Department of National Defence— CFB Esquimalt

Environmental Science Advisory Committee

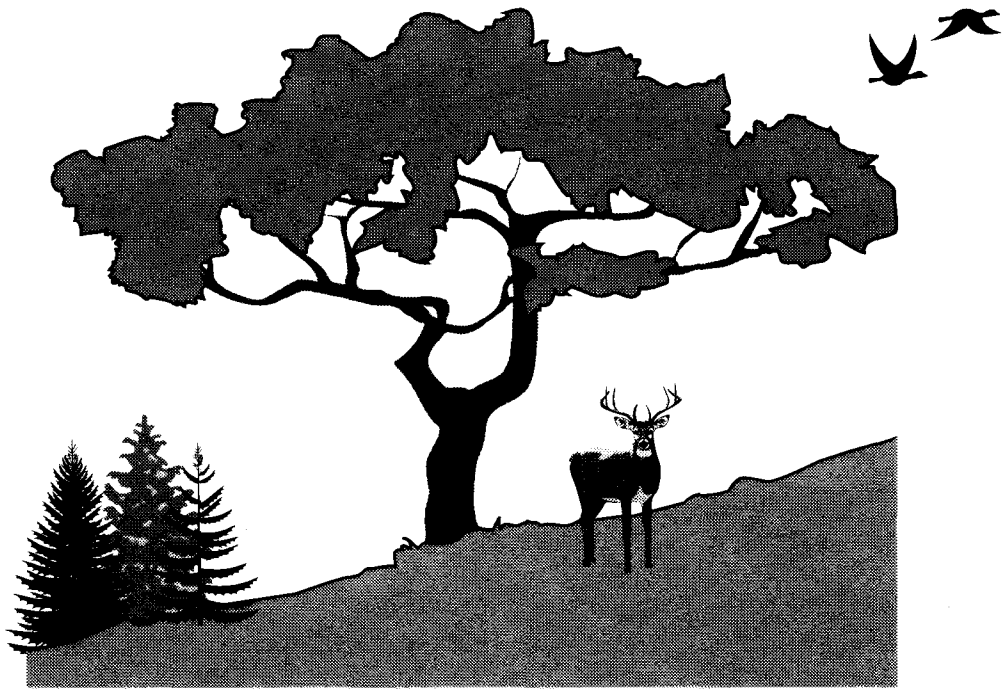
REPORT

1996 Annual Report

Prepared for the Committee by:

Arthur Robinson
J. A. Trofymow

March 1997



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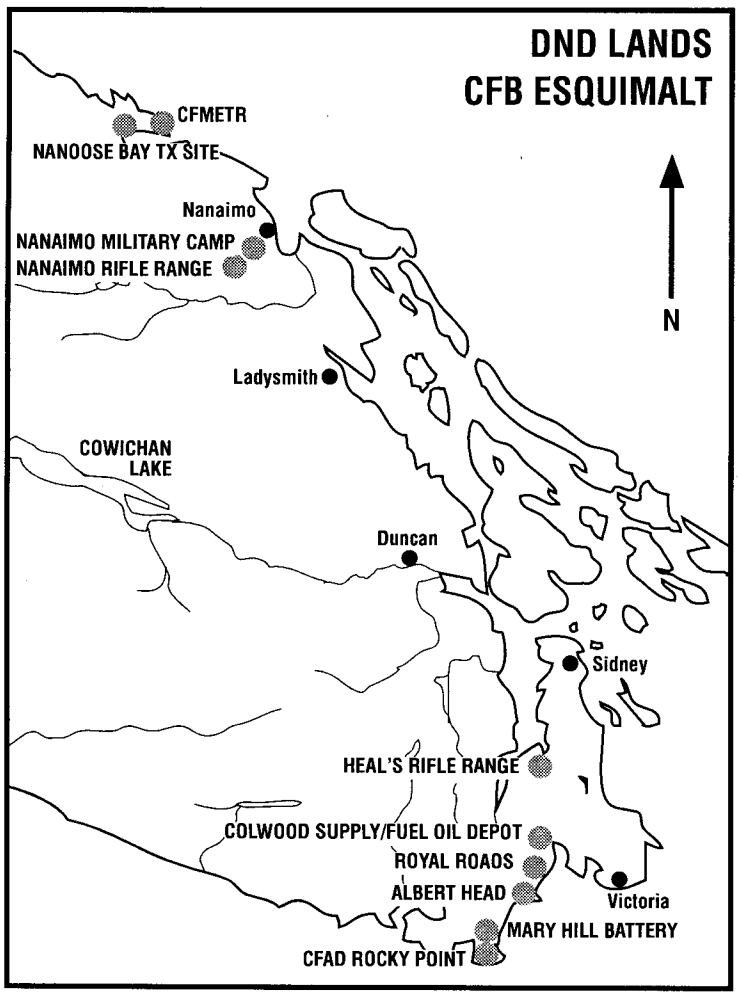
Natural Resources Canada
Canadian Forest Service
Pacific Forestry Centre
506 West Burnside Road
Victoria, BC
V8Z 1M5

Environmental Science Advisory Committee member agencies:

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

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

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
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Victoria, BC V8Z 1M5

Table of Contents

DND Environmental Science Advisory Committee - CFB Esquimalt

1996 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 1996 a total of 25 proposals were received and 24 permits were issued. The committee met four times during the year to review policy and proposals.

To facilitate the communication and transfer results of research on DND properties to member agencies as well as amongst researchers working on CFB Esquimalt lands the committee sponsored one workshop during the year. The workshop was open to all project proponents who had done research on DND lands during the year and was held at Royal Roads University. Nineteen papers were presented by researchers. The workshop was attended by 36 representatives from various organizations and backgrounds.

This purpose of this report is to provide background on the committee, its terms of reference and information on the permitting process. As well the report provides research summaries of reports for permitted projects completed in 1996 and annual reports for permitted 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 committee was structured as a subcommittee under the terms of the DND/CFS Memorandum of Understanding on Forest Management. Soon after the committee was formed it became apparent that the committee's mandate for only the one property would have to be expanded to other properties. In 1995 the committee increased its mandate to include all DND properties at CFB Esquimalt. In 1996, the membership of the committee was expanded to include one representative from Royal Roads University.

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

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

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

A Research and Collection Permit is required for natural science activities within the DND properties and are administered by the DND Environmental Science Advisory Committee - CFB Esquimalt. The permitting system is intended to provide a means for reviewing and managing research and to catalogue ongoing research activities.

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 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 results of research on DND properties to member agencies as well as amongst researchers working on CFB Esquimalt Lands the committee sponsored one workshop during the year The workshop was open to all project proponents who had done research on DND lands during the year and was held at Royal Roads University. Further details on results from this workshop are provided below

Further details on the research reports for permitted projects completed in 1995 and annual reports for permitted projects continuing in following years are detailed in the following sections and appendices. A cumulative bibliography of reports on environmental research conducted on CFB Esquimalt lands since 1994 and available at the Pacific Forestry Centre Library is provided In Appendix 1.

4. Research Projects on DND Esquimalt Properties During 1996

This past year, 1996, was the second full year of activity for ESAC which received a total of 25 proposals for research on CFB Esquimalt properties. Table 1 summarizes information on the proponent, title and brief description for each proposal received.

The committee met four times during the year to review and tract the status of the various proposals that were received. Of the 25 proposals received, 24 were approved and received permits. The status of these 24 approved proposals is shown in Table 2. Researchers are required to provide written annual reports on their activity if projects are continuing and a final report when the project is complete. These reports are compiled as part of this annual report and are provided in Appendices 4 and 5.

A. ESAC Workshop - In January of 1997 at Royal Roads University, Victoria, the ESAC sponsored a workshop. Research project proponents were invited to present the

FORMAL RESEARCH PROJECT PROPOSALS FOR DND PROPERTIES - 1996

Rev. 29 Oct 96

PROPOSAL #	AGENCY	PROJECT	PROPONENT	CONTACT	DESCRIPTION	LOCATION
96-1	Lester B. Pearson College	Student Research Essays	Garry Fletcher	Garry Fletcher	From January to May students of environmental systems and/or biology classes will take part in preliminary research projects on fauna and/or flora in the Lester B. Pearson College Canopy Research Station.	RPPC
96-2	Lester B. Pearson College	Training and Maintenance - Canopy Station	Garry Fletcher	Garry Fletcher	Groups of up to 12 students will access the Canopy Station for maintenance and training purposes.	RPPC
96-3	Royal BC Museum	Bat Studies	David Nagorsen	Garry Fletcher	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, AH
96-4	Canadian Wildlife Service	Installation and Maintenance of Microclimate Monitoring Station	Mike Dunn	Ken Morgan	To install and operate a Microclimate Monitoring Station in association with the Forest Canopy Station.	RPPC
96-5	Canadian Forest Service	Sustainable Development of Natural Sources of Taxol	Al Mitchell	Tony Trofymow	Monitor physiological responses of Pacific Yew to seasonal changes in water, light, temperature and humidity to develop conservation options.	RP, RR, CFOD
96-6	University of Victoria	Community Ecology of the Canopy-Forest Floor Insect/ Arthropod Fauna From an Old-Growth Forest	Neville Winchester	Neville Winchester	Document the community composition of the canopy and ground insect/Arthropod fauna in this old-growth forest.	RP, RPPC
96-7	University of Regina	Vertical Structure of the bat community in old growth temperate rain forests	Mark Brigham	Neville Winchester	Assess the vertical distribution of foraging activity by Vespertilionid bats in Coastal Wstern Hemlock Old-Growth Forests.	RPPC
96-8	Canadian Wildlife Service	Migration Monitoring of Neotropical Birds	Rhonda Millikin	Ken Morgan	Migration monitoring of Neotropical birds by: visual census surveys; mist-netting surveys; banding; and radar monitoring surveys.	RP

PROPOSAL #	AGENCY	PROJECT	PROPONENT	CONTACT	DESCRIPTION	LOCATION
96-9	Alula Biological Consulting	Sharp-tailed Snake Inventory	Christian Engelstoff	Bryan Nyberg	Part of larger Sharp-tailed Snake Inventory planned for the Coastal Douglas-fir Biogeoclimatic Zone. Method includes searches for the snakes under natural cover objects as well as setting up research plots with artificial cover objects.	MHB, RP
96-10	Fisheries and Wildlife, Ministry of Environment	Establishment and Monitoring of Permanent Ecological Plots at Rocky Point	Trudy Chatwin Tara Martin	Ken Morgan	To establish long-term ecological monitoring sites to gain information on species composition, location, density, and frequency for all woody species. One SI/MAB plot has been established in the Douglas-fir community. Another plot will be established in the Garry-oak community.	RP, RPPC
96-11	Wildlife Branch, Ministry of Environment	Urban Cooper's Hawk Habitat Study	Andrew Stewart	Ken Morgan	To study various aspects of the breeding habitat ecology of the Cooper's Hawk in an urban environment.	RR, CFOD
96-12	Victoria Natural History Society	Purple Martin Nestbox Program	Darren Copley	Ken Morgan	To repair and maintain nestboxes and monitor population of purple martins.	CFOD
96-13	BC Conservation Data Centre	Rare Bryophytes at Rocky Point	Nathalie Djan-Chekar	Gail Feltham	Survey of Rocky Point for rare bryophytes.	RR
96-14	Canadian Forest Service	Management of Spruce Weevil - Pissodes Strobi	Michael Hulme	Tony Trofymow	Collect Spruce Weevil for study. Release parasite to a Hack Spruce Weevil, and measure impact of parasite on weevil.	CFMETR, NTX
96-15	University of Victoria	Filming sequence - Canopy Arthropods	Neville Winchester	Neville Winchester	Filming sequence and interview with Canada AM concerning Canopy Arthropods.	RPPC
96-16	Department of National Defence	Site Visit - Trilateral Conference (Defence)	Gail Feltham	Gail Feltham	Site visit by visiting military officials from 3 countries - Garry Oak site and Old Growth Douglas fir.	RP, RPPC
96-17		Raptor Survey	Michael Shepard	Gail Feltham	Survey areas for raptor populations and nesting sites. Consists of aerial raptor nest survey and an owl survey.	AH, MBH, CFMETR, RP
96-18	Malaspina College	Demagraphic study of Allium amplectens	Allan Hawryski	Andy McKinnon	Long term study to monitor changes in population numbers and structure of Allium amplectens (slimleaf onion) using a stage-based matrix model.	CFMETR
96-19	Canadian Forest Service	Infestation of Garry Oak Acorns by the Filbert Weevil and Filbert Worm	Imre Otvos Doris Rohlfs	Tony Trofymow	Study to determine the proportion of Garry Oak acorns infested and killed by the filbert weevil and filbert worm and to determine the biology of the more damaging insect with the aim of reducing its damage.	MHB, RP

PROPOSAL #	AGENCY	PROJECT	PROPONENT	CONTACT	DESCRIPTION	LOCATION
96-20	Canadian Wildlife Service	Garry Oak Ecosystem Restoration	Mike Dunn Richard Hebda	Mike Dunn	Selection of test sites and controls for the removal of Exotic Species (Broom and Gorse). Students of the Restoration of Natural Systems Program will develop the removal protocols and monitoring requirements after removal. Plots will be established, surveyed and treated with follow-up surveys and analyses to be done.	MHB, RP
96-21	University of British Columbia	Garry Oak Acorns	Marilyn Fuchs	Mike Dunn	Determine the effects of burial depth and habitat upon Garry Oak regeneration.	MHB, RP
96-22	University of Victoria	Pileated Woodpecker Study	Carol Hartwig	Ken Morgan	Survey to determine densities of Pileated Woodpecker, coarse woody debris and snags in study sites. Project includes call back survey, habitat survey and prey (ant) survey.	RP
96-23	University of Alberta	Status Report on the Moss Bartramia Stricta Brid.	Rene Belland	Andy McKinnon	Survey and document the occurrence of B. Stricta at CFMETR for the preparation of a COSEWIC report.	CFMETR
96-24	Royal Roads University	Royal Roads University Biodiversity Plots	Bill Dushenko	Bill Dushenko	Set-up and assessment of ecological monitoring plots by BSc EnvironmentalScience students about ecosystems, biodiversity and rsearch/field techniques.	RR
96-25	Canadian Forest Service	Genetic Variation in Garry Oak	D.G. Edwards M. Meagher	Tony Trofymow	Study of genetic variation of Garry Oak. Assessment of genetic variationin populations of Garry Oak.	MHB, CFMETR

Footnotes:
RP - CFAD Rocky Point
RPPC - Rocky Point Pearson College Canopy Station
CFMETR - Canadian Forces Maritime Experimental Training Range, Nanoose Bay
MHB - Mary Hill Battery
CFOD - Colwood Supply/Fuel Oil Depot
RR - Royal Roads Military College
AH - Albert Head
NTX - Nanaimo TX Site

STATUS OF PERMITS ISSUED - 1996

DND ENVIRONMENTAL SCIENCE ADVISORY COMMITTEE - CFB ESQUIMALT

As of March 6, 1997

Prop. No.	Permit No.	Applicant	Title	Approved	Status* Report	Status Complete	Annual Report	Final Report
96-10	P002-96	Trudy Chatwin	Establishment and Monitoring of Permanent Ecological Monitoring Plots at Rocky Point	14-Feb-96	18-Sep-96	31-Dec-96	6-Mar-97	
96-8	P003-96	Rhonda Millikin	Migration Monitoring of Neotropical Land Birds	14-Feb-96	18-Sep-96	31-Dec-96	3-Mar-97	
96-5	P005-96	Al Mitchell	Sustainable Development of Natural Sources of Taxol: Ecophysical of Pacific Yew	14-Feb-96	18-Sep-96	31-Dec-96	24-Dec-96	
96-6	P006-96	Neville Wincester	Community Ecology of the Canopy-Forest Floor Insect/Arthropod Fauna from an Old-Growth Forest	14-Feb-96	18-Sep-96	31-Dec-96	31-Jan-97	
96-21	P008-96	Marilyn Fuchs	Garry Oak Acorns: Production, Dispersal, Germination, Emergence, and the Role of Steller's Jays	18-Jun-96		31-Dec-96		3-Jan-97
96-7	P009-96	Mark Brigham	Vertical Stratification in Forest Dwelling Bat Assemblages	14-Feb-96		31-Dec-96	20-Feb-97	
96-3	P010-96	David Nagorsen	Bat Studies	14-Feb-96	18-Sep-96	31-Dec-96	23-Jan-97	
96-18	P017-96	Allan Hawryzki	Demographic Study Of Allium amplectens	13-May-96	20-Sep-96	31-Dec-96	2-Jan-97	
96-12	P018-96	Daren Copley	Purple Martin Nestbox program	4-Mar-96	18-Sep-96	31-Dec-96	18-Feb-97	
96-1	P021-96	Garry Fletcher	Student Research Essays	14-Feb-96		31-Dec-96	18-Feb-97	
96-2	P022-96	Garry Fletcher	Training & Maintenance of Canopy Structure	14-Feb-96		31-Dec-96	18-Feb-97	
96-4	P023-96	Mike Dunn	Bioclimate Monitoring Station	14-Feb-96	18-Sep-96	31-Dec-96	28-Jan-97	
96-9	P024-96	Christian Engelstoft	Sharp-tailed Snake Inventory	14-Feb-96	20-Sep-96	31-Dec-96	27-Jan-97	
96-11	P025-96	Andrew Stewart	Urban Cooper's Hawk Nesting Habitat Study	14-Feb-96	18-Sep-96	31-Dec-96	24-Jan-97	
96-13	P026-96	Nathalie Djan-Chekar	Survey of Rare Bryophytes	29-Feb-96	18-Sep-96	3-Apr-96		30-Apr-96
96-15	P027-96	Neville Wincester	Filming Sequence - Canopy Arthropods	21-Mar-96		31-Dec-96		18-Feb-97
96-16	P028-96	Gail Feltham	Trilateral Conference (Defence) Site Visit	21-Mar-96	18-Sep-96	31-Dec-96		14-Feb-97
96-17	P029-96	Michael Shepard	Raptor Survey	21-Mar-96		31-Dec-96		19-Feb-97

Table 2

96-14	P030-96	Michael Hulme	Management of Spruce Weevil - Pissodes strobi	27-Mar-96	18-Sep-96	31-Dec-96	24-Dec-96	
96-19	P031-96	I. Otvos/D. Rohlfs	Infestation of Garry Oak Acorns by the Filbert Weevil and Filbert Worm	24-Mar-96	18-Sep-96	31-Dec-96	20-Dec-96	
96-20	P032-96	Richard Hebda/Dunn	Garry Oak Ecosystem Resoration and Monitoring Program	14-May-96	18-Sep-96	31-Dec-96	17-Jan-97	
96-23	P033-96	Rene Belland	Status Report on the Apple Moss Bartramia Stricta Brid.	10-Sep-96		31-Dec-96	15-Jan-97	
96-24	P034-96	Bill Dushenko	Royal Roads University Biodiversity Monitoring Plots	30-Sep-96		31-Dec-96	20-Feb-97	
96-25	P035-96	Edwards/Meagher	Genetic Diversity in Garry Oak	22-Oct-96		31-Dec-96	24-Dec-97	
TOTAL	24			24	15	24	19	5

Table 2

results of their studies on DND lands. Thirty six proponents and others attended the workshop (Appendix 2). Nineteen presentations were made and final and annual reports from these presentations are included in Appendix 3 and 4.

B. Forest Canopy Research Station Activities - The Facility was accessed on 12 occasions by 91 people during the year. The facility was used by two projects - Neville Winchester's (University of Victoria) and Garry Fletcher's (Pearson College).

C. Geographic Information System Database Compilation and Conversion - Over the last three 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 and the Chilcotin Military reserve. During that period much information has been gathered to assess the ecological character of this lands. The committee felt that is was time to merge these new data sets with the existing data and begin a process of analysis to develop conservation plans for these very significant properties.

As much of this information is in varying formats and quality it was agreed that a common Geographic Information System (GIS) format was required. Consequently a GIS project, funded by DND, was initiated to compile and convert this existing spatial data sets to a common format, Arc/Info.

The data will be stored as Arc/Info coverages at the Canadian Forest Service and made available to the three federal agencies through the use of ArcView as the tool used to view data, display plans, produce small maps and query the database

A proposal to do this work was developed and submitted in September 1996 by the committee to DND headquarters. Funding for the project was approved in January 1997 for the committee to carry out the preliminary compilation and conversion of all the identified baseline data into a common Arc/Info format. This part of the project will be completed in the first half of 1997, along with an initial workshop to review and revise conservation management plans..

5. Outlook for 1997

The committee will continue its activities in 1997 reviewing and tracking the status of various research projects on DND Lands sponsoring and annual workshop for researchers and compiling these results in an annual report. As well the committee is investigating setting up a WEB site to further facilitate the dissemination of research findings. The initial phases of the GIS project will have completed the preliminary compilation and conversion of all the identified baseline data into a common Arc/Info format. The data will be stored as Arc/Info coverages at the Canadian Forest Service where it can be accessed remotely by DND or other organizations. This increase capability should greatly help highlight areas of special environmental or research interest both to current and future researchers working on the properties and to DND personnel conducting operations and training activities on these properties.

APPENDIX 1

Cumulative Bibliography of Environmental Science Reports on DND Lands

Placed in the Pacific Forestry Centre Library

28FEB97

CUMMULATIVE LIST OF ENVIRONMENTAL SCIENCE REPORTS ON DND LANDS IN PACIFIC FORESTRY CENTER LIBRARY

Reports for Projects Prior to 1995

1. Crippen Consultants. 1981. Engineering Feasibility and Environmental impact study for a proposed highway Bypass Route of Nanaimo, May 1981. Crippen Consultants, North vancouver, B.C. for Ministry of Transport and Highways. 11 sections + app.

2. Juan de Fuca Environmental Consultants. 1990. Nanaimo Inner Route: Recreation and Landscape Assessments Constraints Report - Initial Identification of Park, recreation and Landscape Contrants, March 1990. Jaun de Fuca Environmental Consultants, Victoria, B.C. Draft 26p. + app.

3. Edwards, W.C. 1990. Assessment of Impact of Highway Relocation near Nanaimo on Ambient Air Quality, July 1990. B.H. Levelton & Associates Ltd. Vancouver, B.C. Prepared for Graeme & Murray Consultants Ltd. Victoria. 15 p. + app.

4. Blood, Donald A. 1991. Island Highway Planning and Preliminary Design Project: Wildlife resource Assessment, February 5, 1991. D. Blood and Associates Ltd., Nanaimo, B.C. Prepared for Crippen consultants Ltd. and B,C. Ministry of Transport and Highways. 95p.

5. Blood, D.A. 1992. Deer Collision Hazard and Mitigation, Nanaimo Inner route, Sept, 22, 1992. D. Blood and Associated Ltd., Nanaimo, B.C. Prepared for Ministry of Transport and Highways and Westland Resource Group Ltd. 31p.

6. Wilson, Ian R. 1992. Archaeological Impact Assessment: Nanaimo Inner Bypass route 192-127. I.R. Wilson Consultants Ltd. Brentwood Bay, B.C. Prepared for Archaeology Branch, Ministry of Tourism and Ministry Responsible for Culture and Ministry of transport and Highways. 11p.

7. Willis, Cunliffe Tait. 1992. Nanaimo Inner Route: Section 530 Harewood Mines Road to East Wellington Road - Special Investigations Report, Sept. 1992. Willis, Cunliffe, Tait and Company, Consulting Engineers. Prepared for the B.C. Ministry of transport and Highways. 6 sections + app.

8. Lashmar, Murray (Editor). 1993. Department of National Defence Lands Southeast Vancouver Island: Initial Evaluation of Knowledge and Notes from a Workshop February 23, 1993. Canadian Wildlife Service, Environment Canada. 91p.

9. Golder Associates Ltd. 1993. Results of Phase 1 Environmental Site Assessment of Proposed Nanaimo Inner route Crossing of the Nanaimo Military Camp, B.C., July 22, 1993. Golder Associates Ltd. Burnaby, B.C. Prepared for Vancouver Island Highway project Management Team. 13 p. + maps.

10. Kent, M.J. 1993. Nanaimo Parkway Project No. 0-6462-5280: Harewood Mines Road to East Wellington Road Vacouver Island Highway Project, December 1993. Par Terr Design Environmental Planners, Victoria, B.C. Prepared for Highway Environment Ministry of Transport and Highways. 39p.

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.

Reports for Projects in 1995

12. Morgan Ken H. (Editor). 1995. Baseline Inventories of Rare Species and Ecosystems of Department of National Defence Properties on Southern Vancouver Island. Report from workshop held at Pacific Forestry Centre in July, 1995. Canadian Wildlife Service, Environment Canada, Canadian Forest Service, Victoria, B.C. 120p. (Includes reports done under Permit Nos. P002-95, P004-95, P010-95, P011-95, P012-95, P013-95, P014-95, P015-95, and P016-95)

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.

14. Ryan, Michael; Radcliffe, Gillian; and Butt, Gordon. 1995. Ecological Assessment of Royal Roads Property, C.F.B. Esquimalt, Vancouver Island. Madrone Consultants Ltd., Duncan, B.C. 48p + map. (Report done under Permit P001-95)

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)

Reports for Projects in 1996

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.

19. Shepard, Michael G. 1996. Owls on Southern Vancouver Island DND Lands. 306 - 825 Cook St., Victoria, B.C. V8V 3Z1. Unpublished manuscript. 5p.

20. Smith, Dan and Lewis, Dave. 1996. Reconnaissance Tree-Ring Studies at CFB Esquimalt. University of Victoria Tree-Ring Laboratory, department of Geography, University of Victoria, Victoria, B.C. UVTRL Report 96-04. 14p.

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)

23. Chatwin, Trudy. 1997. Establishment and monitoring of permanent ecological plots in a Coastal Douglas-fir forest and a Garry-oak woodland at the Rocky Point Department of Defence lands. Ministry of Environment, Lands and Parks, Nanaimo, BC. 123p.

APPENDIX 2

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

DND Environmental Science Advisory Committee

List of Members and Addresses

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Annual Workshop
Environmental Science Advisory Committee

January 31, 1997

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Tony Trofymow	Canadian Forest Service	363-0600
Guy Padova	Royal Roads University	360-2885
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Bev Hall	Royal Roads University	391-2540
Gail Feltham	Department of National Defence	363-5063
Gerry Schrober	PEPS	
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Andy MacKinnon	BC Forest Service	387-6536
Carl MacNaughton	Royal Roads University	598-0746
Amber Gorby	Royal Roads University	
Arthur Robinson	Canadian Forest Service	363-0729

Department of National Defence - CFB Esquimalt

Environmental Science Advisory Committee

ANNUAL WORKSHOP

AGENDA

9:00 a.m., January 31, 1997

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

8:45 - 9:00 Registration

9:00 Welcome

9:15 - 10:00 Presentations

1) Trudy Chatwin - Permit No. P002-96 - Establishment and Monitoring of Permanent Ecological Plots at Rocky Point.
2) Rhonda Millikin - Permit No. P003-96 Migration Monitoring of Neotropical Birds
3) Al Mitchell - Permit No. P005-96 - Sustainable Development of Natural Sources of Taxol
4) Richard Ring - Permit No. P006-96 - Community Ecology of the Canopy-Forest Floor Insect/Arthropod Fauna from an Old Growth Forest

10:00 - 10:15 Break

10:15 - 11:30 Presentations

5) David Nagorsen - Permit No. P010-96 - Bat Studies
6) Allan Hawryzki - Permit No. P017-96 - Demographic Study of Allium amplectens
7) Daren Copley - Permit No. P018-96 - Purple Martin Nestbox Program
8) Mike Dunn - Permit No. P023-96 - Installation and Maintenance of Microclimate Station
9) Garry Fletcher - Permit No. P021-96 - Student Research Essays

11:30 - 12:30 Lunch

12:30 - 3:00 Presentations

10) Christian Engelstoft - Permit No. P024-96 - Sharp-tailed Snake Inventory
11) Andrew Stewart - Permit No. P025-96 - Urban Cooper's Hawk Habitat Study
12) Nathalie Djan-Chekar - Permit No. P026-96 - Survey of Rare Bryophytes
13) Michael Shepard - Permit P029-96 - Raptor Survey
14) Michael Hulme - Permit P030-96 - Management of Spruce Weevil - Pissodes stobi
15) Imre Otvos - Permit No. P031-96 - Infestation of Garry Oak Acorns by the Filbert Weevil and Filbert Worm
16) Richard Hebda - Permit No. P032-96 - Garry Oak Ecosystem Resoration
17) Bill Dushenko - Permit No. P034-96 - Royal Roads University
18) Norm Healey - Edge Effect and Biodiversity in Old Growth Coastal Douglas-fir at Royal Roads University
19) Heather Lewis - Comparing Tree Diameters of Like Species in Varied Ecosystems
20) Guy Padova - Ecotone Effects on Tree species Richness and Diversity Between an Old Field and Forest Ecosystem at Royal Roads
21) George Edwards/Mike Meagher - Permit No. P035-96 - Genetic Variation in Garry Oak

3:00 Wrap up

Poster Display

Gillian Carrigan: Royal Roads University - A Fragile Ecosystem in an Urban Environment

APPENDIX 3

Final Reports for Projects Completed in 1996

Permit No.: P008-96

Title: Garry Oak Acorns: Production, Dispersal, Germination, Emergence, and the Role of Steller's Jays

Project Leader: Marilyn Fuchs

Organization: Centre for Applied Conservation Biology
Faculty of Forestry
University of British Columbia
#270 -2357 Main Mall
Vancouver, B.C. V6T 1Z4

Location: Mary Hill Battery and Rocky Point

Start date: June 24, 1996

Completion date: June 30, 1996

Project Overview:

This study followed up on research initiated in 1994 and 1995 (permit number P008-95). Garry oak (*Quercus garryana*) acorns were planted at different depths and in different habitats in 1994, to determine the effects of these factors upon oak regeneration. Seedlings were measured in 1995, which provided information about the effects of depth and habitat upon seed predation, germination, and seedling emergence. 1996 measurements provided information about second year growth and survival.

Objectives:

1. To determine the role of burial depth and habitat on second year growth and survival of Garry oak seedlings;

2. To identify seedling mortality factors.

Accomplishments to Date:

a. Highlights of Findings:

No relationship was found between initial burial depth and second year survival. However, different survival rates and mortality factors were found among habitat types and between sites.

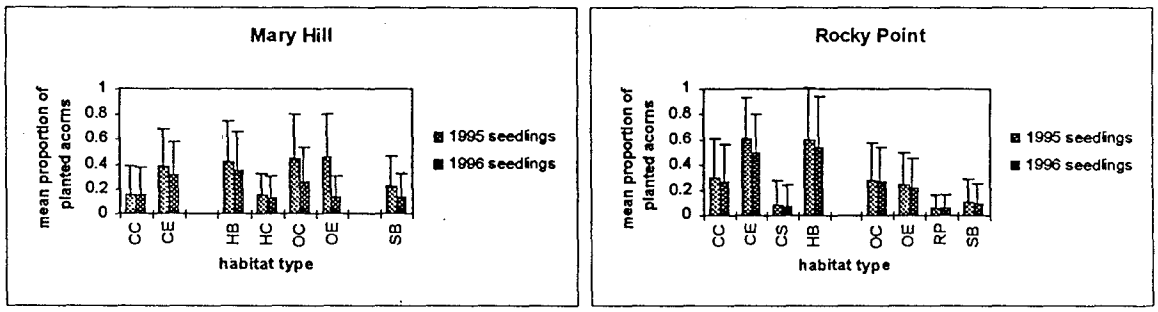


Figure 1: Proportions of acorns planted in 1994 that were seedlings in 1995 and 1996. Each bar represents the mean of 6 planting plots, with 30 acorns planted per plot. Error bars designate standard deviations. Habitat types are: CC=conifer canopy; CE=conifer edge; CS=conifer sapling patch within the oak stand; HB=herb; HC=small clumps of overlapping arbutus, Douglas-fir, and oak canopies; OC=oak canopy; OE=oak edge; RP=riparian; SB=shrub.

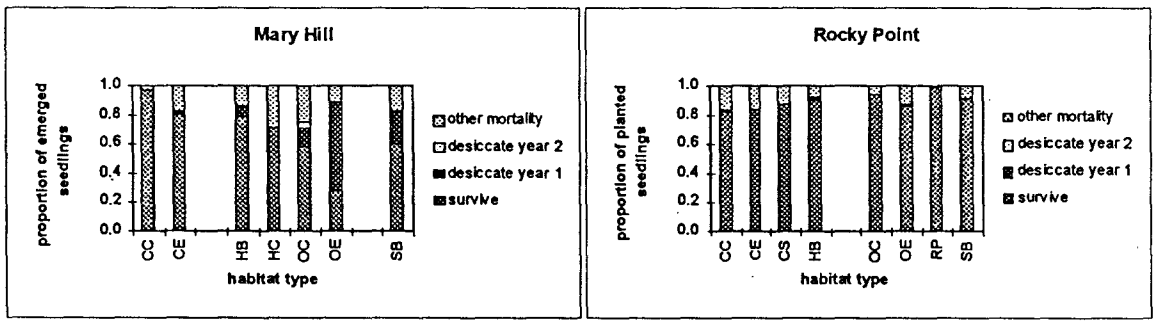


Figure 2: Fate of emerged seedlings. Habitat types are as in Figure 1. "Desiccate year 1" designates seedlings that showed signs of desiccation in June 1995 and were dead in 1996. Actual time of death was not determined. "Desiccate year 2" designates seedlings that showed no sign of desiccation in June 1995 and were dead from desiccation in June 1996. Causes of death for "other mortality" seedlings was usually not determined, as most had disappeared.

1995 emergence results are presented in more detail in the 1995 DND ESAC annual report. Survival rates between 1995 and 1996 were relatively high. Desiccation was the primary identified mortality factor. Desiccation was in evidence almost exclusively at Mary Hill, in thin-soiled habitat types. Most of the seedlings that died from desiccation were stressed and perhaps killed by June of their first year. This occurred after they had produced their first leaves early in their first spring, and before they had gone through their first dry season (late summer to early fall.)

b. Research Activities:

Planting plots were visited in late June, 1996. Seedlings were recorded as present or absent. If present, basal diameter and branch length were measured, and evidence of damage (insect, browsing, desiccation) was noted. For severely stressed seedlings, the root was checked to determine if it was still alive.

c. Extension and Demonstration (1994-1996 research):

Publications:

- Fuchs, M.A., P.G. Krannitz, A.S. Harestad, and F.L. Bunnell. In press. Seeds that Fly on Feathered Wings: Acorn Dispersal By Steller's Jays. Proceedings of Symposium on Oak Woodlands: Ecology, Management, and Urban Interface Issues, San Luis Obispo, CA, March 19-22, 1996.
- M.Sc. Thesis. In progress.

Seminars:

- Pacific Ecology Conference, Friday Harbor, Washington, February 1996.
- ESAC / EMAN meeting, Victoria, B.C., February 1996.
- Canadian Wildlife Service, Delta, B.C., December 1996.

Permit No.: P026-96

Title: Survey of Rare Bryophytes

Project leader: Nathalie Djan-Chékar

Participants: Wilfred B. Schofield, Margaret Schofield, Mike Ryan, Geoffrey A. Godfrey

Organization: British Columbia Conservation Data Centre
Wildlife Branch
780 Blanshard Street
Victoria, BC, V8V 1X5

Location of study sites: Cape Calver

Start Date: March 1, 1996

Completion Date: April 30, 1996

Project Overview:

For the mosses, nomenclature follows Ireland, R.R. *et al.*, 1987, Checklist of the mosses of Canada II, Lindbergia 13: 1-62, except for Isothecium stoloniferum and I. stoloniferum var. cardotii which follow Schofield, W.B., pers. comm., March 1996. For the liverworts, nomenclature follows Stotler, R. and B. Crandall-Stotler, 1977, A checklist of the Liverworts and Hornworts of North America, Bryologist 80(3): 405-428.

Voucher specimens will be deposited at the herbarium of the University of British Columbia (UBC), the herbarium of the Royal BC Museum (V), and J.D. and G.A. Godfrey's personal herbarium. Collection data will be incorporated into the BC CDC's database on rare bryophytes.

We were impressed by the good condition of the bryophyte and lichen communities, particularly in the oak meadows and rock outcrops bordering the coast. Similar communities in public areas are often heavily impacted by repeated trampling.

Objectives:

To document the bryophyte flora at Rocky Point and relocate rare mosses reported for the area

Background

a) Rare BC mosses previously reported for Rocky Point (see Appendix 1 for the BC CDC ranking of these taxa):

b) *Alsia californica* - reported for Rocky Point, on oak bark in oak woods, by W. Savale, July 1961

c) Rare BC mosses known to southeastern Vancouver Island and the Gulf Islands, and which could possibly be found at Rocky Point are listed in Appendix 1.

Results

a) Rare mosses relocated:

Alsia californica:
- Two observations at Cape Calver:
  1. On Poplar and Ocean spray in a relatively moist depression in dry coastal woodland with Douglas fir and Poplar.
     UTM 10U 4599 E 53523 N
     Voucher specimen: N. Djan-Chékar no. 2053
  2. On Garry oak in dry coastal woodland with Douglas fir, Arbutus and Garry Oak
     UTM 10U 4599 E 53522 N
     Voucher specimen: N. Djan-Chékar no. 2055
- W.B. Schofield observed that Cape Calver is the best site for *Alsia californica* which he has seen in British Columbia.
- Potential threats: none under present conditions

b) Rare mosses new to Rocky Point:

Pterogonium gracile:
- One population observed:
  On rock and at base of oak trees in dry coastal woodland with Douglas fir and Garry oak.
  UTM 10U 4599 E 53523 N
  Voucher specimen: N. Djan-Chékar no. 2050
- Potential threats: none under present conditions

c) Other bryophytes collected at Cape Calver:

Mosses:

Bestia vancouveriensis
Bryum capillare
Dicranella heteromalla
Fissidens limbatus
Fontinalis antipyretica var. oregonensis
Homalothecium pinnatifidum
Isothecium cristatum
I. stoloniferum
I. stoloniferum var. cardotii
Leucolepis menziesii
Metaneckera menziesii
Orthotrichum lyellii
Plagiomnium cuspidatum
P. venustum
Pleuridium bolanderi
Rhacomitrium elongatum (epilose variant)
R. heterostichum
Scleropodium cespitans
S. obtusifolium
Tortula princeps
Ulota phyllantha
Zygodon viridissimus var. rupestris

Liverworts:

Apometzgeria pubescens
Cephalozia lunulifolia
Cephaloziella divaricata
Chiloscyphus cuspidatus
Frullania bolanderi
F. californica
F. tamarisci subsp. nisquallensis
Lophocolea cuspidata
Plagiochila porelloides.
Porella cordaeana
P. navicularis
P.roellii
Radula complanata
Scapania americana
S. bolanderi

Appendix 1 - Rare BC mosses known from southeastern Vancouver Island and the Gulf Islands (see Appendix 2 for a definition of ranks and list designations)[1]

Taxa	MOE list	Grank	Srank
Alsia californica	B	G?	S2S3
Andreaea rothii	B	G5	S2S3
Bartramia stricta	R	G?	S1
Brachythecium holzingeri	B	G?	S1?
Bryum canariense	R	G?	S2
Bryum capillare var. torquescens	R	G?T?	S1
Bryum violaceum	R	G?	S1
Crumia latifolia	R	G?	S1
Desmatodon obtusifolius	B	G5	S1?
Dicranella schreberiana var. robusta	R	G5T?	S2
Entosthodon fascicularis	R	G?	S2
Epipterygium tozeri	B	G4?	S2S3
Eucladium verticillatum	B	G5	S2S3
Eurhynchium riparioides	B	G?	S2S3
Fissidens ventricosus	B	G?	S2S3
Fontinalis patula	R	G?	S1
Funaria muhlenbergii	R	G?	S2
Grimmia elatior	B	G?	S2S3
Homalothecium arenarium	B	G?	S2S3
Orthotrichum cupulatum	R	G4G5	S1
Orthotrichum pulchellum	B	G4?	S2S3
Philonotis capillaris	B	G?	S2S3
Philonotis yezoana	B	G?	S2S3
Pleuroziopsis ruthenica	B	G?	S1?
Pterogonium gracile	B	G?	S2S3
Ptychomitrium gardneri	R	G?	S2
Rhacomitrium heterostichum var. affine	B	G5T?	S2S3
Rhacomitrium pacificum	B	G3	S3
Rhizomnium punctatum	B	G5	S1?
Schistidium vancouverense	R	G?Q	S2Q
Tortula amplexa	R	G?	S2
Tortula bolanderi	R	G?	S1
Tortula subulata	B	G?	S2S3

[1] This table is based on the BC Consevation Data Centre's draft tracking list for rare native mosses of BC. The tracking list is currently being revised. Please keep in mind that the data included in this table is preliminary.

Appendix 2. British Columbia Conservation Data Centre - Ranking and List Designations

Each "element" (for example, a species) on the Conservation Data Centre's list is ranked using the system developed over the past 20 years by The Nature Conservancy. This system is now in use in five Canadian provinces, all U.S. states and a number of Latin American countries. Most government agencies within these jurisdictions have also adopted this ranking system.

Each element is ranked at two levels: global (G) and provincial, or "subnational" (S). The global rank is based on the status of the element throughout its entire range whereas the provincial rank is based solely on its status within British Columbia. The global rank is established by a biologist assigned to that element by The Nature Conservancy; the provincial rank cannot exceed the global rank.

The status of an element is indicated on a scale of one to five; the score is based primarily on the number of extant occurrences of the element, but other factors such as abundance, range, protection, and threats are also considered if the information is available. Generally speaking, the Conservation Data Centre will track only those species with ranks of 1-3. In addition to the ranks 1-5, there are several letter ranks; all are defined below.

1 = Critically imperiled because of extreme rarity (5 or fewer extant occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation or extinction

2 = Imperiled because of rarity (typically 6-20 extant occurrences or few remaining individuals) or because of some factor(s) making it vulnerable to extirpation or extinction

3 = Rare or uncommon (typically 21-100 occurrences); may be susceptible to large-scale disturbances; e.g. may have lost extensive peripheral populations

4 = Frequent to common (greater than 100 occurrences); apparently secure but may have a restricted distribution; or there may be perceived future threats

5 = Common to very common; demonstrably secure and essentially ineradicable under present conditions

H = Historical occurrence; usually not verified in the last 40 years, but with the expectation that it someday may be rediscovered

X = Apparently extinct or extirpated, without the expectation that it will be rediscovered

U = Status uncertain, often because of low search effort or cryptic nature of the element; uncertainty spans a range of 4 or 5 ranks

R = Reported from the province, but without persuasive documentation for either accepting or rejecting the report

RF = Reported in error, but this error has persisted in the literature

? = Limited information is available or the number of extant occurrences is estimated
A = An element (usually an animal) that is considered accidental or casual in province; a species that does not appear on an annual basis
E = An exotic or introduced species to the province
Z = Occurs in the province but as a diffuse, usually moving population; difficult or impossible to map static occurrences

In addition to the above ranks, there are four letter qualifiers sometimes used in conjunction with them:

T = Designates a rank associated with a subspecies
B = Breeding; the associated rank refers to breeding occurrences of mobile animals
N = Non-breeding; the associated rank refers to non-breeding occurrences of mobile animals
Q = Taxonomic validity of the element is not clear or in question

The BC Ministry of Environment (MOE) maintains tracking lists of elements at risk. These lists are defined as follows:

RED LIST (R):
Includes any indigenous species or subspecies (taxa) considered to be Extirpated, Endangered, or Threatened in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed. Red-listed taxa include those that have been, or are being, evaluated for these designations.

BLUE LIST (B):
Includes any indigenous species or subspecies (taxa) considered to be Vulnerable in British Columbia. Vulnerable taxa are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. Blue-listed species are at risk, but are not Endangered or Threatened.

Each element is assigned to a list based on its provincial rank. For plants, elements ranked S1 and S2 are designated Red, and elements ranked S1? and S2S3 are designated BLUE

Permit No.: P027-96

Title: Filming Sequence - Canopy Arthropods

Project Leader: Neville Winchester (250) 721-7099

Organization: Biology Department
P.O. Box 3020
University of Victoria
Victoria, B.C. V8W 3N5

Location: Rocky Point - Pearson College Forest Canopy Research Station

Start Date: April 8, 1996

Completion Date: August 31, 1996

Project Overview:

A study of the community ecology of the canopy-forest floor insect/arthropod fauna from old growth forest is being carried out at Rocky Point. A filming sequence about this project will be done with Canada AM and National Film Board The filming sequence will include an interview in the canopy, looking at the arthropod-canopy-biodiversity research.

Objectives:

a) to extend the extension and demonstration aspects of this study to include a film document; and
b) to capture the essence of high-canopy work and the importance that canopy projects have in addressing the goals of Canada's commitment to the Biodiversity Accord.

Accomplishments:

In July a visiting film crew from the National Film Board of Canada (NFB) arrived to film a canopy biodiversity sequence. The logistics and filming dates were the cumulation of 2 years of work between Neville Winchester and the NFB. Filming, under director Tony Ianzelo was part of a much larger project that sought to 'remake' the 1950's NFB film on the geography of Canada. Based on the Carmanah canopy project, the NFB wanted to capture the essence of high-canopy work and the importance that canopy projects have in addressing the goals of Canada's commitment to the Biodiversity Accord. Hence, the logical site to film was at the Rocky Point Canopy station. At this site the filming focused on the techniques that were used to access the canopy and sample arthropods—a continuation of cataloguing the ancient forest canopy biodiversity of the Pacific Northwest. The creation of the station under a joint partnership with Pearson College of the Pacific, University of Victoria, Department of National Defense and Canadian Forest Service was discussed and used as an example of the collaborative linkages that were needed to have a successful canopy/biodiversity program. Participating in the film shoot were Ms. Nancy Prockiw, Mr. Kevin Jordan, and Mr. Neville Winchester. One week of film shooting (with a crew of up to 10 people) was highlighted by the rolling motion film footage taken from a helicopter. With camera's mounted on the struts of the helicopter the film crew was able to film canopy sampling from a unique perspective—that of moving flight passes over trees where researchers were sampling. Points that were stressed in the film shoot were safe canopy access, the importance of retaining biodiversity in these ancient forests and the gathering of spectacular numbers of arthropods (1.4 million arthropods from Rocky Point) that indicate two things: that much of the most basic ecological science has yet to be done, and that these forests are reservoirs for biodiversity and may contain a high number of endemic species. The completion date for the film should be in the fall of 1998.

Permit No.: P028-96

Title: Trilateral Conference (Defence) Site Visit

Author: Gail Feltham (250) 363-5063

Organization: Risk Management Branch
Building 29 Dockyard
Canadian Forces Base Esquimalt
P.O. Box 17000 Stn Forces
Victoria, B.C. V9A 7N2

Start Date: March 30, 1996

Completion Date: March 30, 1996

Project Overview:

On Saturday, March 30, 1996, a site visit was conducted at CFAD Rocky Point with personnel from the United States Department of Defence and Australia's Department of Defence as well as persons from National Defence Headquarters in Ottawa. The trip was arranged as part of a trilateral Defence Conference hosted by the Canadian Department of National Defence. The site visit was intended to demonstrate some of the significant features of the lands held by CFB Esquimalt as well as how research activities have been accommodated in those areas. Personnel from Lester B. Pearson College of the Pacific assisted at the Forest Canopy Station and time available allowed one person to be winched up the tree to the platform. Trudy Chatwin was available at her SI/MAB Garry Oak plot to discuss the work she is conducting there.

Permit No: P029-96

Title: Spring Surveys of Raptors at DND Sites

Project Leader: Michael G. Shepard (250) 380-9195

Organization: Michael G. Shepard
306-825 Cook Street
Victoria, B.C. V8V 3Z1

Locations: Albert Head, CFMETR, Mary Hill Battery, CFAD Rocky Point

Start Date: March 20, 1996

Completion Date: March 31, 1996

Project Overview:

An assessment of spring breeding populations of raptors on the above DND lands.

Objectives:

To determine nesting site locations of Bald Eagles and other diurnal raptors, and to census the owl populations of the above DND lands.

Accomplishments:

a) **Highlights:**
Aerial and ground surveys were conducted in March 1996, and the locations of raptor nest sites, as well as locations of owl sightings were noted. Bald Eagles were most abundant at CFMETR and adjacent islands, and owls of four species were encountered during the surveys.

b) **Research Activities:**
Research activities were limited to censuses on the above-named DND properties.

c) **Extension and Demonstration:**
A brief summary of the project was presented at the annual meeting of the Environmental Science Advisory Committee on January 31, 1997. Two reports were prepared and submitted to DND in 1996. Citations:

Shepard, M.G. 1996a. Bald Eagle nesting sites (1996) on DND properties on southern Vancouver Island. Unpub. report prepared for B.E.P.O., Department of National Defence.

Shepard, M.G. 1996b. 1996 Owl surveys on DND properties on southern Vancouver Island. Unpub. report prepared for B.E.P.O., Department of National Defence.

Appendix 4

Annual reports for Projects Worked on in 1996

Permit No.	P002-96
Title:	Establishment and monitoring of permanent ecological plots in a Coastal Douglas Fir forest and a Garry-oak woodland at the Rocky Point Department of Defence lands
Project Leader	Trudy Chatwin
Organization	Ministry of Environment Lands and Parks 2080 Labieux Road Nanaimo, B.C. V9T 6J9

Location and Study Area Description

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

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

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

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

Project Start Date
This project started in December of 1994

Project Completion Date

The majority of work on the project should be complete by December 1997, although ongoing monitoring of the plots and re-measuring should occur on a continual basis.

Project Overview

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

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

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

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

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

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

Goals and Objectives of the Work

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

The specific objectives of the plot are to :

- inventory woody plants and their distribution
- record forest structure
- detect patterns of recruitment, mortality and regeneration of forest trees
- determine the relative influence of abiotic factors (soil and climate), natural disturbance and human caused disturbance

3. To establish a long-term monitoring protocol that will detect trends, such as patterns of recruitment, mortality, and regeneration of forest trees in the Coastal Douglas Fir ecosystem.

Methodology

Specific protocol instructions for setting up the Smithsonian Man and the Biosphere Ecological Monitoring Plots (Dallmeier and Comisky 1994 *Methodology for the Establishment of Permanent* Plots) has been provided in earlier reports so will not be included here.

Basic steps for establishing the plots are:

1. Survey of 1 hectare area into 25 , 20m.x 20m. quadrats and permanent marking of corners.(Figures 2 and 4)
2. The woody vegetation (including wildlife trees) over 0.04m DBH in each quadrat is identified, mapped with range finders, tagged (with Aluminium tags or plastic coated wire) and measured (DBH, height, height of canopy) Appendices 1 and 3
3. Data entered into BIOMON program and compiled

Results and Progress to February 1997

a) Highlights of Findings

<u>The 1 hectare Church Hill Douglas-fir plot Measured March 1995 through November 1995</u>
Figures 5 and 6: Plot 1 Summary for Church Hill Douglas Fir and Tree location map Plot 1. 1995 Census

1. Has a total of 450 woody plant stems over 0.04m DBH, of which 414 were trees, 36 were shrubs (Ocean spray *Holodiscus discolor,* Red huckleberry *Vaccinium parviflora,* Saskatoon berry *Amelanchier alnifolia*)
2. Species richness is 8 species of trees (Douglas fir *Pseudotsuga menziesii*, grand fir *Abies grandis*, western hemlock *Tsuga heterophylla*, Pacific yew *Taxus brevifolia*, Red alder *Alnus rubra*, shore pine *Pinus contorta*, Scouler's willow *Salix scouleriana*, Bitter cherry *Prunus emarginata* and 3 species of shrub (Ocean spray, Red huckleberry, Saskatoon berry)
3. The tallest tree is a Douglas-fir reaching 55m. with a dbh of 1.4 metres
4. The plot was dominated by grand fir with a relative density of 54.5%, and Douglas fir with a relative density of 35.5%. The two species account for 90% of the stems in the plot. However, when volume is considered in the measure Relative Dominance, Douglas fir tops the list at 73% due to its large dimensions (Figure 9)
5. The basal area for the plot is 86 m^2 which is the highest basal area for any SI/MAB plot thus far measured

6. The Douglas firs aged ranged from 61 to 157 years old (at minimum). The grand firs were somewhat younger and ranged in ages from 57 to 84 years. Dr. Smith estimates that the stand originated in the 1860's after either early settlement land clearing or fire.
7. Regenerating species are grand fir and red alder

The one hectare Garry oak woodland plot Measured February 1996

Figures 7 and 8 Plot 2 Summary Garry oak meadow and Tree location 1996 Census map

1. Has a total of 653 woody stems over 0.04m DBH. All stems, except 3 Ocean spray were trees.
2. Species richness for the plot is 5 species of trees (Douglas fir *Pseudotsuga menziesii*, Garry oak *Quercus garryana,* Shore pine *Pinus contorta*, Arbutus *Arbutus menziesii*) and one species of shrub (Ocean spray *Holodiscus discolor*
3. The plot is dominated by Garry oak with a relative density of 66.1%. Douglas fir has a relative density of 25.1% but due to its larger volume Douglas fir has higher relative dominance measured at 54.8% (Figure 9)
4. Regenerating species are grand fir, Douglas fir and Garry oak
5. Future measurements of the plot may prove interesting as Garry oaks may be shaded out by Douglas fir and grand fir
6. The total basal area of the plot is 44.1m^2

Between plot comparisons are presented in Figure 10 The Church Hill Douglas fir plot has nearly twice the basal area of the Garry oak plot and has 32% less stems.

b) Research activities were outlined in project overview and methods section.

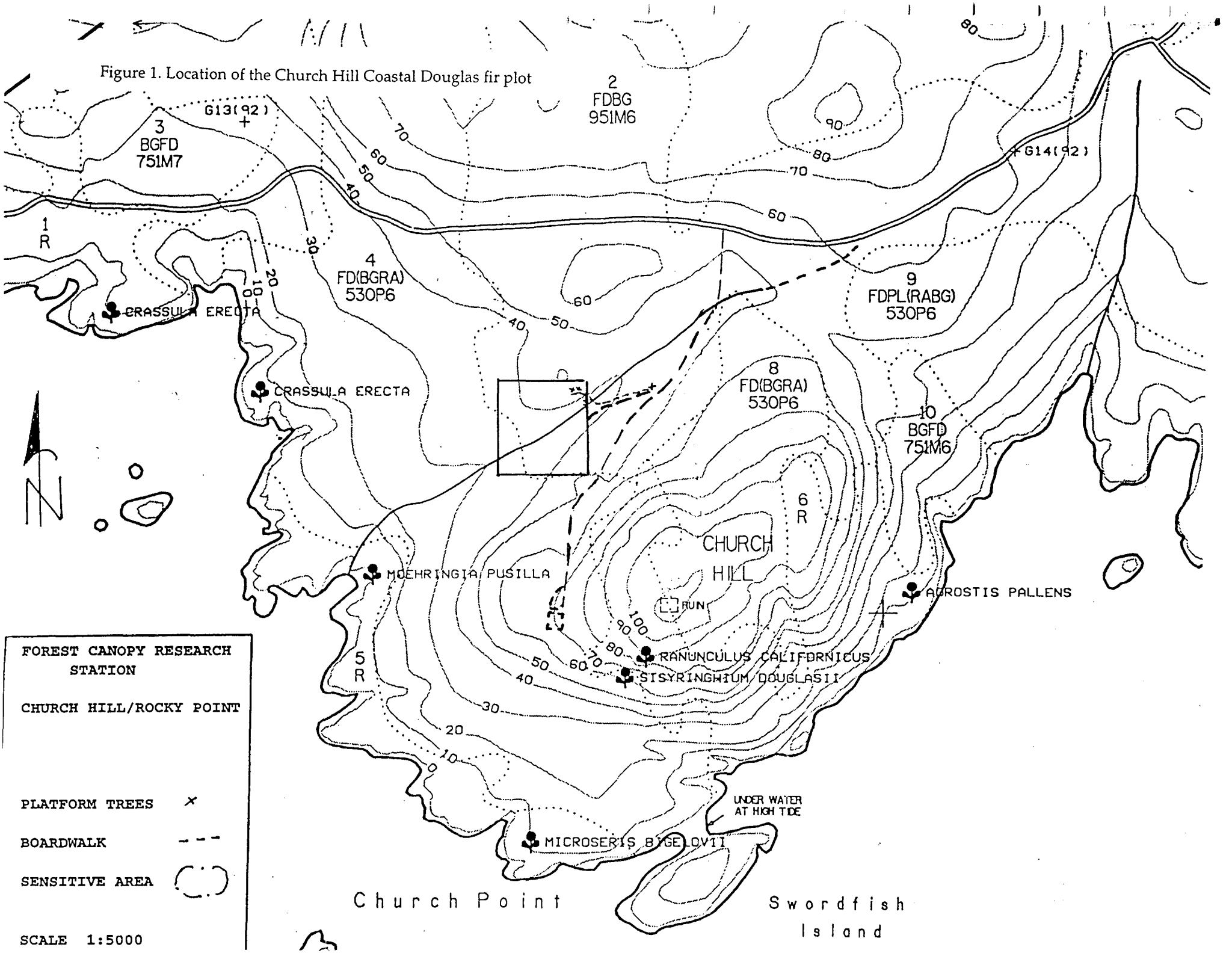
Extension and Demonstration
In the last year of the project a tour and description of the plot activities was undertaken for a Tri-lateral Department of Defence group (Canada-USA-Australia) in March 1996. A presentation was made at a recent meeting (Jan. 31, 1997, Royal Roads) of researchers working on Department of Defence lands.

Recommendations and discussion of ongoing direction for Ecological monitoring plots
The results for these plots provide a baseline of temperate forest data with which to add to the world-wide SI/MAB database. They also provide baseline for EMAN assessments and further studies which include amphibian, bat, arthropod and the dendrochronology studies. However, more plots are needed to capture the variation of forest community structure and composition within the Coastal Douglas Fir biogeoclimatic zone and many more plots would be required to encompass the forest diversity within British Columbia. SI/MAB plots require very labour intensive work on a relatively small area of land, so having an extensive network of SI/MAB plots in British Columbia without an assured funding source may not be possible.

Recent global studies of remaining original forest cover demonstrate the importance of maintaining permanent plots of original forest. Most of the world's original forest cover remains in the Amazon basin and in Canada. Original forest cover in the continental United States is estimated at just over 1%. A network of plots in Canada will be important to maintenance of biodiversity information.

However important the plots may be, I feel there is a need to improve some of the scope of the plot measurements and analysis to make the plot information more relevant to temperate forest situations.

Figure 1. Location of the Church Hill Coastal Douglas fir plot



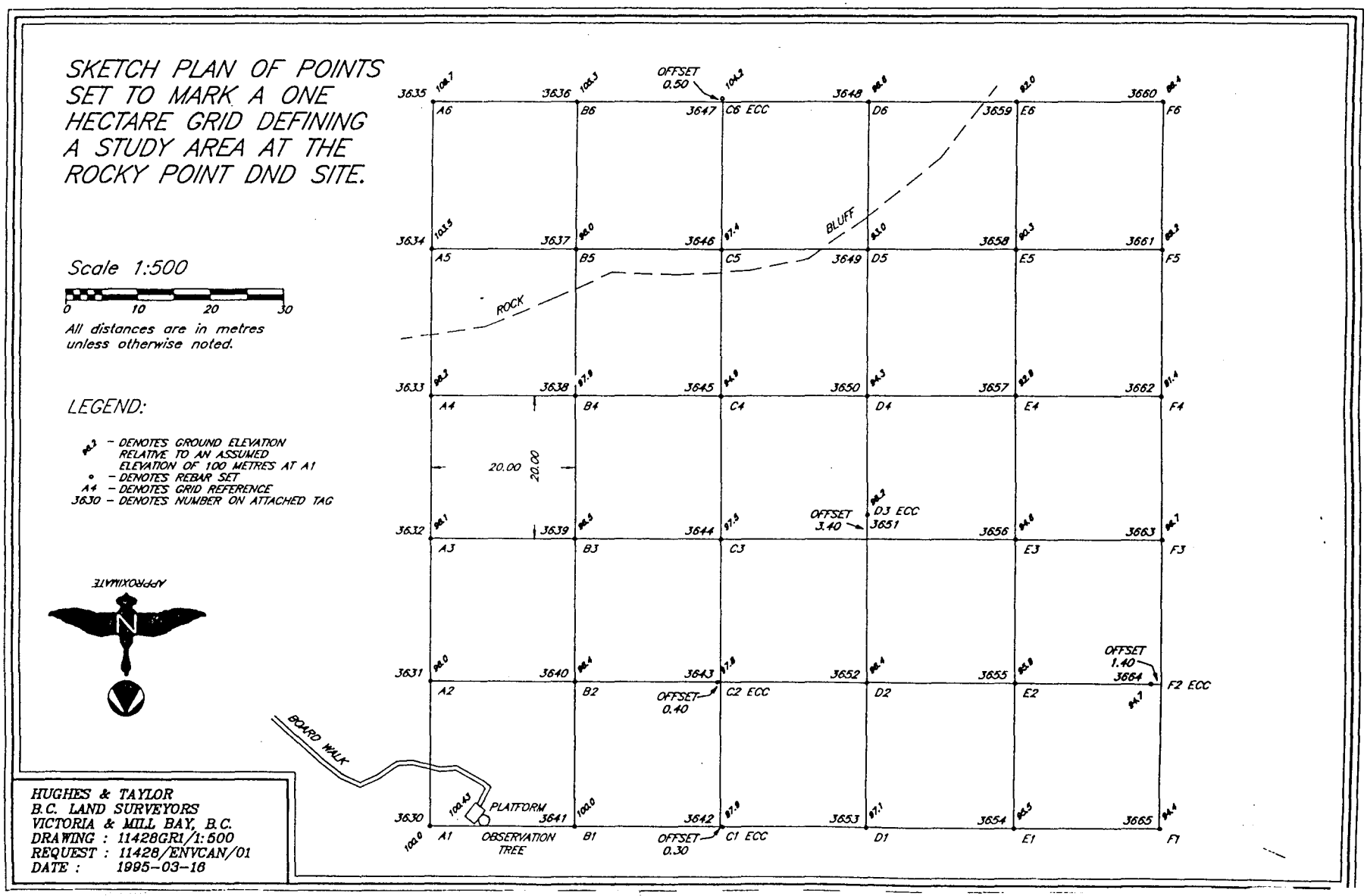


Figure 2. Sketch Plan of Points Set to Mark a one Hectare Grid Defining a Study Area (Church

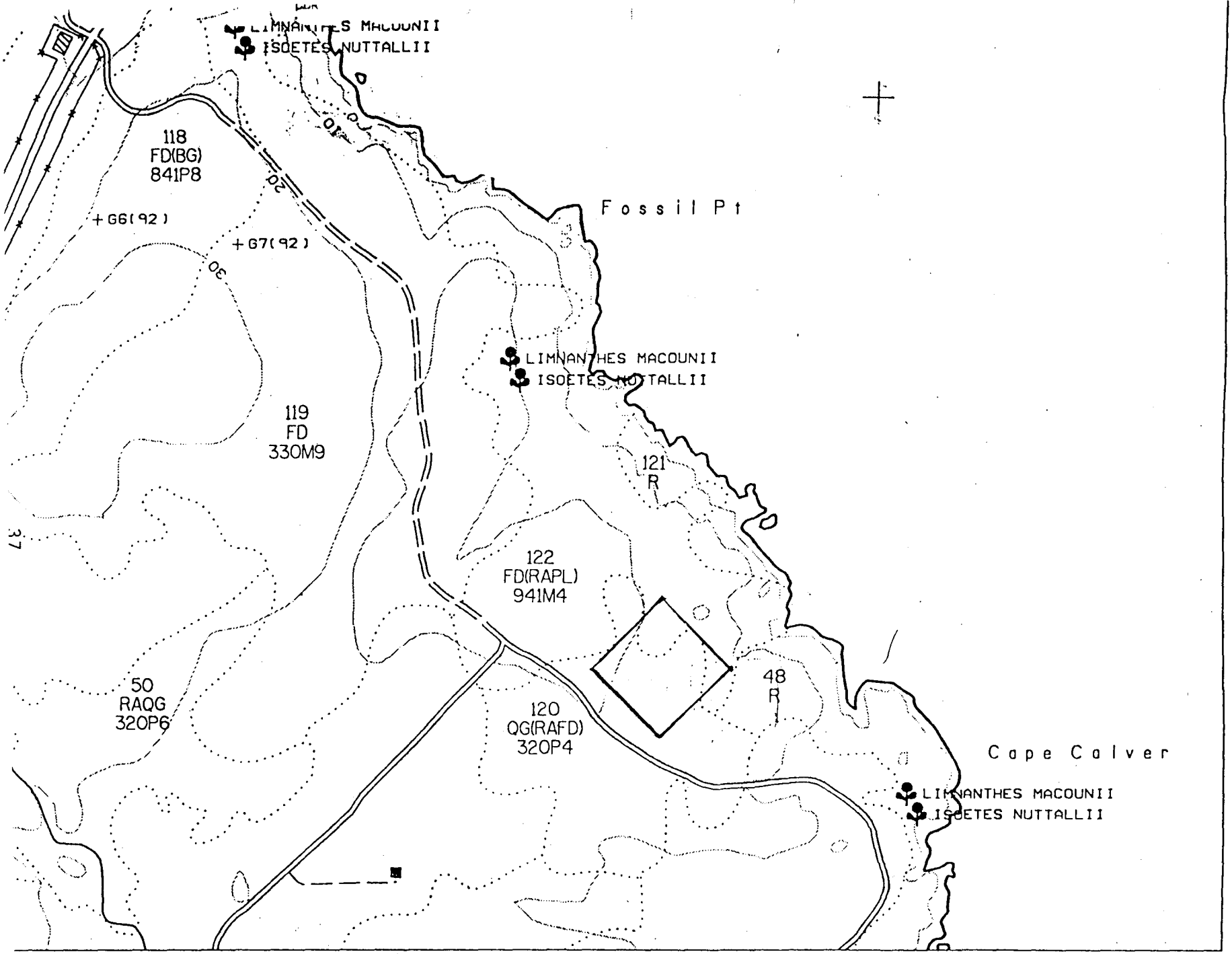
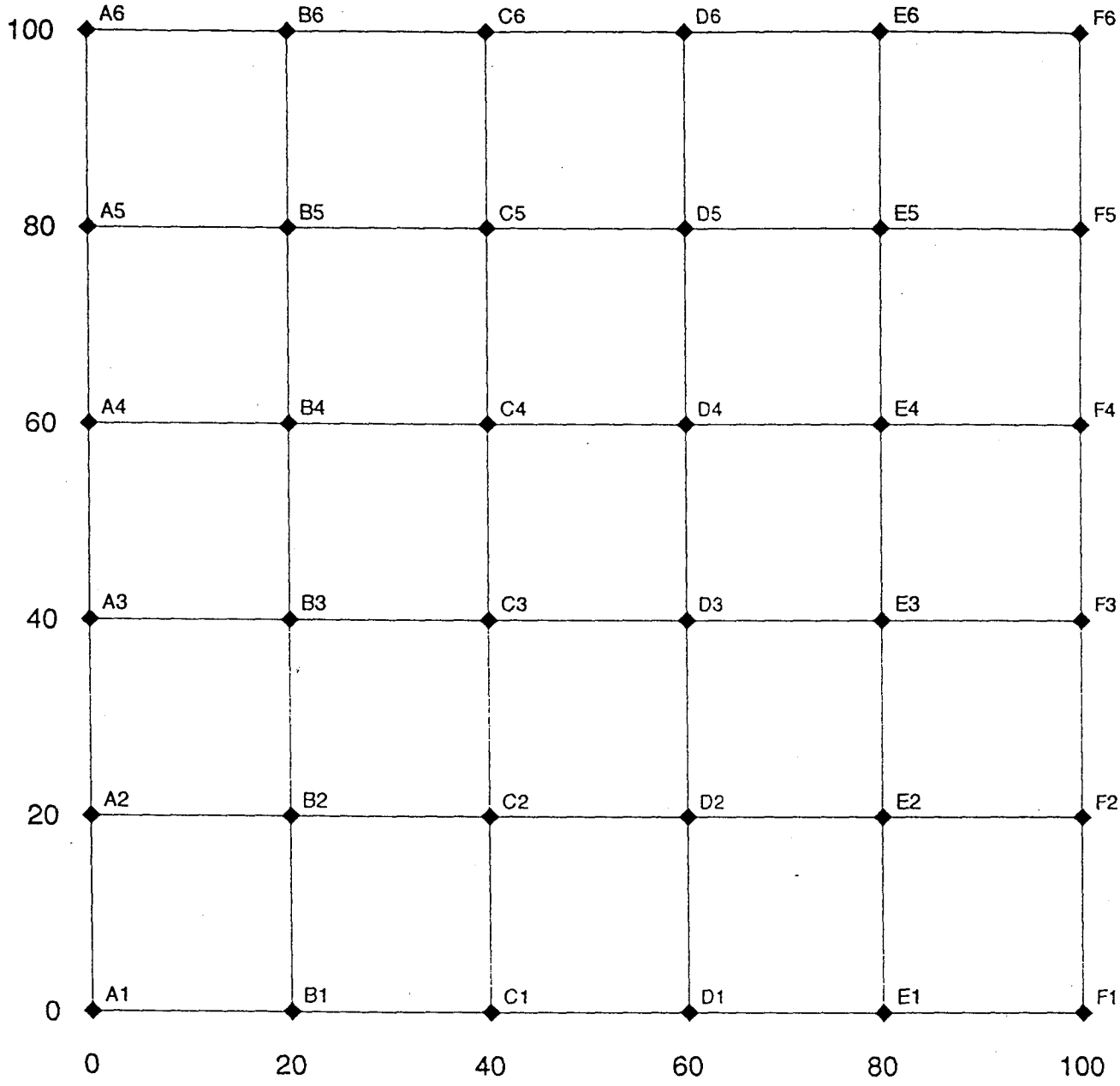


Figure 3. Location of the Garry oak woodland plot

Figure 4.

Sketch Plan Of Points Set To Mark A One Hectare Grid Defining A Garry Oak Ecosystem Study Area At The Rocky Point DND Site.



"A1" denotes number on tag attached to rebar stake

20 metres

North (approx.)

Figure 5. Plot 1 summary for Church Hill Coastal Douglas Fir

Rocky Point, Vancouver, Canada
Garry Oak meadow
All quadrats
Plot 2, 1996

6/01/96 Diameter >=.04

Species		Number of Trees	Number of Stems	Average DBH(m)/Stem	Basal Area	Relative Density	Relative Dominance	Relative Frequency
Pseudotsuga menziesii		161	164	.303	24.168	25.12	54.81	26.67
Quercus garryana		427	434	.194	14.726	66.61	33.39	40.00
Pinus contorta		27	27	.326	3.097	4.21	7.02	15.00
Arbutus menziesii		19	20	.271	2.047	2.96	4.64	10.00
Abies grandis		5	5	.111	.055	.78	.12	6.67
Holodius discolor		2	3	.049	.006	.31	.01	1.67
TOTAL:	6	641	653	.209	44.098			100.00

Figure 6. Tree location map Plot 1. 1995 Census

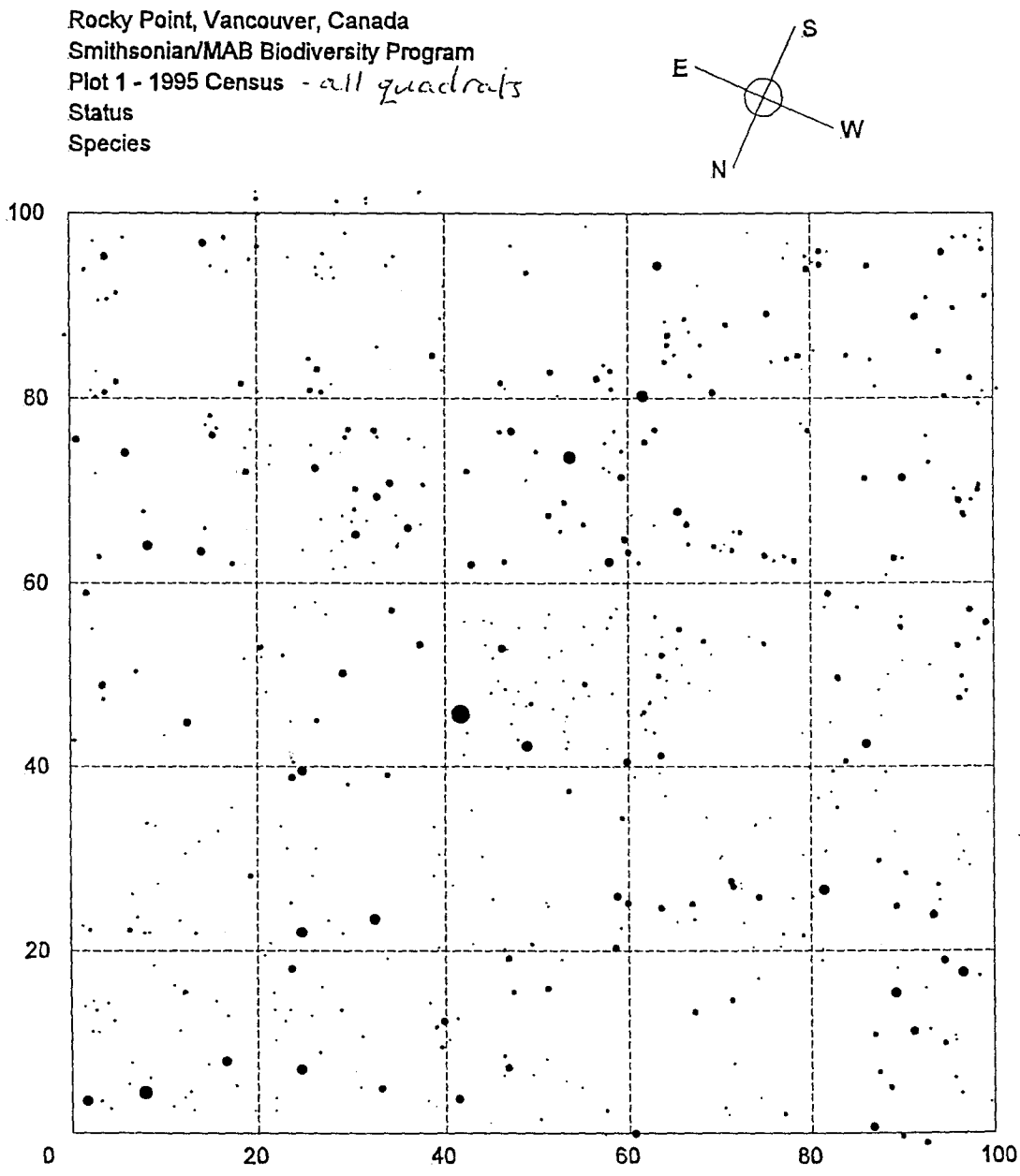


Figure 7. Plot 2 summary Garry oak meadow

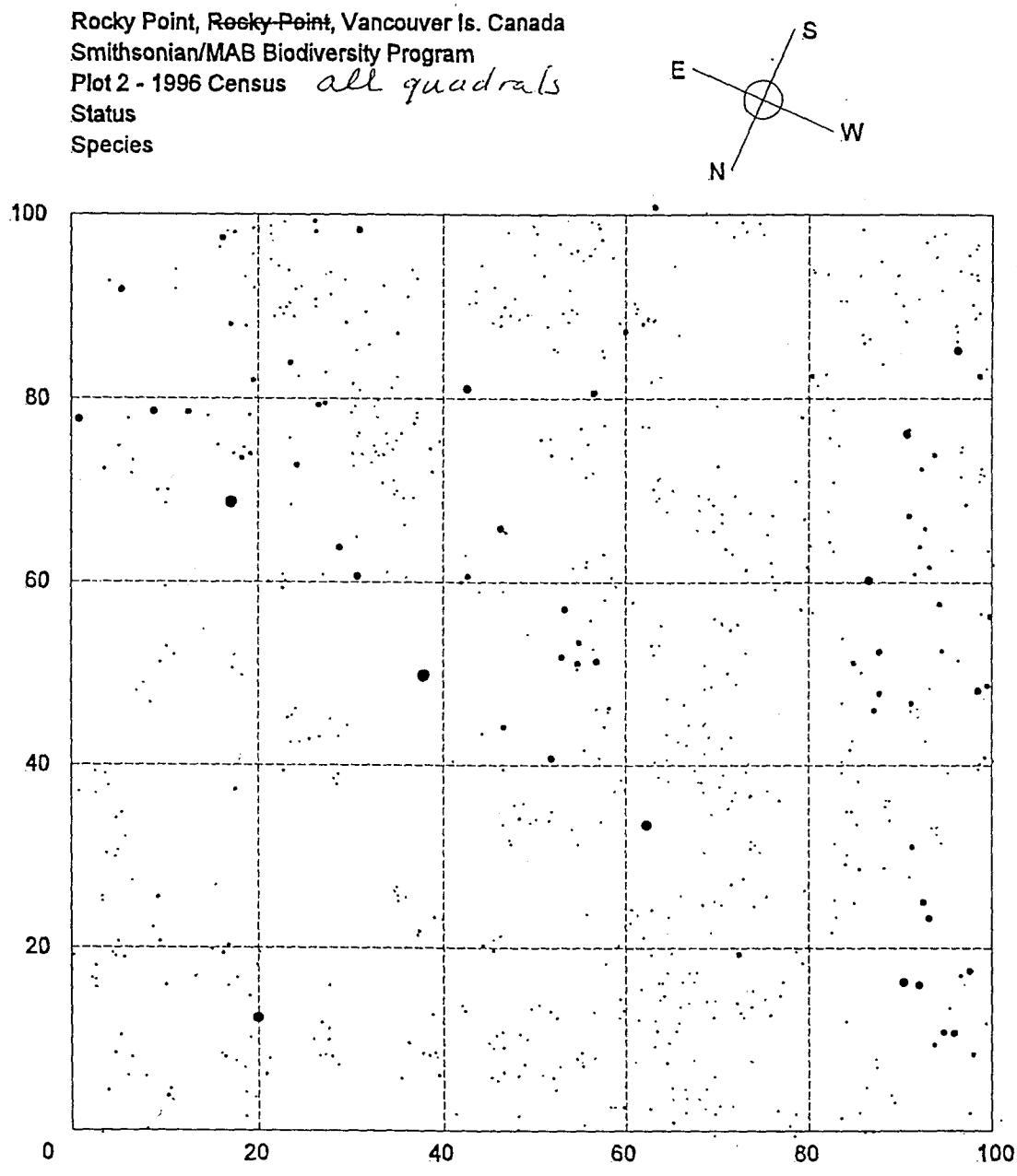
Rocky Point, Vancouver, Canada
COASTAL DOUGLAS FIR

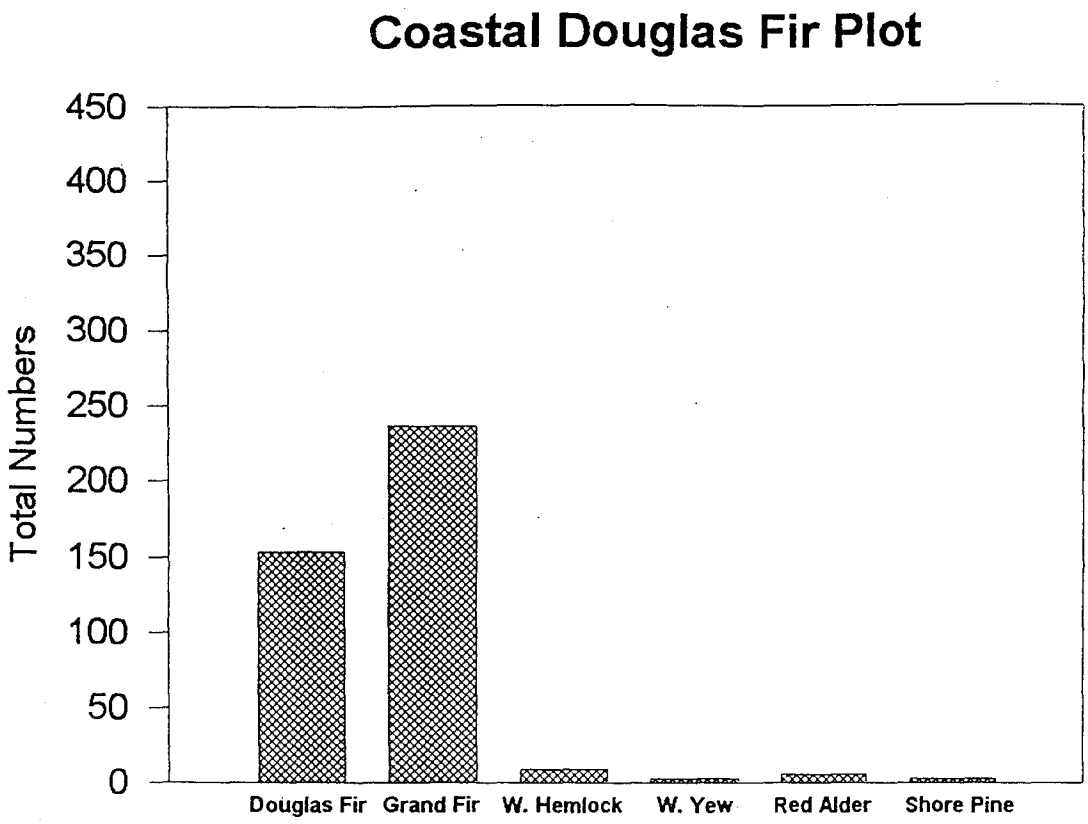
Plot 1, 1995
(all quadrats)

6/01/96 Diameter >=.04

Species		Number of Trees	Number of Stems	Average DBH(m)/Stem	Basal Area	Relative Density	Relative Dominance	Relative Frequency
Pseudotsuga menziesii		153	154	.656	62.877	35.50	73.08	29.49
Abies grandis		235	237	.263	21.868	54.52	25.42	32.05
Tsuga heterophylla		9	9	.174	.369	2.09	.43	8.97
Taxus brevifolia		2	3	.303	.263	.46	.31	2.56
Alnus rubra		5	6	.219	.259	1.16	.30	3.85
Pinus contorta		3	3	.312	.230	.70	.27	1.28
Holodius discolor		19	33	.058	.091	4.41	.11	16.67
Salix scouleriana		1	1	.276	.060	.23	.07	1.28
Amelanchier alnifolia		2	2	.096	.014	.46	.02	1.28
Prunus emarginata		1	1	.100	.008	.23	.01	1.28
Vaccinium parvifolium		1	1	.058	.003	.23	.00	1.28
TOTAL:	11	431	450	.229	86.041			100.00

Figure 8 Tree location map Plot 2 Garry oak 1996 Census





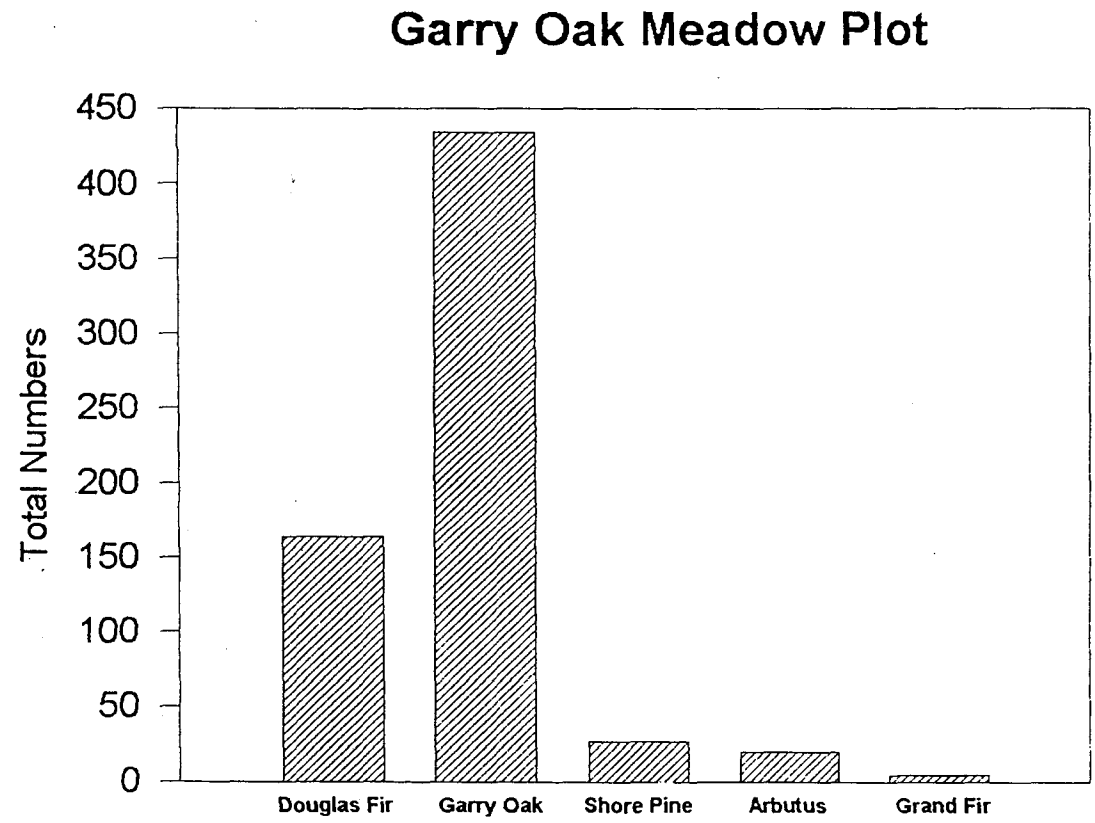


Figure 9 Graphs of total tree numbers by species for each plot

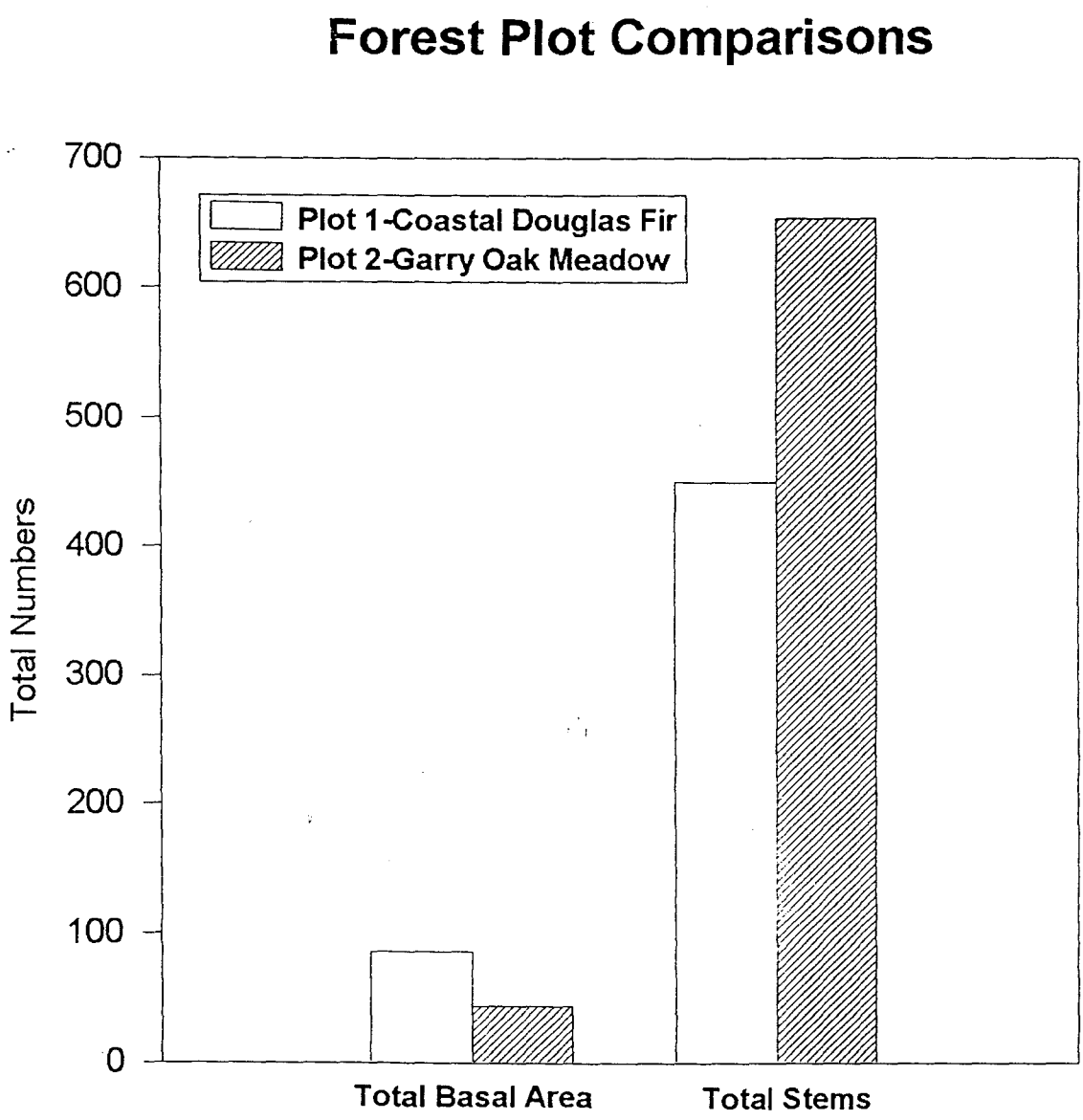


Figure 10. Rocky Point Forest Plot Comparisons

1. Since tree height and wildlife tree measurements were taken, this information should be incorporated into the BIOMON program analysis. Important structure information is lost through this omission in BIOMON.
2. Within the SI/MAB protocol there is no provision for collecting data on woody stems below 0.04 m DBH. Thus, there is no information collected on regenerating small trees or seedlings. My comments above regarding regeneration are merely descriptive. To detect patterns of forest recruitment in temperate forests, this information is vital. Possibly, B.C. Forest Service standard recruitment survey methodology could be used.
3. Since most of the diversity in temperate ecosystems is not contained within trees, but in the more inconspicuous bryophytes, lichens, and understory herbs, and the SI/MAB plots do not measure or account for understory species, the plots do not truly measure species richness. To better detect changes in temperate forest biodiversity, methods of conduct standard measurements for understory species should be incorporated.

The plots have provided an excellent tool for teaching students to conduct standard forest measurements and have provided an excellent venue for co-operative studies. I hope to continue with the work and find interested parties that may use the data to further our understanding of biodiversity in the Coastal Douglas Fir zone.

References

Dallmeier, F. J. and Comiskey. 1994. Methodology for the Establishment of Permanent Plots; Biodiversity Measuring and Monitoring Course 1994. Unpublished report of the Smithsonian Institution/ Man and the Biosphere Biological Diversity Program, Washington, D.C.

Meidinger, D. and J. Pojar. 1991. Ecosystems of British Columbia. Research Branch, Ministry of Forests, Victoria, B.C.

List of Figures and Appendices

Figures

Appendices

Note:

The appendices have been omitted from this Annual Report due to space limitations. This report appears in its entirety in the PFC Library.

Permit No:: P003-96

Title: Migration monitoring of neotropical landbirds.

Project Leader: Rhonda Millikin (604) 940-4669

Organization: Pacific Wildlife Research Centre
5421 Robertson Road
RR1 Delta V4K 3N2.

Location: South-eastern corner of CFAD Rocky Point, centred at Building 100.

Start Date: April 13, 1996

Completion Date: October 7, 1996.

Project Overview: Given the growing concern over large scale declines of forest songbirds, particularly neotropical landbird migrants, it is important to determine if a similar phenomenon is occurring in British Columbia. This is part of an international effort to establish a network of long-term monitoring stations. An important aspect to selection of appropriate sites is long-term tenure, proximity to volunteers, and concentration of migrants. Rocky Point meets all of these requirements and due to it's proximity to Pearson College, offers a unique opportunity to educate international students in a Canadian conservation effort.

Objectives:

1. To demonstrate, the importance of Rocky Point for neotropical migrants, using standardised techniques. The objective is to calculate an estimated total of migrants, by species and age, each census day. Annual changes in the estimated total migrants will help determine if populations are increasing or decreasing. This index is particularly important for species that breed and winter in inaccessible areas or are not effectively sampled by other means (eg. forest birds nesting on the West coast of Vancouver Island).

2. To substantiate population trends measured with diurnal methods (visual and mist-netting) by adapting existing radar technology to measure temporal and spatial aspects of migration patterns. Neotropical landbird migrants are primarily nocturnal migrants.

Accomplishments to Date:

a. Highlights:

We have established a field protocol for visual and mist-net sampling (see Shepard and Millikin in Baseline Inventories of Rare Species and Ecosystems of DND Properties of Southern Vancouver Island by Morgan). Peak migration dates are from March 15 to May 25 and July 20 to October 15. Two experienced people are required to properly conduct this sampling.

Results of the banding data were presented by Michael Shepard. There were again a core of 4 enthusiastic volunteers supporting the work co-ordinated by Michael. The capture rate at Rocky Point (0.3 birds per net hour) is consistent with other migration stations in British Columbia. See list of priority species sampled.

Protocols were also developed for the nocturnal data analysis, to include: a. VCR tapes for bird heights; b. acoustic data and c. acetate sheets (data sheets attached). A number of volunteers are helping out.

Seasonal and time of night activity patterns observed in 1996 were consistent with 1995. Migration activity was again greatest on nights with no wind or following winds. Birds were generally flying at 30kph and mainly below 500m.

b. Research Activities:

A trailer was established at the site to better house the electronic equipment and provide a year-round shelter for both the diurnal and nocturnal projects.

A second marine radar was adapted to a vertical format in order to provide information on the heights of migrant birds. This radar was donated to the project by Fisheries and Oceans. Both the horizontal and vertical radars were recorded simultaneously by video camera onto VCR tape to simulate a 3-D image of nocturnal flight of songbird migrants. The acoustic data were recorded onto the same VCR tape to link with the radar images.

A third marine radar, also donated by Fisheries and Oceans, was set up as a mobile unit at Dungeness Spit, on the Olympic Peninsula. The objective was to establish a site and volunteers for spring of 1997 to validate the reverse migration noted in fall at Rocky Point. This behaviour is thought to indicate the importance of a site for stopover during migration. A site was selected within the state Park and a group of volunteers will assemble on 19 March, 1997, for an introduction to the project and for training.

c. Extension and Demonstration:

Presentations were given to the B.C. Institute of Technology, Vancouver Natural History Society and the Royal Military College, Department of National Defence (DND), Kingston. A poster was presented at the American Ornithologist's Union and copies of this poster were given to the major funding agencies (Deputy Minister of Environment Canada, DND Headquarters, Fisheries and Oceans, B.C. Ferry Corporation and Cornell Lab of Ornithology). A Science Council presentation on this project was prepared for Brian Wilson, Director, Canadian Wildlife Service, Pacific and Yukon Region. An article was published in the 5-12 December Issue of the Georgia Straight highlighting this work. A portion of the acoustic data was submitted for publication in the Proceedings of the 1995 Cape May Partners in Flight meeting.

Permit No.: P005-96

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

Author: A.K. Mitchell, Ph.D. (604) 363-0786

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

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

Start Date: 1993

Completion Date: 1997

Project Overview:

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

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

Objectives:

1) To assist in the development of options for the *in situ* and *ex situ* conservation of Pacific yew.

2) To provide physiological and morphological indications of the stress tolerance of Pacific yew.

Accomplishments to Date of the Project

a) Highlights of findings

Activities in 1996 centered around detecting mechanisms by which environmental stresses are mitigated in foliage of Pacific yews. Preliminary measurements were made of foliar physiology and morphology on Pacific yews growing in natural stands at three locations on DND lands (Colwood Fuel Depot, Royal Roads, Rocky Point).

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

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

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

b) Research Activities

Plot maintenance
Plot maintenance at the three study sites (Rocky Point, Royal Roads, and Colwood Fuel Depot) consisted of ensuring that neutron probe soil moisture tubes were free of water and debris and re-installing protective plugs and covers to tubes that had been disturbed. Dendrometer bands were removed from the trees as they proved ineffective in measuring stem diameter growth increments. Increment cores were taken as a measure of tree growth and will be analysed using a digital dendrochronometer.

Physiological measurements
Photosynthesis was measured on male and two female trees at each site. Both current-year and 1-year-old foliage were analyzed using a portable infra-red gas analysis system (ADC-LCA2, Hoddesdon, England). Leaf areas (one side) of sample shoots were measured in the lab using a Delta-T system (Decagon Devices, Pullman WA). Chlorophyll Fluorescence was also measured current-year and 1-year-old shoots on male and female trees at each site using a CF-1000 (P.K. Morgan, Andover, MA). Samples were taken and foliar nitrogen concentrations of current-year and 1-year-old shoots were determined on all sample trees (18 trees).

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

Data Analysis
Data analysis is in progress using ANOVA and regression techniques. Means will be discriminated using multiple range tests.

c) Extension and Demonstration:

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

Publications (Scientific Journals; refereed):

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

Mitchell, A.K. 1997. Rooting cuttings of Pacific yew (*Taxus brevifolia*) from Vancouver Island locations. Northwest Science (in press).

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. (accepted).

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

Publications (Information Reports; refereed):

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

Prepared by:
A.K. Mitchell, Ph.D.
December 24, 1996.

Permit No.: P006-96

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

Author: Mr. N.N. Winchester Ph: (250) 721-7099
Department of Biology, Fax: (250) 721-7120
email tundrast@uvvm.uvic.ca

Organization: University of Victoria
P.O. Box 3020
Victoria, BC V8W 2Y2

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 old-growth 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 four years of study in the Carmanah Valley and two years of study at the Rocky Point canopy station support the theory that a unique old-growth 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 will offer an opportunity to see if the trends found in the Carmanah canopy study apply across a wide geographic region that include different ancient forest mosaics. These canopy studies represent the only 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. Present forestry practices have unknown consequences on this unique and diverse component of a coastal old-growth forest and we need to provide detailed information on these communities in order to ensure proper management of the resource.

Objectives:

I propose to document the community composition of the canopy and ground insect/arthropod fauna in this old-growth forest, correlate this with biogeoclimatic zone, and compare this community with the Carmanah Valley canopy project. 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 survivourship will be examined in the field to elucidate variables that contribute to the observed community structure.

Accomplishments to Date:

a) Highlights:

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

b) Research Activities:

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

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

Target taxa processed from these traps included the Asilidae (robber flies). Identifications were completed by Rob Cannings (RBCM). These specimens are currently being catalogued and stored. The Symphyta (sawflies) were sorted from the Malaise traps and sent to Dr. H. Goulet (BRD) where they are currently

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

c. Extension and Demonstration

Field research concentrated on the extension and demonstration of arthropod biodiversity. This aspect of the research program was facilitated by conducting tours and completing filming sequences at the Rocky Point research site. In conjunction with Dr. Micheal Dunn I am also spending time installing and getting the microclimate station up and running.

1) Presented two papers on aspects of the project at UNBC and Malaspina University (both were invited, departmental seminars.)

2) Submitted and have been accepted to give 3 papers on aspects of the project at the CBS, ESA, and Soil Ecology meetings.

3) 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.

Permit No.: P009-96

Title: Vertical Stratification in Forest Dwelling Bat Assemblages.

Project Leaders: Dr. R. Mark Brigham; Mr. Paul Bradshaw

Organization: University of Regina

Location: Churchill forest canopy site, DND Rocky Point

1996 Interim report: May 1 to November 1.

Project Overview:

The principle objectives of this study are as follows: to determine if functional links exist between bat morphology and old-growth forest habitat structure, and to examine the extent to which habitat structure, particularly vertical structure, dictates the distribution and composition of forest dwelling bat faunas. Recognizing that forest habitats represent roosting as well as foraging opportunities an additional objective is to examine the roosting requirements of bats in the study area. Old-growth forest typically consists of a broad spectrum of tree age classes which potentially provide a variety of roosting opportunities for bats. Thus habitat structure can provide a surrogate measure of the diversity of roosting spaces in a forest type and so, in turn, influence the composition of local bat faunas.

The 1996 objectives:

1. Assessment of vertical patterns of bat activity through echolocation call sampling in three coastal old-growth forest types on Vancouver Island, British Columbia, expanding and augmenting the 1995 sampling data.

2. Measure and compare differences in habitat structure (in particular vertical structure) between the three study sites, using a combination of techniques to quantify vertical and horizontal habitat complexity.

3. Determine if habitat structure is linked to faunal composition through analysis of vertical distribution patterns of morphologically distinct bat species groups and vertical forest structure in the three study sites.

4. Initiate a radio telemetry study to examine the roosting requirements of forest dwelling bats in the Carmanah study area.

5. Quantify the distribution and density of available roosting resources in the study area to enable the characterization of roost site requirements for bat species.

6. Determine vertical distribution and density patterns of nocturnal flying arthropods in the three study sites so that an understanding of the bat prey base can be developed.

1996 Work Schedule:

May 1 to September 1, data collection.

During this period sites will be visited on a two week rotation with a five night sampling block at each site in turn. During each sample night echolocation calls will be sampled using ultrasonic equipment along vertical transects within the forest. Nocturnal insect traps will also be positioned on vertical transects to sample flying insects at the canopy, understory, and shrub levels. Mist nets and other trapping techniques will be used on a nightly basis to determine local bat species compositions at each study site, and for the collection of echolocation reference calls. Bats caught in mist nets will be measured and weighed, those that meet the mass requirements will be out fitted with radio transmitters and tracked to roost sites. Identified roost trees and immediate surrounding area will be measured.

September 1 to November 1, data analysis and extension.

1996 data will be collated and analyzed. Preliminary findings will be presented at seminars and symposia at the University of Regina and the University of Alberta. Summary of activities for 1996:

1. Echolocation call sampling.

During the 1996 field season three forest types were sampled, augmenting the data collected in the 1995 season. Bat activity was sampled on a total of 65 nights using ultrasonic detectors and nylon mist nets. The sampling intensity (# of nights) per forest type was as follows:

Upper-Carmanah Watershed	-18 nights (44 detector nights)
Rocky Point	-18 nights (45 detector nights)
Bamfield	-19 nights (48 detector nights)

A total of 10 sample nights were lost due to equipment failure or adverse weather conditions. At each site (forest type) sampling trees were climbed by a professional arborist who attached pulleys to canopy level branches. Using these pulleys bat detectors (ultrasonic receivers/recorders) and insect traps could be raised, from the ground, to any height within the forest. Sampling resulted in a total of 2, 300 recorded bat call sequences and the collection of over 10, 000 insect specimens. At present we are in the process of analyzing the echolocation recordings using Anabat 5.2 software. The taxonomic segregation of the insect samples is partially completed, with an expected completion date of January 1997.

2. Mist netting and call reference library:

During the 1996 field season 76 bats, comprising 6 species, were captured in mist nets and harp traps. In descending order of number captured: Myotis lucifugus (Little Brown Bat); Myotis californicus(California Bat);Lasionycteris noctivagans (Silver-haired Ba; Myotis evotis/keenii (Western / Keen's Long-eared Bat); Myotis volans (Long-legged Bat);Corynorhinus townsendii (Townsend's Big-eared Bat) Captured bats were weighed, measured (i.e. standard wing and ear measurements) and held for approximately 1 hour in cloth bags so that fecal samples could be collected. Bats were then fitted with a small chemiluminesent tag (light tag) and released. Pregnant bats that appeared to be close to the end of gestation were released immediately after capture. Bats released with light tags were followed with ultrasonic equipment so that calls could be recorded. Recordings were later analysed and added to an echolocation call reference library that was initiated in 1995.

3. Radio telemetry and bat roost surveys:

A total of 5 bats were fitted with radio transmitters, all of them at the Carmanah study site. The low number of tagged individuals was due to mass restrictions based on the weight of the radio tag. Only bats whose body mass exceeded the 10% threshold (i.e. the radio tag was equal to or less than 10% of the bats body mass) were tagged. This resulted in 45 of the bats caught at the Carmanah Valley site being outside the weight restrictions. A total of 11 trees were located and confirmed as active roost sites (see table 1) Most notable from the radio tracking data is the use of several mature healthy Western redcedar (*Thuja plicata*) trees by a *Myotis Evotis/Keenii* female. Typically only dead or dying trees are used as roost sites.

Table 1:

Bat #	Bat Species	Roost Tree Sp.	Colony Size	Date of first emergence	Date of last emergence
1	M. californicus	Douglas Fir	1	2/June/96	12/June/96
2	M. californicus	Amabillis	3	15/July/96	18/July/96
2	M. californicus	Amabillis	8	21/July/96	22/July/96
2	M. californicus	Cedar	1	25?/July/96	26/July/96
3	M. californicus	Amabillis(same as bat 2 tree# 1)	3	15/July/96	21/July/96
4	M. lucifugus	Hemlock	5	06/August/96	08/August/96
4	M. lucifugus	Hemlock	6	09/August/96	09/August/96
4	M. lucifugus	Hemlock	4	10/August/96	10/August/96
5	M. evotis	Cedar	3	2 days	
5	M. evotis	Cedar	1	1 day	
5	M. evotis	Cedar	9	1 day?	

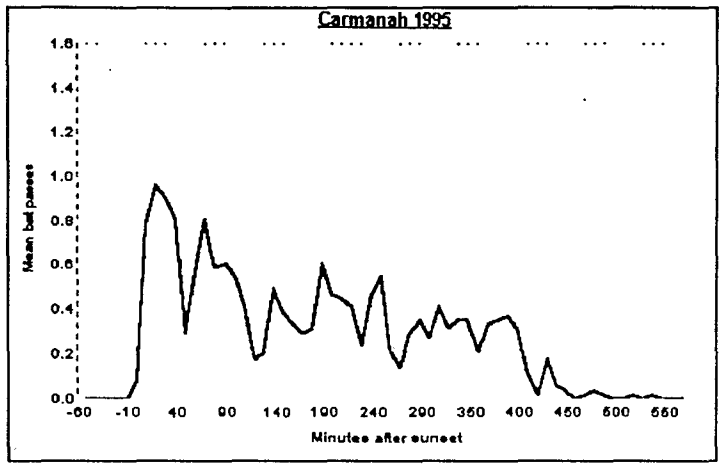
Six 20m x 200m strip plots were randomly placed within the study area. Within each plot all potential roost trees were measured using the same protocol for known roost trees. This resulted in a sample of potentially available trees with measurements that will be compared with confirmed roost trees using discriminate function analysis.

4. Nocturnal insect sampling:

Light suction insect traps were placed on the same vertical transects as the bat detectors, although on different nights to avoid any interference between the two sets of equipment. A total of 46 complete trap samples were collected at the Rocky Point site, 35 at Bamfield, and 24 at the Carmanah Valley study site. Samples were taken at the same elevational zones in the forest as the bat detectors were set at (i.e. canopy, understory, and shrub levels). The battery life confined sample periods to approximately 3 hours. This time frame enabled the traps to run throughout the most active foraging period, beginning shortly after sun set and ending approximately 2.5 hours later. There is, however, typically a secondary peek in

activity in the early hours of the morning (see fig. 1), this period was not sampled, although it is usually smaller (i.e. less intense) than the earlier activity peek.

Figure 1



5. Quantifying habitat structure:

Using a well established technique, vertical profiles of foliage density were constructed for all study sites. Using a 35mm SLR camera, with modified viewfinder, six profiles were measured at random points within nine random 15m radius plots at each study site. This resulted in a total of 54 random profiles that were used to determine mean foliage density for each of the three elevational sample points (canopy, understory, and shrub), and allow for comparisons between the different forest types. Within the nine random circular plots, established at each site, all stems with a diameter at breast height greater than 5cm were identified and measured. This provided data on the density and age class structure of the three forest types. It was found that these measures of horizontal habitat structure strongly influence patterns of vertical structure. For example the Douglas fir (Pseudotsuga menziesii) dominated forest at Rocky Point is characterized by an even age-class structure which results in a dominant canopy layer where most of the foliage is concentrated. In contrast the Western Hemlock (Tsuga heterophyll) forest of the Carmanah Valley has an uneven age-class structure and this results in a more even distribution of foliage with height, so that it is not confined to one stratum of the forest.

Extension activities:

Manuscripts resulting from all aspects of our research will, in due course, be submitted to peer reviewed journals, acknowledging all funding agencies. The M.Sc. thesis of P.A. Bradshaw (PAB) will be defended before the end of April 1997 The B.Sc. honours thesis of K. R. Hecker (KRH) was completed and defended in March 1996. A manuscript resulting from KRH thesis research has been submitted to The Journal of Mammalogy and is under review. Early findings of this research were published in the 'Proceedings of the 1st International Bats and Forests Symposium'. A presentation of some findings resulting from this research was made by (PAB) at the 'Four Corners Bat Symposium' in Durango, Colorado, in January 1996. The audience comprised of federal and state workers from wildlife departments, local volunteer groups, professional biologists, and university researchers. PAB presented data and findings from the 1996 season at a seminar in the University of Regina in November 1996. PAB will also present this research at the annual 'Prairie University Biological Symposium' to be held in Edmonton, Alberta, in February 1997.

In the future we plan to continue this strong commitment to the exposure of our research, and aim to reach as general an audience as possible. Further public talks are planned, and we will continue to give presentations at local schools and museums, and will readily accept invites from the media to talk about our research.

Permit No. P010-96

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

Project Leader: David Nagorsen (250) 387-2933

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

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

Start Date: 18 March 1996

Completion Date: 13 December 1996

Project Overview:

In 1993, a nursery colony of Townsend's big-eared bat (*Plecotus townsendii*) was found in the Command Post at Maryhill. A rare bat on the provincial Blue List, only four other nursery colonies are known for this species in BC. All are unprotected roosts in buildings. The three tunnels associated with gun emplacements at Maryhill are potential hibernacula for Townsend's big-eared bat. A survey of other man-made structures on DND properties in 1995 revealed that the Maryhill structures supported the only significant bat colony roosting in buildings and in 1996 the project focused on this site. To improve temperature regimes, increase accessibility for bats, and prevent human disturbance/vandalism the Maryhill roosts required various renovations that included installing secure locks and modifying their steel doors into "bat gates". Once these alterations were made, the Maryhill site would be the only protected roost of Townsend's big-eared bat in BC and it offered 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.

Objectives (1996):

1. Modify the tunnels and command post at Maryhill by cutting standard bat openings in their steel doors, cutting air vent openings in vertical shafts of tunnels, and installing secure locks on doors of the structures.

2. Install Optic Stow Away (Hoskins Scientific) data loggers in tunnels and command post to record continuous temperatures throughout the year.

3. Inventory the command post bimonthly from May to October to determine population, seasonal pattern, and parturition date for the nursery colony. Collect faecal pellets from floor of nursery colony to assess potential for diet study.

4. Inventory tunnels bimonthly throughout the year to determine the use of tunnels for roosting and hibernation.

5. Opportunistic investigations of any reports of bats using DND structures included reports of a nursery colony in an old farm building at Rocky Point.

Accomplishments to Date

a) Highlights of Findings:

A number of old structures on the DND lands are used as temporary night roosts but the only nursery colonies are the Townsend's big-eared bats in the old command post at Maryhill and a colony of about Yuma myotis (*Mytois yumanensis*) roosting in the joists of an old barn at Rocky Point. Most man-made structures on the DND lands evidently are not suitable for bat nursery roosts.

Sealing structures and converting the existing steel doors to "bat gates" was successful. At various times bats occupied the command post, tunnels #1 and #2 and building #1020; their only access was through the 15X50 cm openings cut in the doors.

Single, torpid Townsend's big-eared bats occupied tunnels in March and April and a single torpid individual was found in tunnel #1 on 5 January 97. However, no bats were found roosting in tunnels during the day from May-December. Tunnels are too cool (<17° C) for nursery colonies in summer. It is not clear why Townsend's big-eared bat has not accepted the tunnels for hibernation sites. Except during occasional cold spells, mean daily temperatures in winter may be too warm (>10° C) or temperature regimes may be too variable for hibernation.

Bats used building #1020 as summer night roost. and occasionally as a summer day roost for solitary males. No bats were found hibernating in this building October-December. Although the site is not used as a hibernacula, winter temperatures are within the hibernation range for Townsend's big-eared bat.Bats roosted in the command post from 2 April to early October. The nursery colony reached a

maximum population of 17 adults by early July; parturition (births) occurred between 12 July-2 August. The population build up of adults and parturition is correlated temperature profiles. Mean monthly summer temperatures in the nursery colony site (17-22° C) are about 3-4° C warmer than mean monthly ambient temperatures. Relative to daily ambient temperatures, daily temperatures in the roost are remarkably stable varying only 1-2° C.

Insect fragments from prey transported to the command post and faecal pellets collected under the roost can be used to study food habits.

Vandalism continues to be a problem at Maryhill. All door locks showed evidence of 'picking', several locks were damaged, and the door to tunnel #2 was bent presumably with a winch.

b) Research Activities:

Modifications to structures were made by DND contractors March 1996 with tunnel 3 left unaltered as a control. Locks were installed on doors 28 March.

Data loggers were installed 2 May. Ambient and temperatures in structures were recorded through December. Temperature readings from loggers were downloaded bimonthly and imported into Microsoft Excel.

Large samples of faecal pellets and insect fragments were collected from cloth sheets placed on the floor of the Command Post July and August. The feasibility of identifying prey remains was assessed by an entomologist.

Bimonthly inventories were done throughout the year to determine bat use of tunnels and command post bimonthly.

I also inventoried a reported bat colony in an old barn at Rocky Point

c) Extension:

No publications; CHEX TV did a news segment on bat conservation and the modifications to the structures.

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.

Permit No. P017-96

Title: Population Demographics of *Allium amplectens* Torr.

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

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

Location: CFMETR (Nanoose) Site

Start Date: May 13, 1996

Completion Date: December 31, 1996

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 amplectens* Torr.

Objectives:

To better understand the population dynamics of this rare species and therefore the proportional significance of the factors which contribute towards these changes such as its distribution, breeding biology, microhabitat preferences and environmental influences. Newly acquired information incorporating demographic and environmental stochasticity will be used to establish a predictive model of future population viability.

Accomplishments of the Project (at the CFMETR Site & elsewhere in British Columbia)

a) Highlights of findings to Date/Project

1. Several new sites of *A. amplectens* have been found in southwestern British Columbia. This optimistic finding needs to be tempered with the fact that over 3 times as many historical populations have not been relocated and a number of newly located populations are in extremely vulnerable sites.

2. Plants from all sites in British Columbia sampled to date are triploid; unlike populations in Oregon and California where tetraploids also occur. Tetraploids are thought to be outcrossers while triploids are thought to be apomictic.

3. Breeding work on a population south of Nanaimo resulted in plants which did not produce seed. This is inconsistent with current assumptions that triploid variants of this species are self fertile and capable of producing their own seed.

4. Being a clonal and ephemeral species plants often grow in very densely packed geographical locations with significant above ground parts for only a short period of the year often making them difficult to locate unless one is at the exact location at the appropriate time of year. This tight packing of all known individuals within geographically small areas makes populations susceptible to extirpation.

5. It is important that populations have a ready source of water each spring (underground spring?) for maximal development and reproduction although by mid summer most sites have become extremely dry.

6. Total numbers of flowering plants (bulbs) was down at CFMETR in 1996 from 1995. Although it is tempting to conclude this was a direct consequence of a reduced spring rainfall the previous year leading to a slower buildup of nutrient reserves for the subsequent years flowering the dataset is not large enough as yet to ascertain this.

7. A significant number of bulbs which flowered in 1995 did not in 1996 and visa versa. Of those which flowered in both years most produced a larger number of flowers.

b) Research Activities

Research activities at the CFMETR site during 1996 were restricted to counting total numbers of breeding plants, monitoring the life stages of *Allium amplectens* within permanent plots and observing the biotic and abiotic microhabitat characteristics of each population.

Breeding work was carried out on a population south of Nanaimo.

Information from the 1995 and 1996 datasets is now being incorporated into a Lefkovitch matrix model in order to analyze changes in the population structure during the first transition (from 1995 to 1996).

c) Extension and Demonstration

None

Permit No.: PO18-96

Title: Purple Martin Nestbox Program

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

Location: Colwood Supply/ Fuel Oil Depot

Start Date: March 1, 1996

Completion Date: October 1, 1996

Project Overview:

This site is one of only 6 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. Also with a larger, more stable population, we can start some research pertaining to life history, migration patterns, etc...

Accomplishments of the Project:

a) **Highlights of the 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.

An accurate count of returning birds was not made this year.

b) **Research Activities:**

There was no research done again on these birds. The 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.: P021-96

Title: Lester B. Pearson College Student Research

Project Leader: Garry Fletcher (250) 391-2411

Organization: Lester B. Pearson College of the Pacific
RR 1
Victoria, B.C. V9B 5T7

Location: CFAD Rocky Point - Pearson College Forest Canopy Research Station

Start Date: February 1, 1996

Completion Date: May 30, 1996

Project Overview:

Pearson College set up the Forest Canopy Research Station system as a response to the request of the Department of National Defence to promote research on it's properties. The facility, which consists of four trees with platforms and ladders , is available for work by some students or for collaborative projects with outside researchers.

Pearson College students are able to do research of a preliminary nature on flora and fauna of the area in the February to May period. The students will select a topic and carry out the data collection and analysis. This normally would not involve more than three students.

Objectives:

a) to provide students with research project opportunities; and

b) to enable students to assist other researchers in data collection and preliminary studies on fauna and flora of the area.

General Approach and Methodology:

The students will select a topic pertaining to what can be done around the Forest Canopy Research Station. The students will access the canopy site early in the year along with an appropriate faculty member or outside researcher who is providing advice. Data collection will be carried out by the student. Using this data and subsequent analysis, the student will prepare an extended essay report.

Accomplishments:

One student collected data and is preparing a report. The report is not available as of this date.

Permit No.: P022-96

Title: Training and Maintenance of Canopy Structure

Project Leader: Garry Fletcher (250) 391-2411

Organization: Lester B. Pearson College of the Pacific
RR 1
Victoria, B.C. V9B 5T7

Location: CFAD Rocky Point - Pearson College Forest Canopy Research Station

Start Date: January 1, 1996

Completion Date: November 15, 1996

Project Overview:

Pearson College set up the Forest Canopy Research Station system as a response to the request of the Department of National Defence to promote research on it's properties. The facility, which consists of four trees with platforms and ladders attached in the canopy was constructed in the spring of 1995. Three of the trees are in a group with the fourth tree separated from the group by about 100 meters. Access to the canopy is by means of a winch where one is hauled up to the platform which is about 30 meters above the ground. One tree in the group of three has a winch. Access to the other two is by means rope bridges which connect the three trees. The fourth tree has its own winch. Access further into the canopy is by means of ladders attached to the trunk. In order to maintain the facility and provide training for Pearson College students, year-round access is maintained.

Objectives:

a) to provide training and maintenance on the canopy system;

b) to provide students with research project opportunities; and

c) to enable students to assist other researchers in data collection and preliminary studies on fauna and flora of the area.

General Approach and Methodology:

Students and faculty of the Wilderness Service will access the canopy as needed for maintenance. Along with this goes the necessity for training a small group of both first and second year students. A team to run the system requires a faculty member and several students on the ground crew as well as several in the canopy. Normally, no more than 12 students would be on site. Operating protocol is strictly followed.

The Forest Canopy Research Station Operating Committee was organized to oversee the operation and maintenance of the facility. The committee developed an Operating Protocol and maintain a log on the operation of the facility. The committee ensures that annual inspections of the facility are done and that the facility is maintained.

Accomplishments:

During the year the facility was used for training and was used by two projects - filming for Neville Winchester's project and for a Pearson College project. The Microclimate station was installed in the facility.

The facility was accessed 12 times during the year by 91 people.

The facility was serviced on March 13 and 14 and was inspected on September 6.

Permit No.: P023-96

Title: Bioclimate Monitoring Station

Author: Michael Dunn / Neville Winchester

Organization: Pacific Wildlife Research Centre
University of Victoria, Biology

Location: Rocky Point - Church Hill Forest
Canopy Research Site

Start Date: March 1-3, 1996 (Installation)

Completion Date: Ongoing

Project Overview:

Install and operate a microclimate station in association with the forest canopy research station and the Smithsonian Forest Biodiversity Plot. Instrument array will be at various elevations on Tree #1. Sensor will record temperature humidity and insulation through the canopy to below the soil surface (temperature only). An automated, self-tripping rain gauge has also been installed. In situ data logger has been installed at base of tree.

Objectives:

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

Accomplishments to Date:
After the initial installation of early March 1996 (a complete set of sensors was not sent in original shipment), most of the year has been spent trouble-shooting the sensor array and downloading the data logger. Subsequently, the station has not been fully operational over this period and still requires some work (two of the installed sensor in the canopy appear to be malfunctioning). Only one 18 day data record has been recovered over the period and no further analysis has been done. Over the next year objectives are to get the station fully operational, secure a reliable method to field download the data logger on an 18 day cycle, and identify a custodian to regularly download the data logger and provide database outputs of the raw data.

Permit No.: P024-96

Title: Sharp-tailed Snake Inventory Within the Coastal Douglas Fir Biogeoclimatic Zone, June - November 1996.

Author: Christian Engelstoft, (250) 652-9770)

Organization: Alula Biological Consulting 1967
Nicholas Road, Saanichton, B.C. V8M 1X8,

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

Start Date: June 1996

Completion Date: 15 November 1996

Project Overview:

Little is known about the biology and distribution of the sharp-tailed snake, a species red listed by the Ministry of Environment. A project to learn more about the snake has been proposed to the Habitat Conservation Fund and Forest Renewable British Columbia.

Because this project can compliment the biodiversity projects on the DND, and because there is a possible sighting of sharp-tailed snake from this area, the DND land is an important area of the larger sharp-tailed snake inventory project planned for the Coastal Douglas Fir Biogeoclimatic zone (See attached proposal).

Proposed research methods include searches for sharp-tailed snakes under natural cover objects such as rocks and logs. As well, research plots with artificial cover objects (corrugated roofing tin sheets approximately 1x1 m in dimension) will be established. The latter is to minimize impact on the habitat. The period for the project will depend on funding, but a minimum of two months is planned for either the spring or fall of 1996. A report will be submitted at the end 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 to Date/Project

- Developed a better understanding of Sharp-tailed Snake's habitat requirements.
- The limited data suggest that Sharp-tailed Snakes have a increased activity in September and early October. Extended the known activity season from 26 September to 9 October.
- Found a new location inhabited by Sharp-tailed Snake on Saltspring Island.
- Found that tar roofing paper is a cheap and efficient material for artificial cover object.

b) Research Activities

The two methods utilized in this project were time-constraint searches (TCS) and establishment of artificial cover object (ACO) plots. The TCS method was used to search different potential Sharp-tailed Snake habitats throughout the study area. The ACO method was used in area where Sharp-tailed Snakes had been found as a way to survey that area repeatedly with little habitat modification. No Sharp-tailed Snakes were found on the DND property, but a total of 8 snakes were found on Saltspring and North Pender Islands.

c) Extension and Demonstration

Following abstract was appeared in the and a presentation was given during the meeting.

Program and abstracts of the First Annual Meeting of the Working Group on Amphibians and Reptile Conservation in Canada, University of Calgary October 5 - 7, 1996.

Title of talk: **Sharp-tailed Snake (Contia tenuis) surveys in south-western British Columbia.**

The Sharp-tailed Snake exists at the northern limits of its distribution in southern British Columbia and is on the provincial Red List. In June 1996, a project was begun on behalf of the Ministry of Environment, Lands and Parks to investigate the distribution and habitat use of the Sharp-tailed Snake on southern Vancouver Island and the Gulf Islands, where most of the previous sightings took place. The project is funded by Forest Renewal BC and approved in principle for 3 years. The methods to date have consisted of conducting time-constrained searches in likely habitats and establishing transects of artificial cover objects (ACO's) near sites with previous Sharp-tailed Snake sightings. The materials used for the ACO's were chipboard, tin roofing and asphalt roofing. Two Sharp-tailed Snakes were found in a garden on North Pender Island, bringing the total number of confirmed sightings in the province to 14. The ineffectiveness of the methods in locating Sharp-tailed Snakes in their natural habitats may have been partially due to unfavourable weather (hot and dry) during most of the survey period. The main result of the project to date has been information on distributions of amphibians and other reptiles, such as the Northern Alligator Lizard (Elgaria coerulea) and Long-toed Salamander (Ambystoma macrodactylum), on the Gulf Islands.

Permit No.: P030-96

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, BC V8Z 1M5

Location of study sites: Nanoose TX and CFMETR

Start Date: April 1 1996

Completion Date: Continuing

Project Overview:

Spruce weevil is the most damaging plantation pest of spruce throughout the province. No satisfactory way is known to manage the insect, to prevent multi-million dollar losses . In 1989 a small area of spruce was planted at Nanoose TX and CFMETR with one objective of using these spruces to study management techniques for the spruce weevil. The trees have now grown sufficiently that the weevil has started to attack and damage them. The time is 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, Eubazus semirugosus, well known to attack Pissodes weevils but no other species of insects. As we expected when the trees were planted in 1989, this type of parasite has not so far found these isolated groups of trees naturally, meaning we can clearly measure the impact of the parasite when we introduce it. The two DND sites are thus particularly well suited to this work because they are isolated from other spruces making it difficult for spruce-dwelling insects to move in and out, which would complicate our observations.

Objectives:

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

Accomplishments to Date:

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

A widespread natural infestation of Pissodes strobi is now underway on the Picea sitchensis planted in 1989. The leaders of many trees have been killed, and we expect that all trees will be attacked by Pissodes strobi in the next few years. Our studies indicate the Pissodes strobi population to be healthy and in a vigorous stage of expansion. Parasites introduced into sleeve cages surrounding ovipositing weevils at the tops of trees, lived for at least 2 weeks, and appeared to lay eggs through the bark of the tree into the eggs of the weevil.

b) **Research Activities:**

Research activities were limited to enclosing weevils and parasites in sleeve cages at the top of spruce trees, and assessing the egg-laying capabilities of the weevil.

c) **Extension and Demonstration:**

None

Permit Number : **P031-96**

Title: Study of the impact of acorn feeding insects on the Garry oak ecosystem in the southeast Vancouver Island area.

Project Leader: Doris Rohlfs

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

Start Date: June 1996

Completion Date: December 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 Great Victoria area. Garry oaks are restricted primarily to the southeast tip of Vancouver Island and the southern Gulf Islands. Because of the poor regeneration of the Garry oak there is interest in the insects that infest and damage 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; AliNiazee, 1980).

The value of the Garry oak landscape to society is now being recognised and appreciated and the Victoria City Council adopted a resolution identifying the historical and ecological significance of the Garry oak ecosystem. Garry oak has been referred to as "our foundation native species". Not only is Garry oak a unique species, but the Garry oak ecosystem has a high concentration of rare plant species when compared to the rest of the province. Garry oak ecosystems have been identified as "hot spots" of biological diversity (Erickson, 1993). The decline of Garry oak trees would inevitably result in a shrinkage of its ecosystem and a decline in the other rare species in this unique ecosystem. Research on insect pests of Garry oak is therefore required.

Objectives:

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

This project has five specific objectives:

1. Determine the proportion of Garry oak acorns infested by the filbert weevil and the filbertworm

2. Determine:
   a) the life history of the more abundant species of these two insect pests
   b) identify parasitoids, if any, of this insect and
   c) determine the role of the parasitoids in regulating the pest populations.

3. Investigate the relationship between acorn size and infestation rates.

4. Determine the proportion of the infested acorns that can germinate into viable seedlings.

5. Determine the life history of the second, less abundant species of Garry oak acorn attacking insect.

Accomplishments to Date

a) Highlights of findings to Date

A total of 727 acorns were collected from Mary Hill and Rocky point in the 1996 summer and fall collections. At Mary Hill, 300 acorns were collected by pole prunner from 15 trees (x = 20) (Table 1) and 40 acorns from the 9 seed traps (y = 4.4) (Table 2). At the Rocky Point location, 290 acorns were collected by pole prunner from 15 trees (x = 19) and 97 acorns from the 11 seed traps (y = 8.8).

All the acorns were processed to determine percent infestation. Although the 1996 data has not been calculated to date, preliminary results from 1995 have shown that approximately 46% of Garry oak acorns are infested with the filbert weevil and/or filbertworm. Of this 46%, 45.5% were infested with the filbert weevil and 40.2 with the filbertworm. 14.3% of the infested acorns contained both the filbert weevil and the filbertworm.

b) Research Activities

i) SAMPLE COLLECTION

Research activities included collecting acorns by seedtraps and pole prunner. Seed traps are constructed with a wire basket and a plastic insert with a fibreglass bag. Each trap has a collecting surface area of $0.25m^2$. The traps are staked into place with a 1.8m metal stake. Two traps will be placed under each of the sample trees. There are 32 traps at both Mary Hill and Rocky Point. Collections will be made twice a week from the beginning of August until the end of November. Pole prunners were used to collect acorns from 15 sample trees at each location by snipping the acorns from the tree.

ii) SAMPLE PROCESSING

All the collected acorns will be taken back to the Pacific Forestry Centre (PFC) and dissected to determine the percent of acorns infested by the filbert weevil and filbertworm. This will be determined by using a guillotine type knife to section the acorns. All the sections of the kernel will be examined for the presence of insect infestation and amount of feeding damage. All larvae were removed from the kernel and preserved in alcohol for measuring head capsule size. A portion of the acorns will be x-rayed to determine infestation levels without destroying the acorn to allow for the emergence of the insects form the infested acorn.

Insect feeding and damage will be estimated using the scale (0-6) developed by Swiecki *et al* .(1991) where 0 = no damage and 6=>97.5% damage. The percentage intervals in this scale are pre-transformed (Little and Hills, 1977) using the arcsin transformation, which permits analysis by parametric statistical techniques without further statistical analysis.

Rating	Percent interval	Interval midpoint (pct)
0	none visible	0
1	trace to 2.5	0.6
2	>2.5 to 20	9.5
3	>20 to 50	34.5
4	>50 to 80	65.5
5	>80 to 97.5	90.5
6	97.5	99.4

c) Extension and Demonstration

None to date.

References:

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

Erickson, W. 1993. Garry oak ecosystems. Province of British Columbia, Ministry of environment, Lands and Parks. pp. 5.

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

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

Permit No.: PO32-96

Title: Establishment and Monitoring of plots in the Garry oak Ecosystem: Restoration and Monitoring Program

Project Leader: Richard J. Hebda, Ph D. 250-472-4569

Organization: Restoration of Natural Systems
Sedgewick C171
University of Victoria
P.O. Box 1700
Victoria, B.C., V8W 2Y2

Start Date: June 22,1996

Completion Date: December 31,1996 (Permit)
March 31, 1997 (Project Completion)

Project Overview:

Garry oak-meadow ecosystems are among the rarest and most threatened in Canada. The invasion of exotic plant species is a serious problem in remnant Garry oak communities. The Rocky Point and Mary Hill DND properties provide excellent sites for characterization and long term monitoring of Garry oak communities. They also provide an opportunity to test the effectiveness of removal of exotic species on the recovery of this threatened ecosystem.

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 plant species and monitor the effects of removal.

Accomplishments to December 31,1996 of the Project:

a) Highlights of findings to December 31,1996
Shallow soils on rocky high relief sites appear to support a greater diversity of native plant species than deeper soils in gentler slopes.

Rocky sites contain deep pockets of soil with black A horizons extending 50-75 cm or more below the surface and reaching bedrock in some instances. This observation suggests that Mary Hill has been a Garry oak-meadow site since deglaciation, supporting the argument that this unique plant association has had a long and stable history. Its distinctness persistence and limited occurrence indicate that it is of national significance.

Less mass of broom occurs on rocky steep sites and it is easier to remove than from deeper soils on gentler slopes.

A team of 5-10 people can effectively remove broom and other exotic shrubs from a 100 m^2 quadrat in about 1-11/2 hour.

A colony of one of Canada's rarest mosses (Bartramia stricta) was discovered in one of the monitoring quadrats. The only other known population is at Nanoose Hill near Parksville, Vancouver Is. Nearest U.S. populations occur in Califomia and Idaho.

b) Research Activities
Detailed plant species cover data were obtained in June for 6 100 m^2 quadrats (trees and shrubs) and 60 1 m^2 quadrats (shrubs, herbs and bryophytes) at Mary Hill.

The three rocky knoll sites were revisited in December and cover data for the 1 m^2 units was estimated again. At the same, time detailed estimates were made for bryophytes and lichens and collections were made for critical determination.

Comprehensive physical and chemical data were obtained for selected soil samples from the study sites. The classification of these soils is being investigated.

c) Extension and Demonstration
Project activities were integrated into University of Victoria Course ER 312a Field Study, a compulsory parts of the Diploma and Certificate requirements in the Restoration of Natural Systems Program. The 18 students recorded data on standard Province of B.C. vegetation, site and soil description sheets.

Field and close-up photographs of bryophytes mainly from the Mary Hill site are being compiled into an illustrated key with the support of biodiversity funds from the Canadian Wildlife Service.

Permit Number: PO33-96

Title: Status Report on the Apple Moss *Bartramia stricta* Brid. In Canada

Project Leader: René J. Belland (430) 987-3054

Organization: Devonian Botanic Garden, University of Alberta, Edmonton. T6G 2E1.

Location: CFMETR (Notch Hill portion)

Start Date: September 23, 1996

Completion Date: December 31, 1996.

Project Overview:

Notch Hill is the only known site for the moss *Bartramia stricta* Bridel in Canada. This small plant is on the British Columbia Conservation Data Center S1 list and is considered "Critically imperiled because of extreme rarity (5 or fewer extant occurrences or very few remaining individuals) or because of some factor(s) making it especially vulnerable to extirpation or extinction". The species is included on the British Columbia Ministry of Environment (MOE List) "Red List", making this moss a candidate for legal designation as endangered. The nearest populations to the CFMETR site is in northern California.

Objectives:

The current project documented the habitat, reproductive status, and population status of *Bartramia stricta* at Notch Hill.

Accomplishments of the Project

a) Highlights of Findings of the Project

Fifteen patch groups (183 patches in all) of *Bartramia stricta* were found, varying in total size from 4 cm^2 to 7250 cm^2. The total size of all patches was about 1.5m^2.

Six of the groups found has sporophytes, suggesting that the species produces spores regularly.

Bartramia stricta is most common on somewhat exposed humus rich soil, and occasionally on exposed rock outcrops.

b) Research Activities

Research activities were limited to photographing the species habitat, measuring plant population sizes, describing micro-habitat, and documenting spore production.

c) Extension and Demonstration

Status report to be submitted to Committee On the Status of Endangered Wildlife In Canada (COSEWIC).

Permit No.: P034-96

Title: Royal Roads University Biodiversity Monitoring Plots

Project Leader: Dr. Bill Dushenko, Professor (250) 391-2580

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

Location: Royal Roads

Start Date: October 3, 1996

Completion Date: November 30, 1996 (to be on-going)

Project Overview:

The project involved the set up and preliminary assessment of two long-term ecological monitoring plots on the Royal Roads property. This property contains a rare, and potentially-threaten 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 set up the plots, determine the information to be obtained, 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 conserving the natural ecosystems occurring on the Royal Roads property.

Objectives:

1. Provide a learning environment for RRU students on the measurement and study of biodiversity in different ecosystems;

2. Provide RRU students with a first hand understanding of biodiversity and interactive relationships existing within ecosystems, and the importance of conservation;

3. Develop long-term ecological monitoring objectives for the Royal Roads property; and

4. Demonstrate the importance of conserving ecosystems at Royal Roads for teaching, experimental, and research purposes.

Accomplishments of the Project to Date

a) Highlights to Date:

Since the project was initially set up as a teaching and research tool for the students, the findings reported here focus on the collective learning experience of the class. One "real life" challenge encountered by the students was the quality assurance/quality control of the data being collected in the field by 10 different teams spread across the two plots. Since not all of the data was always obtained consistently between teams, each individual student was required to carefully review the database and select information from the overall data set which they deemed to be reliable. Time constraints, exacerbated by poor weather conditions at times, were also placed upon the students given the short period of time (5 weeks) provided by the education module to execute the project and complete their research reports. Another factor included minimizing potential impacts during the collection of information from the plots. These factors required careful planning, problem-solving, time management and coordination on the part of the working teams and individual members. For some 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 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.

b) Research Activities

The two monitoring plots measuring 1 ha each were set-up using methodology similar to that described under the SI/MAB (Smithonian 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 quadrants 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 quadrants 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 quadrant 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.

c) Extension and Demonstration

In addition to reports submitted by the students 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 ecological monitoring (plot) project will be 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 will be set up and maintained by current and future students in the RRU Environmental Sciences Program.

d) Future Directions

It is planned that the ecological monitoring project 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. The existing plots will be re-surveyed and rebar stakes marked and erected to permanently delineate the plots and facilitate their relocation in subsequent years. Trees and saplings will also be permanently marked, using aluminum tags, and mapped for future identification. Surveying will also be extended to include soils (i.e., coring profiles and soil zoology), epiphytic plants (i.e., moss), invertebrates (including insects), and wildlife. Since the current plots represent edges or ecotones of the larger Coastal Douglas Fir Biogeoclimatic Zone, an additional monitoring plot will be set up in one of the older, more-buffered interior forest areas on the property as a basis for comparison. Continued permitting for the existing project and addition of the third interior plot on the property will be sought from ESAC.

Current plans are also underway to set up a weather/climate monitoring station at Esquimalt Lagoon near the saltmarsh (Plot 2) on the property which will allow the opportunity to correlate long-term ecological and biodiversity changes with climate. It is anticipated that this will be followed by the set-up of additional stations at other monitoring plots on the property along with instrumentation to sample and monitor atmospheric chemistry - particularly acid-generating precipitation and atmospheric contaminants. Information of this nature would be valuable in assessing the relative effects of anthropogenic impacts on the ecosystems and selecting appropriate ecological indicators.

Some additional long-term goals include the setup of a canopy study area at Royal Roads 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 current objectives of EMAN.

Permit No.: P035-96

Title: Genetic Diversity in Garry Oak

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

Organization: MDM Forgene/FTB Forest Tree Beginnings

Location: CFMETR/Mary Hill Battery

Start Date: November 1 1996

Completion Date: December 31, 1998

Project Overview:

Garry oak is BC's only native oak, yet nothing is known about its genetic variation. The results of this work may help authorities at all levels assess the need to preserve local populations in view of the patterns and degree of genetic variation found in this research.

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

There are no reportable findings as the project began in November 1996.

b) Research Activities

Garry oak vegetative bud samples were collected on December 6 at CFMETR, and on December 20 at Mary Hill Battery. At each site 6-10 buds, scattered around the lower crowns, were removed from 30 trees. This material, plus similar collections from up to 20 other locations, will be refrigerated (0-1?C) until laboratory work, comprising extraction and analysis of isozymes, begins early in 1997.

c) Extension and Demonstration

None