour was to provide the participants of the tour with an opportunity on site to learn more about the research projects being carried out at Rocky Point.

Accomplishments to Date:

Twenty seven participants took part in the tour. Two sites were visited at Rocky Point, one in the Gary Oak ecosystem and the other in the Douglas-fir ecosystem. Researchers responsible for certain research projects in the Gary Oak ecosystem and the Pacific Yew project at Rocky Point were on site and made presentations to the group. The participants had an opportunity to view the site and to talk to the researchers. Unfortunately, time constraints did not allow for the Forest Canopy Research Station part of the tour to be done as access to the Canopy Station was delayed due to a military training exercise being carried out in that vicinity.

Research Activities:

None

Extension and Demonstration:

This was the entire focus of the event, with the target being the tour participants.

Permit Number: P047-98

Title: Survey and Limited Collection of Hardwood Decay Pyrenomycetes (Fungi)

Project Leader: Dr. Brenda Callan (250) 363-0744

Organization: Canadian Forest Service, Natural Resources Canada
506 West Burnside Road, Victoria, B.C. V8Z 1M5

Location: CFAD Rocky Point

Start Date: April 16, 1998

Completion Date: April 19, 1998

Project Overview: Rocky Point's unique collection of mature trembling aspen and other hardwoods provides a protected site for relatively undisturbed fallen coarse woody debris. Large fallen logs at this site serve as repositories for wood decay pyrenomycetes (small black fungi).

The purpose of this survey and collection trip was to further add to a preliminary species list of hardwood decay pyrenomycetes in the vicinity of Rocky Point. Pyrenomycetes are a group of fungi (ascomycetes) that are often associated with hardwood decay. They form dark or sometimes brightly coloured crusts on the surfaces of recently dead trees or on wood. Some species are large and easily spotted in the field, yet they have only been collected once or twice in the Pacific Northwest, indicating that they could be possibly rare here. However, the ecology and distribution of these fungi have not been widely explored in British Columbia. Undisturbed mature hardwood stands with recently dead fallen trees are among the richest habitats for these organisms. Sites in southern Vancouver Island such as those found at Rocky Point provide easily accessible, protected collecting areas rich in a diversity of hardwoods (aspen, alder, and oak). The collections made on this one-day foray include some new occurrence records for the province of British Columbia.

For an excellent taxonomic overview of these fungi, complete with colour photographs, the following web site is recommended:

<http://mycology.wsu.edu/xylariaceae/default.asp>

Collection and Identification List:

All specimens were collected on April 18, 1998 in the vicinity of Cape Calver, by the following two collectors:

- Dr. Brenda Callan, Natural Resources Canada, Pacific Forestry Centre, Victoria BC
- Dr. Jack Rogers, Department of Plant Pathology, Washington State University, Pullman WA, USA.

Specimens were examined, identified, and preserved in the Pacific Forestry Centre's Forest Pathology Herbarium (an internationally recognized collection, which is abbreviated DAVFP hereafter). DAVFP collection numbers are referenced below with each specimen. These data will also soon be added to a database on the following web site: www.pfc.cfs.nrcan.gc.ca/biodiversity/herbarium
Duplicate collections are also housed at Washington State University with Rogers.

Collection number: 1

Host: *Holodiscus discolor* (Pursh) Maxim.

Fungus: *Hypoxyton fuscum* (Pers.:Fr.) Fr.

DAVFP No.: 25420

Comments: Polygon 47. **New host record.**

It is a surprise to find this collection on *Holodiscus*, and collections # 11 and #15 on *Alnus* because the main host elsewhere is *Betula*. The pigment described by Rogers and Ju in the website (cited above) is greenish in the majority of collections made elsewhere. Pigments (exuded in potassium hydroxide) from all three of these collections is orange, which made the initial identification difficult. This is a complex species, which in time may be divided into a number of taxa.

Collection number: 2

Host: *Alnus rubra* Bong.

Fungus: *Diatrypella verrucaeformis* (Ehrh.:Fr.) Nits.

DAVFP No.: 25421

Comments: Polygon 49. **New record in B.C.**

Collection number: 3

Host: *Alnus rubra* Bong.

Fungus: Immature reddish-brown pulvinate *Hypoxyton multiforme*

DAVFP No.: 25422

Comments: Polygon 49. No ascospores in part of collection retained at PFC

Collection number: 4

Host: *Prunus* sp. (probably *P. emarginata*)

Fungus: *Biscogniauxia mediterranea* (De Not.) Kuntze var. *microspora*

DAVFP No.: 25423

Comments: Polygon 49. **New host record.**

Collection number: 5

Host: *Alnus rubra* Bong.

Fungus: *Diatrype flavovirens* (Pers.:Fr.) Fr.

DAVFP No.: 25424

Comments: Polygon 49

Collection number: 6

Host: *Populus tremuloides* Michx. var. *vancouveriana*

Fungus: *Nemania serpens* (Pers.:Fr.) S.F. Gray

DAVFP No.: 25425

Comments: Polygon 47. Typical except for acute and conspicuous ostioles.

Collection number: 7
Host: decayed angiosperm wood
Fungus: *Nemania serpens* (Pers.:Fr.) S.F. Gray
DAVFP No.: -
Comments: Polygon 47.

Collection number: 8
Host: *Alnus rubra* Bong.
Fungus: *Biscogniauxia mediterranea* (De Not.) Kuntze var. *microspora*
DAVFP No.: -
Comments: Polygon 49. Collection at Washington State University

Collection number: 9
Host: *Alnus rubra* Bong. (fallen)
Fungus: *Hypoxyton multifforme* Fr.
DAVFP No.: -
Comments: Polygon 49. Sent to Washington State University

Collection number: 10
Host: *Quercus garryana* Dougl. at roadside
Fungus: *Nemania serpens* (Pers.:Fr.) S.F. Gray var. *macrospora* (J.H. Miller) Pouzar
DAVFP No.: 25426
Comments: Polygon 120. **New host record.** This material seems a bit different from the usual concept of this taxon, especially the greyish black ascospores. It seems associated with *Q. garryana* wood – J.D. Rogers has several other collections made this day at Cape Calver. This could turn out to be a new taxon.

Collection number: 11
Host: *Alnus rubra* Bong.
Fungus: *Hypoxyton fuscum* (Pers.:Fr.) Fr.
DAVFP No.: 25427
Comments: Polygon 49

Collection number: 12
Host: bark, dicot tree
Fungus: *Eutypella cerviculata* (Fr.) Sacc.
DAVFP No.: 25428
Comments: Polygon 49. Material is in fairly poor shape. This is a genus with a lot of ill-defined species. The ostioles are coarser than what is called "*cerviculata*" in Europe.

Collection number: 13
Host: *Alnus rubra* Bong.
Fungus: *Biscogniauxia mediterranea* (De Not.) Kuntze var. *microspora*
DAVFP No.: 25429
Comments: Polygon 49. **New record for BC.**

Collection number: 14
Host: Fallen *Alnus rubra* Bong.
Fungus: *Hypoxyton rubiginosum* (Pers.: Fr.) Fr.
DAVFP No.: 25430
Comments: Polygon 47. Overmature

Collection number: 15
Host: fallen ? *Alnus rubra* Bong.
Fungus: *Hypoxyton fuscum* (Pers.:Fr.) Fr.
DAVFP No.: 25431
Comments: Polygon 49

Collection number: 16
Host: *Alnus rubra* Bong.
Fungus: *Hypoxyton multiforme* Fr.
DAVFP No.: 25432
Comments: Polygon 49

Collection number: 17
Host: *Alnus rubra* Bong.
Fungus: *Hypoxyton multiforme* Fr.
DAVFP No.: 25433
Comments: Polygon 49

Highlights of findings to date:

The two new provincial records (collections 1 and 2 above) and two new host records (collections 4 and 10) are significant additions to our knowledge of these fungi.

Research activities

Collections of *Nemania serpens* will be used in taxonomic studies of this genus. These collections have raised questions as to what the "real *N. serpens* var. *macrospora* is in relation to them. It would be interesting to further study this species to determine if it is consistently or exclusively associated with Garry oak.

The collections of *H. fuscum* exhibit an atypical host association – generally *H. multiforme* is the predominate associate on alder.

Extension and demonstration: None at this time.

Permit No.: P053-98

Title: Field Tour for Environmental Studies

Project Contact: Donald Eastman
(250) 721-7354 or (250) 479-8382
Email: deastman@uvic.ca

Organization: School of Environmental Studies
University of Victoria
P.O. Box 1700
Victoria, B.C. V8W 2Y2

Location: CFAD Rocky Point, (Victoria)

Start Date: September 26, 1998

Completion Date: October 31, 1998

Project Overview:

A one-day field trip by the Environmental Science 318 class. The trip was organized around a series of site visits with resource personnel to explain active research projects and to explain the ecological significance of the area.

Objectives:

The primary objectives for the field trip were to expose students to the ecological importance of the Rocky Point area, and to indicate the importance of ecological research in conserving such areas

Learning objectives for the students were as follows:

By the end of this trip, you should be able to:

1. Generally describe the Garry Oak ecosystem; why it is of conservation concern; and the importance of the Rocky Point area for this ecosystem.
2. Understand the ecological significance of the Steller's Jay to the Garry Oak ecosystem.
3. Appreciate the significance of tree canopy studies for understanding the biodiversity of forest ecosystems.
4. Describe some methods used to study bird migration, e.g., banding, mist netting, as well as appreciate the significance of Rocky Point for migrating birds.

Accomplishments to Date:

One field trip was held on Saturday, September 26. The trip lasted from about 0900h-1600h. Approximately 20 students participated in the outing. A second trip scheduled for October was not held due to time constraints.

Research Activities:

None

Extension and Demonstration:

The main purpose of this trip was extension and demonstration. The following sites were visited with various resource personnel:

Introductory comments and an orientation: Tony Trofymow provide useful information about the management at Rocky Point, and the research program.

Bird migration: Mike Shepherd described the bird-banding station - purpose, methods, initial findings – and the significance of the Rocky Point site. He also outlined the role of bird banding in studying bird migration.

Garry Oak ecosystem: Adolph and Aluna Ceska present ecological information about this ecosystem, and the conservation significance of the ecosystem, in general, and the Rocky Point site. Marilyn Fuchs described the role of Stellar's Jay in the dispersal of Garry oak acorns, based on her recently completed Master's degree on this subject.

Douglas-fir ecosystem: Ecological comments were given by Adolph Ceska. Neville Winchester described of the forest canopy station – its purpose, methods used, results to date, and the significance to conservation biology of forest canopy studies. A CBC radio crew was present at this site to interview Dr. Winchester.

Hawk watching from several vantage points, to gain an appreciation of the importance of the Rocky Point site for the migration of birds of prey.

Based on feedback from the students, this trip was a very informative and interesting trip. To have access to such an important and ecologically significant area close to the university is valuable.

Permit Number: P048-98

Title : North American Forest Biology Workshop/ Western Forest Genetics Assoc. (Tour)

Author: A.K. Mitchell, Ph.D. (250) 363-0786
T.A. Bown (250) 363-0681

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

Location: Rocky Point (Department of National Defense)

Date: June 23 1998

Completion Date: June 23, 1998 (One day only)

Project Overview:

In recent years DND has made this exceptional area available to forest biologists for a wide range of studies including everything from bird life to canopy insects. The tour, conducted by Canadian Forest Service forester Art Robinson and Tom Bown, included a walk through a Garry oak meadow and an old growth Douglas-fir forest as well as handouts outlining a wide variety of research projects. On going forestry problems such as introduced weed species and social issues such as forest archaeology were discussed.

Objectives:

1. To conduct a tour of research activities under way at Rocky Point.
2. To raise awareness of the values of DND lands on Southern Vancouver Island.

a) Accomplishments to Date:

The tour was a one-day excursion attended by delegates to an international conference on Forest Biology held in Victoria (Dr. A. Mitchell, Chair). Approximately 50 delegates from Canada, the USA and Scandinavia attended.

b) Research Activities

The following research topics were discussed by experts in their respective fields.

Speakers and topics discussed:

1. Mike Shepard VGI Vision Group International Inc.: An overview of the migration monitoring of neotropical land birds at Rocky Point.
2. Mike Meagher Canadian Forest Service.: Genetic variation in populations of Garry oak *Quercus garryana* in the pacific Northwest.
3. Morley Eldridge Millennia Research Ltd.: An overview of forest archaeology in coastal B.C. and a description of Millennia's survey work on the prehistoric archaeology sites of Rocky Point.
4. Karen Hogg Canadian Forest Service.: Overview of the problems with introduced Scotch broom *Cytisus scoparius*.
5. Richard Ring University of Victoria.: An overview the canopy research platform project and preliminary findings of canopy arthropods.
6. Tom Bown and Keri Stockburger Canadian Forest Service.: A review of the research and findings by Al Mitchell at Pacific Forestry Centre on Pacific yew *Taxus brevifolia*.

c) Extension and demonstration

The tour was a technology transfer vehicle. Delegates were introduced to DND ESAC Objectives and priorities and contact was made with the following researchers.

Tour Leader:

Tom Bown	Canadian Forest Service	(250) 363-0600 tdown@pfc.forestry.ca
Arthur Robinson	Canadian Forest Service	(250) 363-0600 arobinson@pfc.forestry.ca
Morley Eldridge	Millennia Research Ltd. Victoria B.C.	(250) 656-0450 millres@islandnet.com
Mike Shepard	VGI Vision Group International Inc.	(250) 658-4844 mgs@vgivision.com
Mike Meagher	Canadian Forest Service (retired)	(250) 363-0600 mmeagher@pfc.forestry.ca
George Edwards	Canadian Forest Service (retired)	(250) 363-0600 gedwards@pfc.forestry.ca
Karen Hogg	Canadian Forest Service	(250) 363-0600 khogg@pfc.forestry.ca
Richard Ring	University of Victoria	(250) 721-7102 raring@uvic.ca
Keri Stockburger	Canadian forest Service	(250) 363-0681 kstockburger@pfc.forestry.ca

For further information:

Web Pages:

Canadian Forest Service Pacific Forestry Centre	http://www.PFC.Forestry.CA
Millennia Research Ltd.	http://www.islandnet.com/~millres/
University of Victoria	http://www.uvic.ca/
VGI Vision Group Inc.	http://www.vgivision.com/

Permit No.: PO49-98

Title: Vertical Profiling of Air Pollutants by Tethered Balloon

Author: Dr. Ian McKendry (604) 822 4929

Organization: Geography Department/Atmospheric Science Program
University of British Columbia
1984 West Mall, Vancouver, B.C. V6T 1Z2

Location: CFS Aldergrove, DND Esquimalt Property

Start Date: July 1, 1998

Completion Date: August 31, 1998

Project Overview:

The Lower Fraser Valley episodically suffers from summertime degraded air quality due to the development of photochemical smog during anticyclonic weather conditions. Previous research has focussed on the daytime pollutant concentrations and their distribution in the region. However little is known about the vertical distribution and transport of pollutants (notably ozone) at nighttime. In particular there is concern that pollutants are transported toward Georgia Strait during nighttime and then recirculated over the Lower Fraser Valley the following day. Because of its central valley location and secure environment, CFS Aldergrove represents an ideal location at which to base intensive meteorological observations.

Objectives:

By utilizing tethered instrumented balloons, to measure the vertical distribution of ozone and meteorological variables up to 1000m AGL throughout the night and early morning.

Based on tower based fast response instrumentation, to directly measure vertical fluxes of ozone throughout the night.

Appendix 5

Additional Annual Reports for Projects Worked on in 1998

Permit No.: P034-98

Title: Establishment of EMAN Long-term Ecological Monitoring Plots at Royal Roads

Project Contact: Dr. Bill Dushenko/Dr. Jan Addison
(250) 391-2580/(250) 391-2585

Organization: Applied Research
Royal Roads University
2005 Sooke Rd.
Victoria, B.C. V9B 5Y2

Location: Royal Roads

Start Date: March 31, 1998

Completion Date: Continuing (report as of January, 1999)

Project Overview:

The project involved the survey of two long-term ecological monitoring plots on the Royal Roads property. This property contains a rare, and potentially-threatened collection of ecosystems - including old and mixed forests, upland fields, marine shoreline and wetlands - which are surrounded by a growing urban sprawl. Students in the B.Sc. in Environmental Sciences Program at Royal Roads University were directly involved in the project which provided them the opportunity to learn about ecosystems, the study of biodiversity, and to develop their field techniques and research skills. The students were required to conduct field surveys, collect the data, develop research question(s) on biodiversity based on their observations, and produce a scientific field report addressing their own selected research topic.

The intent is to maintain these and other plots in the long-term to monitor biodiversity and ecological changes at the property in relation to natural and anthropogenic impacts from a research perspective, as well as providing a teaching and experimental environment for students at RRU and elsewhere in the future. This project also has important implications in terms of its links with EMAN (Ecological Monitoring Assessment Network) and other ecological monitoring research at Rocky Point and elsewhere in the region, which represent isolated fragments of the same biogeoclimatic zone (Coastal Douglas Fir). The project also emphasizes the importance of preserving the natural ecosystems occurring on the Royal Roads property.

Objectives:

The objectives of the study plots are to:

- 1) monitor long-term ecological changes at the property in relation to natural and anthropogenic impacts including climate change, atmospheric contaminants, physical disturbance and exotic invasive species;

- 2) provide a teaching and training platform for environmental science students at RRU, including a first hand understanding in the measurement and study of biodiversity and interactive relationships existing within different ecosystems, and the importance of conservation; and
- 3) foster public environmental education on the Royal Roads property and demonstrate the importance of preserving ecosystems at Royal Roads for teaching, experimental, and research purposes.

Accomplishments to Date:

a) Research Activities

This project is currently in its second year.

Year 1: The first year involved the testing of protocols and initial surveying of the plots. The project was initially set up as a teaching and research tool for students in the 1996/97 B.Sc. Environmental Science Program. The two monitoring plots measuring 1 ha each were set-up using methodology similar to that described under the SI/MAB (Smithsonian Institute/Man and the Biosphere Program) in October of 1996. These plots included a transitional area encompassing a salt marsh/estuary and Douglas Fir Forest along Cottonwood Creek at the southeast end of Royal Roads, and a second transitional area encompassing an upland field and Western Red Cedar old forest at the southwest end of the property. The corners of each plot and the twenty-five 20 x 20 m quadrats within were marked with wooden stakes and rope. A team of 5-6 students were assigned one of five 20 x 100 m transect bands across the two ecosystems encompassed by each plot. Measurements and field observations were conducted by each team on the tree (and canopy), shrub and herb/ground layers within each of five quadrats comprising their assigned transect. These activities included tree and plant identification, tree diameter, canopy cover, numbers or percent cover of individual plant species, measurements of tree cover; and field observations. Microhabitat information was also recorded for each quadrat including soil type and moisture content, detritus, and light conditions. This information was assembled in a master database which could be accessed by all students in the program and used to address their own selected research questions or hypotheses.

For many of the students, this project served as an initiation into conducting field research and scientific report writing, and provided the opportunity for them to work as part of a field team, and individually in terms of developing and addressing their own research questions in a scientific context. Many of the students developed an appreciation for conducting ecological field work including the importance of field observation, and the collation and assimilation of large databases, along with developing an appreciation of the environmental and conservation issues surrounding biodiversity in the ecosystems of Royal Roads. Some of the research topics examined by the students in the first year of the project are listed below:

- biodiversity near a salt marsh stream,
- changes in forest plant diversity at a salt marsh boundary
- biodiversity of plant species in transition zones and forest,
- microhabitat preferences of scotch broom,
- comparison of biodiversity between salt marsh and mature Douglas fir forest,
- shrub species diversity in a Douglas fir ecosystem, and
- seedling growth vs. canopy cover as related to biodiversity.

Year 2: In the second year of the program, the two monitoring plots were re-surveyed and permanently marked by the 1997/98 B.Sc. Class in the spring of 1988. This was achieved by

installing permanent 0.5 m high aluminum posts to mark the corners of the plots and the individual quadrats contained within each. Sign posts were installed along the perimeters of the plots to warn the public about the research areas. Individual trees were also tagged and labelled using aluminum tags which were safely screwed into the bark of the trees at breast height using stainless steel wood screws. Similar measurements on trees and canopy layers, vegetative ground cover, and soil physical measurements were conducted as in Year 1. Additional surveys were also conducted to assess soil macrofauna species diversity in the forest plots. Pairs of soil samples were obtained on the periphery of the plots (5 each) for earthworms and larger arthropods, respectively. Earthworms were collected and sorted from the soil samples in the field. Large, mobile arthropods were extracted in the lab using Tullgren funnels from samples of both soil and coarse woody debris (CWD). The forest floor was also surveyed for CWD by assessing decay class and size to gain an understanding of the decomposition state of the forest floor and to relate this information to soil macrofauna diversity.

Weather monitoring stations with Stevenson screens were also installed at each of the plots in the spring of 1998 to assist in assessing the short and long-term effects of changing climate on the ecosystems. Measurements at Plot 2 near Esquimalt Lagoon currently include daily max./min. temperatures; relative humidity; wind speed, direction and distance; and precipitation. Instrument monitoring for air particulates and some atmospheric chemicals will also be available at this station in the near future. Two smaller stations have also been set up at Plot 1 to measure and compare max./min. temperatures in the open upland field and the adjoining, but more-enclosed, cedar forest.

b) Highlights of Findings to Date:

The information below outlines a few of the more interesting highlights provided in a recent platform presentation given at the National EMAN conference in Victoria in January of 1999.

Figure 1: % Average Canopy Cover in Upland Cedar-Dominated Forest of Plot 1

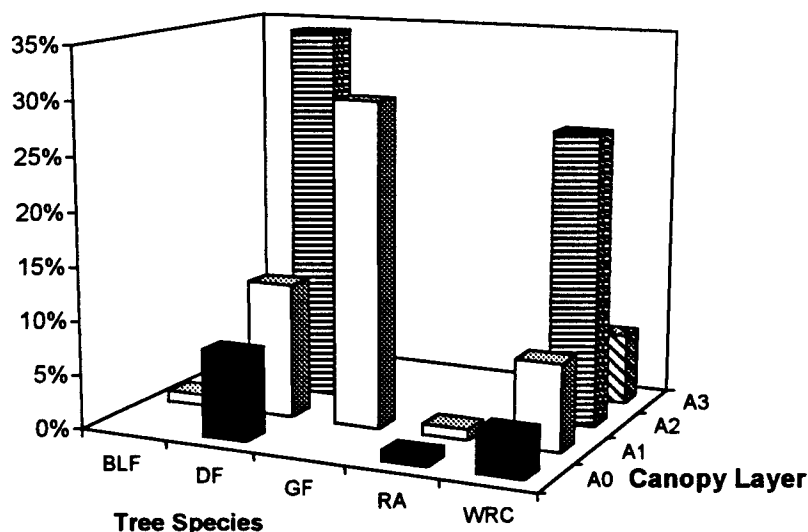


Figure 1 (above) highlights preliminary species percentage cover estimates down through the four upper canopy layers in Plot 1, ranging from veterans (A0) – dominants (A1, > 25 m) – main canopy (A2, > 20 m) – secondary canopy (A3, < 10m). Five major species were represented in this plot

including Bigleaf maple – BLM (*Acer macrophyllum*), Douglas-fir – DF (*Pseudotsuga menziesii*), grand fir - GF (*Abies grandis*), red alder - RA (*Alnus rubra*), and western redcedar – WRC (*Thuja plicata*). Veterans in this cedar stand were, on average, represented primarily by Douglas-fir, followed by cedar, and red alder. Canopy composition changed considerably upon moving down through the different layers with grandfir primarily occupying the dominant canopy, and Douglas-fir and cedar representing the secondary canopy. This differed considerably from Plot 2 by Esquimalt Lagoon (not shown) where canopy cover estimates of individual species in the forest were much greater, reaching upwards of more than 50% (compared with 35% in Plot 1). The canopy in Plot 2 was also more mixed as the first four canopy layers were represented by a larger number of tree species (8) compared with in Plot 1. Early indications are that the dominant species in the Plot 1 forest edge may be shifting from cedar to other species (e.g., Douglas-fir and grandfir) in Plot 1.

Preliminary results for climatological measurements at Royal Roads indicated that daily maximum temperatures for the July – August period in 1998 were highest in the old field at Plot 1 (Station 3) reaching a maximum of over 30°C. Temperatures were up to 4°C cooler on average under the cedar forest canopy at Plot 1 (Station 2) compared with Station 3. Station 1, located by Plot 2 near Esquimalt Lagoon, was intermediate in relation to the other two stations for this period reflecting the moderating influence of winds from the Strait of Juan de Fuca. Precipitation measurements at Royal Roads for November – generally one of the wetter months on Vancouver Island – were found to be comparable to other monitoring stations in the southern Vancouver Island region including Gonzales, University of Victoria, Malahat, Hartland and downtown Victoria. The results also suggest that precipitation at Royal Roads is probably representative of the southern Vancouver Island region.

Preliminary results for coarse woody debris (CWD) indicated that lower decay classes comprised a larger proportion of the total percentage of CWD in the upland cedar forest of Plot 1 compared with the mixed Douglas Fir forest of Plot 2 by the lagoon. Later stages of decay comprised a larger proportion of the total percentage of CWD in Plot 2, compared with Plot 1. This may be reflective of the greater public usage (and subsequent trampling) of Plot 2 by Esquimalt Lagoon for trails and recreation compared with Plot 1. The largest percentage of CWD in both plots was represented by the intermediate stages of decay.

Figure 2: Relative Abundance of Soil Taxa in Forest Plots

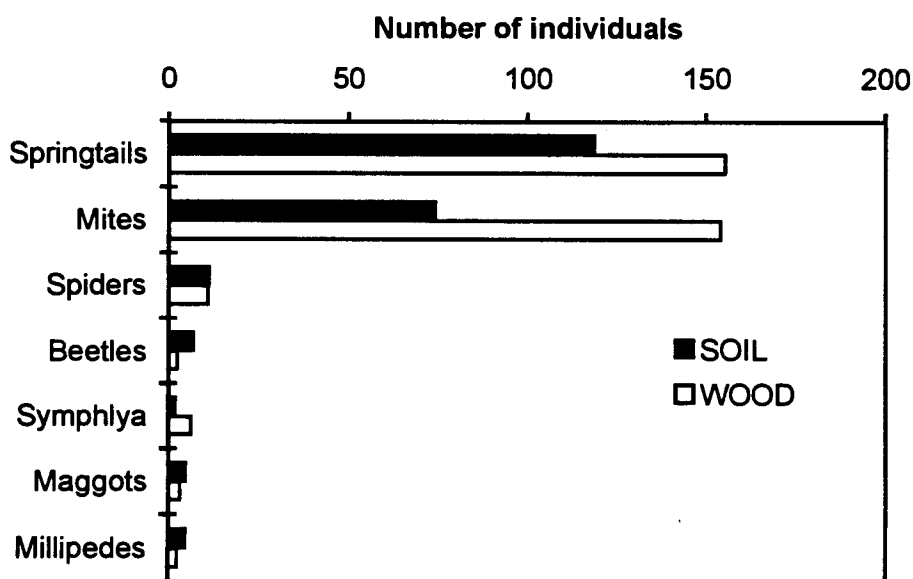


Figure 2 (above) provides combined results for various arthropod taxa in soil and CWD (wood) samples from both plots. A larger number of individuals of the most abundant taxa (i.e., springtails and mites) were found in CWD compared with soil. This demonstrates the important functional inter-relationships between these ecological components in terms of the decay process and subsequent nutrient release, and the maintenance of soil macrofauna species diversity.

c) Extension and Demonstration

In addition to reports submitted by the students in the 1996/97 and 1997/98 classes for evaluation in the course module, research and findings by four of the students in the Environmental Sciences Program at RRU were presented at the ESAC (Environmental Sciences Advisory Committee) 1996 Annual Workshop at Royal Roads University in January, 1997. The students and their presentation titles were as follows:

- Heather Lewis - *Comparing Tree Diameters of Like Species In Varied Ecosystems*
- Guy Padova - *Ecotone Effects On Tree Species Richness And Diversity Between an Old Field and Forest Ecosystem at Royal Roads*
- Norm Healey: *Ecotone Edge Effect and Biodiversity in Old Growth Coastal Douglas-fir Forest at Royal Roads*
- Gillian Carrigan: *Royal Roads University - A Fragile Ecosystem in an Urban Environment*

The following paper was presented as a platform presentation at the 5th National Science Meeting of EMAN conducted in Victoria in January, 1999:

Janet Addison, William T. Dushenko, Beverley Hall, Jim McTaggart-Cowan, and Heather Stewart. 1999. Establishment of EMAN long-term biodiversity plots at Royal Roads University (RRU), B.C: Baseline investigations and preliminary results.*

This was also accompanied by a poster presentation, providing field methodology and species lists, at the same meeting as follows:

Janet Addison, William T. Dushenko, Beverley Hall, Jim McTaggart-Cowan, and Heather Stewart. 1999. Establishment of Ecological Monitoring and Assessment Network (EMAN) Long-term Biodiversity Plots at Royal Roads University (Hatley Park) Property, Colwood, B.C.*

A website, <http://jems.royalroads.ca> has been set up as part of the climate monitoring station project by Jim McTaggart-Cowan which provides hourly average, and daily max./min temperatures; hourly average relative humidity, wind direction speed and distance; and hourly average and daily precipitation data.

Although not yet implemented, plans are still in place to have information on the ecological monitoring project profiled as part of the Royal Roads University web site in which an illustrative overview of the project will be provided along with highlights of current research/findings. This may be linked more advantageously from the RRU homepage to the new website currently being set up by EMAN.

d) Future Directions

The ecological monitoring project will be continued at Royal Roads on a long-term basis as both a education tool for future students at RRU, and research purposes to monitor the long-term effects of natural and anthropogenic impacts on the property.

Some outstanding issues still need to be addressed, such as the past vandalism which has occurred on the plots and the RRU campus in general. This may come about through greater public education about the grounds, including interpretative signs at points of interest. There are currently plans in place by the RRU Environmental Management Action Team (EMAT) committee to initiate this. Another issue is ensuring the reliability of the data collected through more rigorous quality assurance/quality control procedures. This will be aided in part by the recent development of the Windows-compatible SI/MAB tree database program by EMAN. This program was recently obtained from EMAN and will be used to verify the data collected to date and incorporate it into a database format which can be made more widely available on the EMAN website. Permanent aluminum tagging on the remaining trees, and sub-quadrat markers for ground vegetation in the two plots will also need to be completed.

An additional monitoring plot is currently being set up in one of the older, more-buffered interior forest areas on the property as a basis for comparison. This will include a fourth weather/climate monitoring station to specifically monitor precipitation runoff from the forest canopy in addition to other measurements. A French exchange student from Ecole Nationale d'Ingénieurs des Travaux Agricoles (ENITA) de Bordeaux will be coming to work on a volunteer training program as part of their studies on the new plot during the summer of 1999. They will also be involved in database input and field verification activities for the existing plots described above.

Work is also advancing on examining the atmospheric chemistry of precipitation at Weather Station 1 by Esquimalt Lagoon. This is being conducted by a group of students from the 1998/99 B.Sc. Environmental Science Class at RRU, who are looking at metals, ammonia, nitrates, sulphates, and pH (acidity) in precipitation samples as part of their major project group thesis. This will be augmented by future studies examining environmental pollutants in trees, understory vegetation and soils in the research plots.

Some additional long-term goals may include the setup of a canopy study area at Royal Roads, and small mammal studies in the future which would complement similar projects currently underway at Rocky Point and other areas. Many of the project's goals will be achieved through the assistance of students in the Environmental Programs, who will value greatly from such a learning experience, as well as collaborative partnerships between researchers at RRU and other agencies and institutions. The project will also facilitate a number of links with other related projects in the region and the current objectives of EMAN.

Continued permitting for the existing project and future endeavours will be sought from ESAC.

Permit Number: P054-98

Title: Non Timber Forest Products Inventory and Review for Management

Author: Signy Fredrickson (250) 226-7063

Organization: Royal Roads University
Victoria BC

Location: Nanaimo Rifle Range

Start Date: October 1997

Completion Date: Spring 2000

Project Overview:

The Snuneymuxw (Nanaimo) First Nations, with the University of Victoria Centre for Public Sector Studies and School of Environmental Studies are currently initiating a Non-Timer Forest Product (NTFP) pilot project on the DND rifle range in Nanaimo. The objective of this project is to provide a land base for research of NTFPs, and an understanding of what practices and management will provide for their sustainable use. Community employment and education and an opportunity for holistic land stewardship are among the Snuneymuxw First Nation's objectives for this project.

Objectives:

My thesis project will consist of completing the initial phase of fieldwork for the Snuneymuxw First Nations NTFP's Pilot Project, the inventory. This is necessary for understanding what products are available for management and what future research opportunities exist. Included in the inventory will be medicinal, nutraceutical, food, and greenery species of plants and mushrooms.

Accomplishments to Date:

Last fall a reconnaissance of the Nanaimo rifle range lands was done in order to stratify the area into similar habitat types for surveying purposes. Formal surveys will begin this spring, and continue throughout the year.

Highlights of findings to Date:

During the reconnaissance several commercial mushroom species were identified. These included chantarelles (*Cantharellus cibarius*) and cauliflower mushrooms (*Sparissis crispa*). Salal (*Gaultheria shallon*), which is a valuable species for floral greenery, was found to be the most common understory shrub. The inventory will serve to quantify these and other non-timber forest product resources.