Department of National Defence— CFB Esquimalt

Environmental Science Advisory Committee

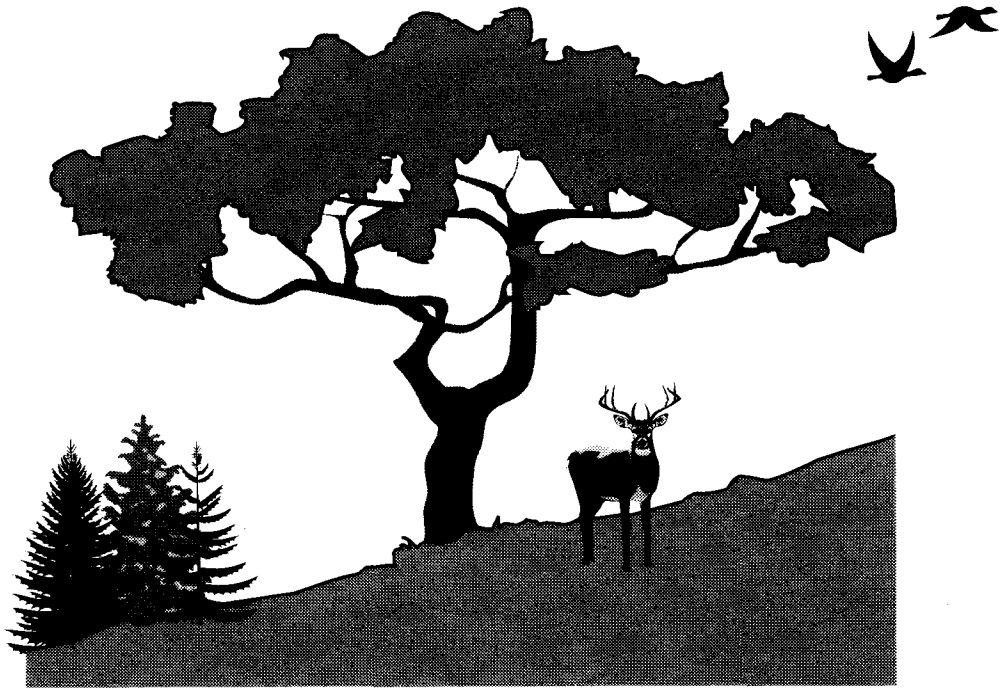
REPORT

1995 Annual Report

Prepared for the Committee by:

Arthur Robinson
J. A. Trofymow

April 1996



Natural Resources Canada
Canadian Forest Service

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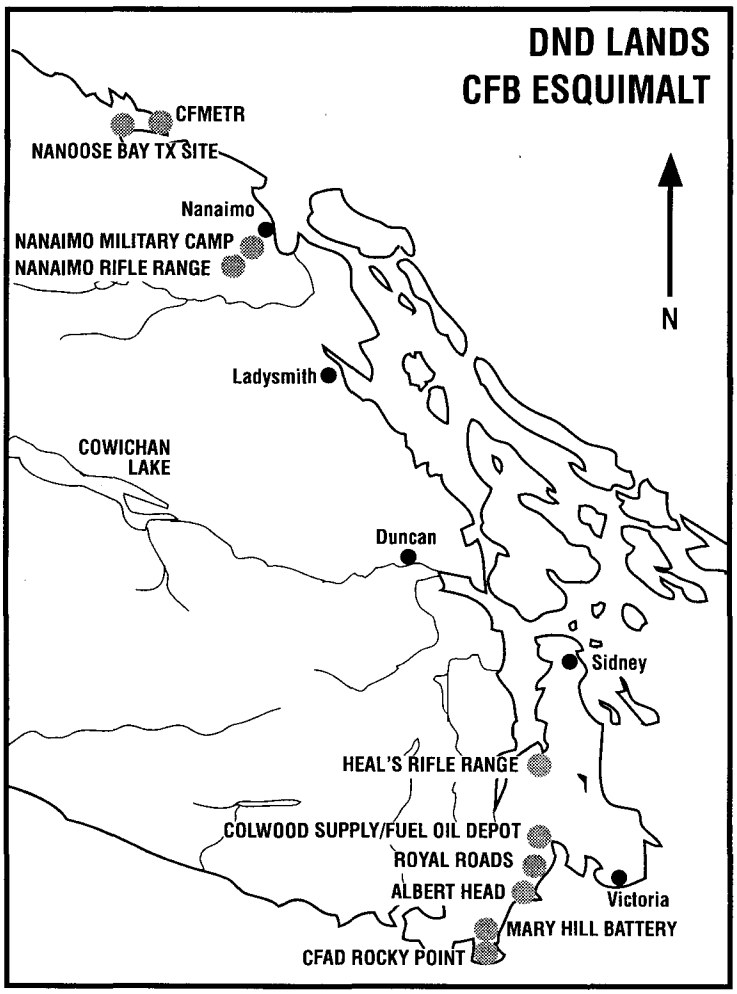
Canada

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



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Victoria, BC V8Z 1M5

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

Table of Contents

DND Environmental Science Advisory Committee - CFB Esquimalt

1995 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 1995 a total of 22 proposals were received and 20 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 cosponsored two workshops during the year. One sponsored jointly by the committee and Environment Canada was open to all project proponents who had done research on DND lands during the year. The other was held at the Pacific Forestry Centre and was for the project proponents who had conducted work under a joint proposal coordinated by the Canadian Wildlife Service and funded by DND Headquarters.

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 1995 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.

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 and the B.C. Ministry of Forests with the responsibility of providing professional expertise, advise and supervision of research being conducted on CFB Esquimalt properties. The Terms of reference for this committee is given in Appendix 1A.

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 and safety and maintenance of the station.

Terms of reference for the committee and operating protocol are given in Appendix 1B.

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.

A more detailed description of the permit system is given in Appendix 1C. 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 cosponsored two workshops during the year. One sponsored jointly by the committee and Environment Canada was open to all project proponents who had done research on DND lands during the year. The other was held at the Pacific Forestry Centre and was for the project proponents who had conducted work under the joint proposal coordinated by the Canadian Wildlife Service and funded by DND Headquarters. Further details on results from these 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 2.

4. Research Projects on DND Esquimalt Properties Prior to 1995

Prior to the establishment of the formal research permit system in 1995 a total 12 environmental research projects had been just completed or were underway or on DND properties (Table 1). Seven of the projects continued as permitted projects in 1995 and annual or final reports for them are contained in Appendices 4 and 5. References to project reports completed in 1994 are provided in Appendix 2.

5. Research Projects on DND Esquimalt Properties During 1995

This past year, 1995, was the first full year of activity for ESAC which received a total of 22 proposals for research on CFB Esquimalt properties. Table 2 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 22 proposals received, only 20 were approved and received permits. The status of these 20 approved proposals is shown in Table 3. 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. Canadian Wildlife Service Workshop - As a result of discussions in December, 1994, between DND and CWS, eleven studies were set up to inventory rare species/ecosystems on DND properties on Southern Vancouver Island. Several of the projects were subcomponents of larger, ongoing studies taking place on certain DND properties.

In late July, 1995, the project members met at the Pacific Forestry Centre (Canadian Forest Service) in Victoria to present the results of their studies; and to make recommendations for managing the properties in terms of their conservation values. A report titled "Baseline Inventories of Rare Species and ecosystems of Department of National Defence Properties of Southern Vancouver Island" was compiled by K.H. Morgan. This report summarizes the results and the management recommendations arising from that workshop. The individual submissions to the report are presented as part of Appendix 4.

B. Joint ESAC/EMAN Workshop - In November of 1995 at Work Point, CFB Esquimalt, Victoria, the ESAC sponsored a joint workshop with Environment Canada Environmental Monitoring and Assessment Network. Research project proponents were invited to present the results of their studies on DND lands. Thirty four proponents and others attended the workshop (Appendix 3). Eleven presentations were made and final and annual reports from these presentations are included in Appendix 4 and 5.

C. Forest Canopy Research Station Activities - The Facility was accessed on 36 occasions during the year. The facility was used by two projects - Neville Winchester's (university of Victoria) and Mark Brigham's (University of Regina).

6. Outlook for 1996

The committee will continue its activities in 1996 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 and will be helping coordinate inputs into the translation and development of map based information onto a GIS based product. The latter 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.

TABLE 1 **RESEARCH PROJECTS UNDERWAY ON DND PROPERTIES - BEFORE 1995** **31 December 1995**

AGENCY	PROJECT	PROPONENT	CONTACT	DESCRIPTION	LOCATION	STATUS
Canadian Forest Service	In Situ Physiological Studies of the Pacific Yew	Al Mitchell	Tony Trofymow	Physiological research began in May 1993 examining the response of Pacific Yew to exposure. Photosynthesis, tree water status and other physiological parameters are being measured, plus environmental data on soil moistures.	RP, RR, CFOD	New Proposal
Royal B.C. Museum	Amphibian and Reptile Population Monitoring	Stan Orchard	Ken Morgan	Detailed long-term amphibian and reptile population monitoring. Pools are mapped out and surveyed for plant and animal communities.	RP, MHB	New Proposal
Canadian Wildlife Service	Garry Oak Seedling Establishment	Pam Krannitz	Ken Morgan	Garry Oak seedling survival project initiated in 1993. About 3000 seedlings have been tagged and measured. Remeasurement to be done.	RP, MHB, CFMETR	New Proposal
Canadian Wildlife Service	Bi-weekly Bird Surveys	Ken Morgan, Bruce Whittington	Ken Morgan	Bi-weekly bird surveys in old growth begun in 1993.	RP	New Proposal
Canadian Wildlife Service	Migration Monitoring of Bird Populations	Rhonda Millikin	Ken Morgan	Migration monitoring of bird populations.	RP	New Proposal
University of Victoria	Forest Canopy Arthropod Sampling	Richard Ring, Neville Winchester	Neville Winchester	A sampling program for arthropods, looking at arthropods from the forest floor to the canopy (utilizing the Forest Canopy Research Station). Focus is on taxonomy survey and relationships to habitat.	RP	New Proposal
Individual	Snail Study	David Boag	Don Beamish	Study of slugs and snails.	HRR	Existing permit to 1997

TABLE 1 (CONT'D) RESEARCH PROJECTS UNDERWAY ON DND PROPERTIES - BEFORE 1995

AGENCY	PROJECT	PROPONENT	CONTACT	DESCRIPTION	LOCATION	STATUS
University of Victoria	Classification and Interpretation of Garry Oak Plant Communities	Wayne Erikson	Andy MacKinnon	Two parallel projects. The classification and interpretation of Garry Oak plant communities in southwestern B.C., and wildlife habitat and classification for Garry Oak ecosystems. Data has been collected from a large number of ecological plots.	RP, MHB, CFMETR	Progress report received. Final report due in December.
Canadian Forest Service	Ecological Assessment of DND Properties	Madrone Consultants	Tony Trofymow	Classify and map the natural ecosystem of five sites within CFB Esquimalt.	MHB, AH, RP, NTXS, CFMETR	Report in PFC library
Western Canada Wilderness Committee Malaspina College	Ecological Assessment of Nanaimo Rifle Range	WCWC	Don Beamish	Classify the natural ecosystem of Nanaimo Rifle Range.	NRR	Still underway
Department of Highways	Nanaimo Bypass Study	Department of Highways	Don Beamish	Assessment of ecosystems and rare species that may be affected by the Nanaimo Bypass.	NRR	Report on file at DND
B.C. Ministry of Forests	Sensitive Ecosystem Mapping	Peggy Ward, Chris Clement	Andy McKinnon	Assessment and mapping of sensitive ecosystems.		Report in PFC library

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

TABLE 2 **FORMAL RESEARCH PROJECT PROPOSALS FOR DND PROPERTIES - 1995**

PROPOSAL #	AGENCY	PROJECT	PROPONENT	CONTACT	DESCRIPTION	LOCATION
95-1	BC Wildlife Tree Committee	Survey of Wildlife Dependent Species	Stewart Guy	Tony Trofymow	To gain information and build baseline data on wildlife tree uses in old growth stands on Rocky Point.	RP
95-2	Royal B.C. Museum	Bat Inventory - DND Lands	David Nagorsen	Garry Fletcher	To conduct bat inventories on structures on the Mary Hill property, and to monitor for hibernating populations.	MHB, AH, RP
95-3	Lester B. Pearson College	Student Extended 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 area.	MHB, RPPC
95-4	BC Ministry of Environment	SI/MAB Ecological Monitoring Plots	Trudy Chatwin	Mike Dunn	To establish long-term ecological monitoring sites to gain information on species composition, location, density, and frequency for all woody species.	RP, RPPC
95-5	Canadian Wildlife Service	Migration Monitoring - Landbirds	Rhonda Millikin	Ken Morgan	To demonstrate, with data, the importance of Rocky Point for neotropical migrants, and to calculate an estimated total of migrants, by species and age, each census day.	RP
95-6	Canadian Wildlife Serv.	Birds Surveys of Old Growth	Ken Morgan	Ken Morgan	To investigate the seasonal variability in species composition and numbers of birds at Mary Hill.	MHB
95-7	Canadian Forest Service	Ecological Assessment	Doug Pollard	Tony Trofymow	To produce detailed maps showing the distribution of the main vegetation communities, and to prepare recommendations for conservation measures at Royal Roads.	RR
95-8	Canadian Forest Service	Sustainable Development of Taxol	Al Mitchell	Tony Trofymow	To monitor physiological responses of Pacific Yew to seasonal changes in water, light, temperature and humidity to develop conservation options.	CFOD, RR, RP
95-9	University of Regina	Ecology and Behaviour of Insectivorous Bats	R.M. Brigham	Mike Dunn	To assess the vertical distribution of foraging activity by Vespertilionid bats in Coastal Western Hemlock Old-Growth Forest and Very Wet Hyper-maritime.	RP
95-10	University of Victoria	Forest Canopy Arthropod Sampling	Richard Ring, Neville Winchester	Neville Winchester	A sampling program for arthropods, looking at arthropods from the forest floor to the canopy (utilizing the Forest Canopy Research Station). Focus is on taxonomy survey and relationships to habitat.	RPPC

TABLE 2 (CONT'D) FORMAL RESEARCH PROJECT PROPOSALS FOR DND PROPERTIES - 1995

PROPOSAL #	AGENCY	PROJECT	PROPONENT	CONTACT	DESCRIPTION	LOCATION
95-11	Canadian Wildlife Service	Garry Oak Regeneration	Pam Krannitz	Ken Morgan	To re-measure Garry Oak seedlings previously labelled in 1993 and measured in 1994.	MHB, RP, CFMETR
95-12	University of British Columbia	Garry Oak Acorn: Production, Dispersal, Germination	Marilyn Fuchs	Ken Morgan	To investigate production and damage levels to acorns; to assess the role of Stellar's Jays in dispersal and establishment of Garry Oak.	MHB, RP
95-13	B. C. Ministry of Environment	Migration Raptors	Andrew Harcombe	Ken Morgan	Conduct spring inventory of migrating raptors.	RP
95-14	Royal B.C. Museum, Canadian Wildlife Service, B.C. Min. of Environment	Rare Plants Inventory	R. Cannings, A. Ceska, A. Harcombe	Ken Morgan	Standard vegetation survey to determine extent and population of rare plant species.	MHB, CFMETR
95-15	B.C. Ministry of Environment	Inventory/Map Small Wetlands	A. Harcombe	Ken Morgan	Locate and characterize small wetlands to supplement Madrone Report	RP
95-16	B.C. Ministry of Environment	Detailed Garry-Oak Ecosystem Mapping	A. Harcombe	Ken Morgan	Provide more detail to extent of Garry Oak ecosystems mapping carried out by Madrone.	RP, CFMETR
95-17	B.C. Ministry of Environment	Rare Butterfly Inventory	A. Harcombe	Ken Morgan	To locate and inventory suspected rare butterfly species associated with unique ecosystems.	MHB, RP, CFMETR
95-18	Royal B.C. Museum Columbia	Inventory of Rare Invertebrates	R. Cannings	Ken Morgan	Survey and inventory the extent of rare invertebrate species to help characterize population size and habitat requirements.	RP
95-19	Uvic	Demographics of Allium Amplectens	A. Hawryzki	Andy McKinnon	Long term study to monitor changes in birth, growth and death of individuals and in population trends.	CFMETR
95-20	Uvic Nat. Soc.	Purple Martin Nestbox Program	D. Copley	Ken Morgan	Repair and maintain nestboxes and monitor population.	CFOD

TABLE 2 (CONT'D) FORMAL RESEARCH PROJECT PROPOSALS FOR DND PROPERTIES

PROPOSAL #	AGENCY	PROJECT	PROPONENT	CONTACT	DESCRIPTION	LOCATION
95-21	White Bear	Film Turkey Vultures	S. Wilkey	Gail Feltham	Film migration of turkey vultures.	RP
95-22	Woodfall Comm.	Film Interview in Bat Habitat	J. Thompson	Gail Feltham	Film interview of Mark Brigham in bat habitat.	RPPC

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

Table 3 - STATUS OF FORMAL PROPOSALS - 1995

DND ENVIRONMENTAL SCIENCE ADVISORY COMMITTEE - CFB ESQUIMALT

AS OF FEBRUARY 14, 1996

Prop. No.	Permit No.	Applicant	Title	Approved	Status * Report	Status Complete	Annual Report	Final Report
95-7	P001-95	Doug Pollard	An Ecological Assessment of Forest Land Within Royal Roads, CFB Esquimalt	17-Jan-95	14-Feb-96	14-Nov-95		14-Nov-95
95-4	P002-95	Trudy Chatwin	Proposal to Establish Permanent Smithsonian/Man and the Biosphere (SI/MAB) Ecological Monitoring Plots at the Rocky Point Department of National Defence Lands Near Victoria	17-Jan-95	14-Feb-96		01-Nov-95	
95-5	P003-95	Rhonda Millikin	Migration Monitoring of Neotropical Landbirds	17-Jan-95	14-Feb-96		30-Jan-96	
95-6	P004-95	Ken Morgan	Bird Surveys of Old Growth Forests	17-Jan-95	14-Feb-96	01-Nov-95		01-Nov-95
95-8	P005-95	Al Mitchell	Sustainable Development of Natural Sources of Taxol	17-Jan-95	14-Feb-96		22-Dec-95	
95-10	P006-95	N. Winchester	Community Ecology of the Canopy-Forest Floor Insect/Arthropod Fauna from an Old-Growth Forest	17-Jan-95	14-Feb-96		05-Jan-96	
95-11	P007-95	P. Krannitz	Garry Oak (Quercus garryana) Regeneration	17-Jan-95	14-Feb-96	09-Jan-96		09-Jan-96
95-12	P008-95	Marilyn Fuchs	Garry Oak Acorns: Production, Dispersal, Germination, Emergence and the Role of Steller's Jays	17-Jan-95	14-Feb-96			22-Dec-95
95-9	P009-95	R.M. Brigham	Ecology & Behavior of Insectivorous Bats in the Canopy of Old-Growth Forests: British Columbia	17-Jan-95	14-Feb-96		05-Jan-96	
95-2	P010-95	David Nagorsen	Bat Inventory of DND lands	03-Mar-95	14-Feb-96		01-Nov-95	
95-13	P011-95	A. Harcombe	Migrating Raptors	03-Mar-95	14-Feb-96	01-Nov-95		01-Nov-95
95-14	P012-95	R. Canning, A, Ceska,	Rare Plants Inventory	03-Mar-95	14-Feb-96			01-Nov-95
95-15	P013-95	A Harcombe	Inventory/Map Small Wetlands	03-Mar-95	14-Feb-96	01-Nov-95		01-Nov-95
95-16	P014-95	A. Harcombe	Detailed Gary-Oak Ecosystem Mapping	03-Mar-95	14-Feb-96	01-Nov-95		01-Nov-95
95-17	P015-95	A. Harcombe	Rare Butterfly Inventory	03-Mar-95	14-Feb-96	01-Nov-95		01-Nov-95
95-18	P016-95	R. Cannings	Inventory of Selected Rare Invertebrates	03-Mar-95	14-Feb-96	13-Feb-96		13-Feb-96
95-19	P017-95	A.Hawryzki	Demographics of Allium Amplectens	01-Aug-95	14-Feb-96		15-Dec-95	
95-20	P018-95	D. Copley	Purple Martin Nestbox Program	01-Aug-95	14-Feb-96		01-Jan-96	
95-21	P019-95	Susan Wilkey	Film Turkey Vultures	19-Sep-95	14-Feb-96	14-Nov-95		14-Feb-96
95-22	P020-95	John Thomson	Film Interview Bat habitat	18-Oct-95	14-Feb-96	14-Nov-95		14-Feb-96

95-1		Stewart Guy	Survey of Wildlife Tree Dependent Species found in Rocky Point					
95-3		Garry Fletcher	Student Extended Essays					
TOTAL	20			20	20	10	8	12
* Text of Status Report contained in the minutes of the ESA Committee dated November 14, 1995								

APPENDIX 1

A. Terms of Reference - DND Environmental Science Advisory Committee - CFB Esquimalt

B. Terms of Reference - Forest Canopy Research Station Operating Committee

C. Research and Collection Activities Permit System

APPENDIX 1 - A

DND ENVIRONMENTAL SCIENCE ADVISORY COMMITTEE
CFB Esquimalt

Terms Of Reference

Introduction

The Department of National Defence controls and administers approximately 4,612 ha on 19 different properties in British Columbia with a potential for forest management. A Forest Management Plan has been prepared to encompass all 19 properties.

A LETTER OF UNDERSTANDING (December 1, 1993 - December 1, 1998) concerning forest research studies on DND owned lands in British Columbia was signed in 1993 between the Department of National Defence (Maritime Forces Pacific Headquarters) (DND) and the Canadian Forest Service (Pacific Forestry Centre) (CFS) and acknowledged by the University of Victoria, Lester B. Pearson College of the Pacific, and the Canadian Wildlife Service. The Letter was amended in 1995 to include the B.C. Ministry of Forests as a signatory and expand the terms of reference. The purpose of this Letter of Understanding is to provide an administrative framework for cooperation between DND and CFS to improve the level of forest management and to authorize the conduct of research on lands administered by the Department of National Defence in British Columbia at CFB Esquimalt.

The Letter of Understanding (LOU) will be implemented by a joint scientific advisory committee which may be supported by technical subcommittees. The Scientific Advisory Committee will ensure coordination, compatibility of approach and achievement of the objectives.

DND ENVIRONMENTAL SCIENCE ADVISORY COMMITTEE - CFB Esquimalt

The Committee will be structured and will function in accordance with the following:

(a) The seven member Committee will be comprised of two representatives from the Department of National Defence and one representative each of Canadian Forest Service, University of Victoria, Lester B. Pearson College of the Pacific, B.C. Ministry of Forests and the Canadian Wildlife Service.

(b) The Committee shall:

1) ensure that the intent of the LOU is carried out;

2 approve standards and procedures required for the efficient administration and management of the LOU;

3) coordinate research carried out on properties controlled by CFB Esquimalt;

4) review and evaluate research proposals submitted to the DND Forest Management Committee;

5) make recommendations to the DND Forest Management Committee concerning the acceptance of research proposals;

6) collect and archive all the resulting reports, making them available to members of the Committee as well as other recognized agencies;

7) Prepare an annual compendium of research conducted on DND property and make it available;

8) meet once every three months or as mutually agreed upon;

9) establish a subcommittee to oversee the operation of the Forest Canopy Research Station; and

10) Other subcommittees may be established as required and may include representatives on an advisory basis from other departments, agencies, industry, or other non-governmental bodies.

(c) Decisions of the Committee will be made by a majority vote of no less than five members.

APPENDIX 1 - B

FOREST CANOPY RESEARCH STATION OPERATING COMMITTEE

Terms of Reference

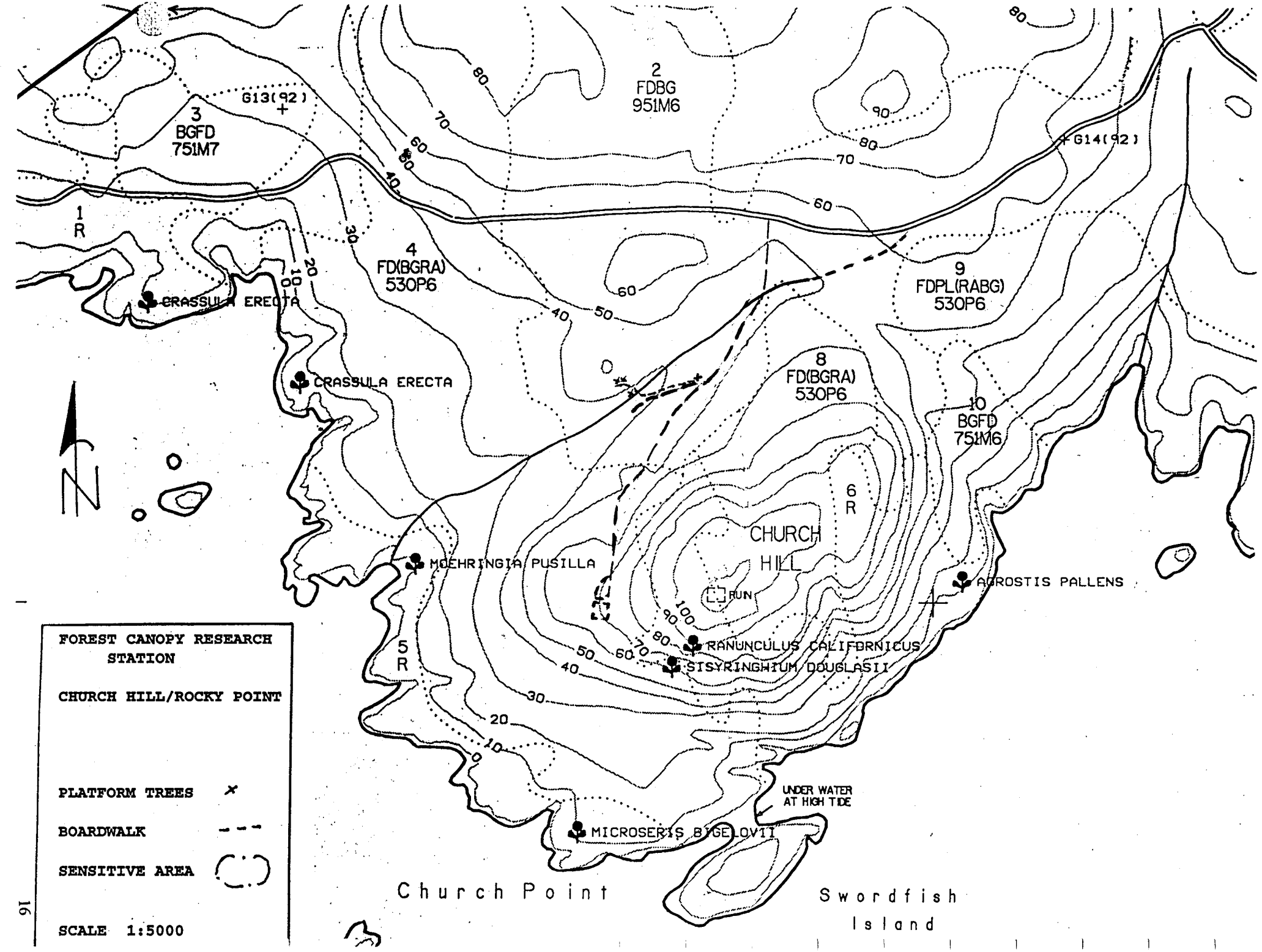
Pearson College owns and maintains a Forest Canopy Research Station facility located on Department of National Defence (DND) lands at Rocky Point. While the facility consists of the platforms, ladders, boardwalks and other installed equipment and material, the area of the facility extends from the forest crown to the subsurface aquifer. The trees, plants, natural resources and surface rights within the facility area remain in the ownership of DND. The location of the facility is shown on the attached map.

The committee shall be composed of representatives from Lester B. Pearson College of the Pacific and University of Victoria and shall function in the following manner:

1. The committee shall maintain the facility in a safe and usable condition.
2. The committee shall oversee the operation of the facility.
3. The committee shall be responsible for the development and updating of the operating protocol for the facility.
4. The committee shall allow researchers to use the facility for research projects that have been approved by the DND Environmental Science Advisory Committee - CFB Esquimalt (ESAC).
5. The Committee shall collect a user fee from researcher for use of the facility. The revenue from the fees shall be used to maintain the facility.
6. The researcher may conduct approved research on the ground within the designated facility area. If the above ground portion of the facility (platforms, ladders, etc.) are not being used, a user fee will not be charged.
7. If there is a conflict of use of the facility in terms of time, etc., a priority of use will be established by the Committee.
8. The Committee shall provide at the end of each fiscal year (June 30) a financial report to the ESAC as well as a summary of activity and list of users.

The Operating Protocol for the Forest Canopy Research Station facility is attached.

The area of the Forest Canopy Research Station facility is delineated on the attached map.


FOREST CANOPY RESEARCH STATION
CHURCH HILL/ROCKY POINT
PLATFORM TREES
BOARDWALK
SENSITIVE AREA
SCALE 1:5000
N
1 R
2 FDBG 951M6
3 BGFD 751M7
4 FD(BGRA) 530P6
5 R
6 R
8 FD(BGRA) 530P6
9 FDPL(RABG) 530P6
10 BGFD 751M6
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CRASSULA ERECTA
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MOEHRINGIA PUSILLA
CHURCH HILL
RUN
RANUNCULUS CALIFORNICUS
SISYRINGHIUM DOUGLASII
AGROSTIS PALLENS
MICROSERIS BIGELOVII
UNDER WATER AT HIGH TIDE
Church Point
Swordfish Island

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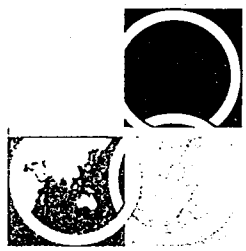

FOREST CANOPY RESEARCH PROJECT OPERATING PROTOCOL

Pearson College owns and maintains a Forest Canopy Research Station facility located on Department of National Defence (DND) lands at Rocky Point. While the facility consists of the platforms, ladders, boardwalks and other installed equipment and material, the area of the facility extends from the forest crown to the subsurface aquifer. The trees, plants, natural resources and surface rights within the facility area remain in the ownership of DND. The location of the facility is shown on the attached map.

In the interest of promoting the safe and appropriate use of this facility and its systems the following operating procedures have been established:

1. All research conducted in the area must be reviewed and approved by the Scientific Advisory Committee of the Department of National Defence, Canadian Forces Base Esquimalt;

2. To contribute to funding the costs of maintaining the facility/system a modest user fee will be paid into a specific station operating fund held by Pearson College;

   Fees will be as follows:
   a) Scientific projects $200.00 and 10.00/day after initial 15 days;
   b) Other projects by donation and agreement;
   c) Pearson College will provide all additional operating funds required.

3. The facility/system may only be operated under the direct supervision of a Certified Safety Officer who must be present at all times;

4. Safety Officers must be certified by Arbornaut Access and all projects must either retain a Safety Officer or pay for certification training for an appropriate individual;

5. The winch, handle, keys and log book will normally be kept at Pearson College and will only be issued to a Safety Officer;

6. Log and inspection records are of vital importance and it is the responsibility of the Safety Officer to maintain the records;

... /2

RR. 1, VICTORIA
BRITISH COLUMBIA
CANADA V9B 5T7
PHONE (604)478-5591
FAX (604)478-6421
SC009@freenet.victoria.bc.ca

7. The Safety Officer will use their discretion and experience to determine the safe number of persons using the system or on a platform at any time (maximum of 4/platform is a guideline) and the safety of working in wind and weather conditions;

8. The specified winch must always be used for ascending except in an emergency situation;

9. A minimum of three people including a Safety Officer must be present at all times when the facility/system is in use although two people are acceptable provided **both** are certified Safety Officers;

10. The first person up the facility/system must be familiar with the system and be capable of self rescue;

11. Open fires and smoking are prohibited and wildfires must be reported to DND personnel at CFAD Rocky Point immediately;

12. No food may be consumed in the research area although food may be consumed in the parking area;

13. Any equipment failures, safety concerns or incidents involving safety or injury must be reported immediately to the Safety Officer identified by Pearson College as in charge of facility/system operations; and

14. Access to the site is controlled and is considered to be entirely at the discretion of the Base Commander, C.F.B. Esquimalt, therefore visitors are encouraged to adhere to both the intent and spirit of these procedures to ensure ongoing research is not jeopardized.

22 November 1994

APPENDIX 1 - C

RESEARCH AND COLLECTION ACTIVITIES ON DEPARTMENT OF NATIONAL DEFENCE PROPERTIES

1. Research Permits, Inquiries and Information

Research and collection permits are required for natural science activities within The Department of National Defence (DND) properties and are administered by the DND Forest Management Committee. 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 significant physical disturbance to the land or any other significant adverse effect on the environment.
* research that involves the setting up of scientific monitoring instruments or of structures used in connection with scientific research.
* research that requires the exclusive use of any portion of a DND property.

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

2. Permit Application and Information Requests

When applying for a Research and Collection Permit, the enclosed application form must be completed to allow a full evaluation of the proposed project. Completed application forms and information requests should be directed to the attention of the DND Forest Management Committee. The mailing address and telephone number are shown on the enclosed application form.

Permits issued for projects that exceed 12 months in duration must be renewed annually. The permittee will be expected to submit a request for that renewal to the DND Forest Management committee, indicating whether or not any changes have been made as to the project. If changes have been made, a brief description of the extent of those changes must accompany the request for renewal.

3. Research Function And Impact

Scientific research is not a principle function of DND property. However, research by qualified individuals and institution is encouraged, especially research which contributes to the knowledge and understanding of the functioning of ecosystems and environmental management.

Research and collection activities within DND property should normally not involve physical disturbance of the natural and cultural resources of the property or interfere with operations and management of the site. Where there is potential conflict between military use of the site and proposed research initiatives, military use will take precedence. If research and collection activities are of a "destructive" kind (e.g., plant and animal collecting) are the only reasonable way to obtain required information and there are few or no other comparable sites at which to conduct those activities, then the restrictions relative to physical disturbance and interference in a particular property may be waived.

4. Environmental Impact Assessment

DND has a legal obligation to ensure that all projects and activities undertaken on DND lands are subject to environmental assessment. All phases of proposed activities are evaluated for their potential effect on the ecosystem.

Research proponents are responsible for providing an environmental assessment of their project. A suggested outline for the assessment report is available from DND and the Canadian Forest Service (CFS). The assessment may be prepared as a stand alone document or as a component of the research proposal.

The environmental assessment should be conducted during the development of the research proposal. This ensures that environmental, logistical and local community considerations are taken into account at the planning stage, and reduce the possibility of delays due to environmental assessment requirements.

Assessments must meet DND standards and be accepted before any work can proceed. DND will evaluate the assessment to ensure that requirements are met. Further assessment may be required, depending upon the nature of the project and the potential for impacts.

5. Access to DND Property

Access to DND property is controlled and in some areas may be restricted or even prohibited. The permittee must make prior arrangements for access to the property and must check in at the designated checkpoint when accessing the property. When leaving the property, the permittee must also check out at the checkpoint.

Vehicle access for research and collection activities will normally be restricted to designated routes.

6. The Process: Research Proposal to Final Report

The permit process is summarized in Figure 1. The proponent contacts DND. A research proposal and environmental impact assessment of the proposed research is sent to the DND Forest Management Committee for evaluation. DND or Canadian Forest Service (CFS) can provide information with respect to the requirements for the proposal and the impact assessment. Proposals must be received at least three months before proposed commencement of field work.

The proposal is forwarded to the appropriate DND Scientific Advisory Committee which will ensure that the proposal is evaluated for compatibility with DND policy and objectives, scientific merit and the adequacy of the environmental impact assessment.

Based on the evaluation the proposal is either accepted, denied or must undergo modification. The prospective researcher is notified of the decision. If the proposal is denied, a statement of reasons for denial is issued. If the proposal requires modifications these are communicated to the researcher with the option to modify for re-evaluation.

Once a proposal is accepted, a permit is granted, conditions of the permit discussed and any special permit conditions are applied.

During the conduct of field work on DND property, the researcher is expected to keep the permit in his/her possession at all times. All members of the research team must be aware of and follow the conditions of the research permit and DND regulations.

The researcher is expected to maintain contact with the DND Scientific Advisory Committee, to advise of progress and to check in at the conclusion of the field season to provide an informal update of progress.

The researcher is required to submit the DND Forest Management Committee two copies of a progress report, describing the activities of the field season by December 31 of the year in which the field season was completed.

Three copies of the final project report are due upon completion of the project. One copy of each published scientific report is to be submitted to the DND Forest Management Committee.

Summaries of progress reports and/or final reports will be included as part of the Annual report put out by the DNDESAC. In addition, project overviews and report summaries submitted to the DNDESAC will be put on a World Wide Web Home Page.

The researcher is responsible for the final disposition of any artifacts or specimens in the manner specified in the permit conditions.

Contact DND Forest Management Committee
Develop research proposal including Environmental Impact Assessment (EIA) and submit to DND Forest Management Committee for evaluation 90 days before start of proposed work

↓

Proposal evaluation:
- compatibility with DND policy & objectives
- scientific merit
- adequacy of EIA

→ Proposal denied

↓

← Modify proposal and re-submit

↓

Proposal accepted, permit granted.
Permit condition and special conditions established.
Logistics, timing and access and DND commitment determined

↓

Field Work:
Permit in Possession
Provide field session debriefing

↓

Progress Report:
Due on December 31 of field season year

↓

Final Report:
Due upon project completion

↓

Final disposition of specimens/artifacts

Figure 1: The Process: Research Proposal to Final Report

An annual compendium of research conducted on DND property will be prepared and made available to the general public and the research community. The compendium will identify the researcher, their affiliation, the subject of the research, status of the research, and a description of the study.

General Permit Conditions

1. In accordance with the intent of DND objectives, military use will take precedence over research and collection activities. The permittee shall exercise all reasonable discretion to ensure that research and collection activities do not conflict with or compromise DND activities or the resource base.

2. The permit is valid only for specific research and collection activities in the specified areas and for the dates identified on the permit.

3. Permits are not transferable and must include the names, when known, of all authorized project members who must be prepared to show a copy of the permit on request of an authorized person. If names are not known then the number of people involved should be included.

4. Irrespective of any previous authorization given to the permittee, the managing agency representatives or DND's representatives may restrict travel within or access to any area covered by the permit. Such restriction will remain in effect until such terms as the restrictions are lifted.

5. The permittee is responsible for ensuring that public safety is not endangered by activities associated with the project.

6. The research participants are responsible for reporting and fighting fires started by their activities.

7. The permittee will be held accountable for unnecessary damages to resources or property arising directly or indirectly from the project.

8. Collection is restricted to those types and numbers of specimens, where appropriate, which are indicated in the permit.

9. All specimens collected under the authority of a Research and Collection permit will remain the property of DND and are considered to be on loan to the permittee until final disposition of the specimens is approved. This condition does not apply to those specimens (e.g. small mammal carcasses, water samples, etc.) which will be destroyed during research or which are not intended to be kept indefinitely.

10. Should the permittee discover any previously unknown or unrecorded artifact, site or natural or cultural feature in the course of any research and collection activity that is not specifically covered by the terms and conditions of the permit, the find must be left in tact and reported immediately to DND.

11. By December 31 of a calendar year, the permittee will furnish the DND Forest Management Committee with two copies of a brief progress report outlining the results of that year's field activities. This report will include a discussion of the purpose, methods and results of the field research. A summary of this report may be put on a World Wide Web Home Page.

12. Within 90 days on completion of the entire research project, the permittee will prepare and submit a final report (3 copies) of the research findings to the DND Forest Management Committee. If a publication or thesis is subsequently produced from the research findings, the permittee is required to provide one copy of this document at no cost to DND. A summary of this report may be put on a World Wide Web Home Page.

APPENDIX 2

Cumulative Bibliography of Environmental Science Reports on DND Lands

Placed in the Pacific Forestry Centre Library

06MAY96

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.

7. 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.

8. 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.

9. 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)

APPENDIX 3

ESAC Committee Members and Participants in Joint ESAC/EMAN Workshop

DND Environmental Science Advisory Ccommittee

List of Members and Addresses

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B.C. Ministry of Forests - Research Branch
31 Bastion Square
Victoria, B.C. V8Z 3E7
(604)387-6721

Joint Meeting/Workshop
ESAC/EMAN

February 13, 1996

Name	Organization	Phone #
Marilyn Fuchs	UBC	822-0975
Joel Ussery	CRD Parks	478-3344
Allan Hawryzki	Malaspina University/College (Ext. 2315)	753-3245
Colin Gray	DOE/ECB/Science Division	666-2917
Dan Smith	UVic Geography	477-4732
Jeff Ward	CRD Parks	478-3344
Mark Hornell	CRD Regional Planning	360-3244
Chris Kissinger	BC Parks	391-2300
Lee Humble	CFS	363-0644
Rob Cannings	Royal BC Museum	356-8242
Neville Winchester	UVic Biology Dept.	721-7099
Jeff Aramini	C.C.H.	822-2375
Craig Stephen	Centre for Coastal Health UBC	822-5391
Tom Bown	CFS	363-0681
Karen Hogg	CFS	363-0600
Adolf Ceska	BC Ministry of Forests	356-2180
Warren McCormick	BC Environment, Nanaimo	751-3171
Doug Bright	Applied Research Div., Royal Roads	391-2584
Larry Barr	Min. of Env., Lands,Parks, Nanaimo	751-3136
David Nagorsen	Royal BC Museum	387-2933
Tara Martin	Consultant, Salt Spring Island	537-5340
Trudy Chatwin	Ministry of Env., Land & Parks	751-3150
Graham B. Smith	DND, Construction Eng. Env. Ofcr.	363-4914
Gail Feltham	DND, Base Env. Protection Officer	363-7233
Ken Morgan	CWS, Inst. Ocean Sciences	363-6537
Rhonda Millikin	CWS - Delta	946-8546
Bruce Thomson	Science Div., Conservation Br., EC	664-9122
Eric Taylor	Science Div., Conservation Br., EC	664-9123
Al Mitchell	CFS	363-0786
Tony Trofymow	CFS	363-0677
Arthur Robinson	CFS	363-0729
Daniel Charlebois	CFS	363-0790
Glen Jamieson	DFO, PBS	756-2223
Mike Dunn	CWC	

APPENDIX 4

Final Reports for Projects Completed in 1995

A - Permit P001-95

Title: An Ecological Assessment of Forest land within Royal Roads, CFB Esquimalt.

Author: Michael Ryan, Gillian Radcliffe and Gordon Butt

Organization: Madrone Consultants Ltd.
1877 Herd Road, R.R. #1
Duncan, B.C. V9L 1M3

Location: Royal Roads

Project Overview:

The work was carried out to provide a scientific information base that will guide the delineation, characterization and management of parts of Royal Roads as (I) representative examples of forest ecosystems within the Douglas-fir Biogeoclimatic Zone or special habitats for plant and animal species, possible associated with Esquimalt Lagoon. In addition to conservation objectives, these actions may also secure sites that are proving to be invaluable for research.

Ecosystems were classified and mapped at 1:5,000. Both the forested and non-forested ecosystems were described and management recommendations were made. The work was carried out by a consultant who produced a report. The summary of the report follows.

MADRONE CONSULTANTS LTD.

Ecological and Environmental Services
1877 Herd Road, Duncan, B.C., V9L 1M3

Tel: (604) 746-5545
Fax: (604) 746-5850

Ecological Assessment of Royal Roads Property C.F.B. Esquimalt Vancouver Island

for:

Department of Natural Resources
and
Department of National Defense

by:

Michael Ryan, M.Sc., R.P.Bio
Gillian Radcliffe, M.Sc., R.P.Bio.
Gordon Butt, M.Sc., P.Ag., P.Geo.
MADRONE CONSULTANTS LTD.
1877 Herd Road, R.R. #1
Duncan, B.C., V9L 1M3

August, 1995

SUMMARY

1. The objectives of this project were to classify and map the natural ecosystems of the Royal Roads property (C.F.B. Esquimalt) on Southeast Vancouver Island, to assess their ecological values and integrity, and to provide appropriate conservation recommendations.

2. The study area is located in the Colwood Municipality, and borders Esquimalt Lagoon, a National Wildlife Refuge of high value to migrating waterfowl. The general surrounding area has been heavily disturbed.

3. The study site occurs within the Coastal Douglas-fir biogeoclimatic zone. This ecological zone has a cool Mediterranean type climate and is confined to elevations below 150 m on Southeast Vancouver Island, the Gulf Islands, and a small part of the Sunshine Coast. This zone encompasses some of the most endangered habitats and flora in British Columbia.

4. The area is underlain by the Metchosin Formation. Glacio-marine deposits commonly overlie the bedrock, and well sorted fluvio-glacial sands are common.. Podzols dominate the site in well drained locations, while gleysols are more restricted in distribution, being confined to areas with impeded drainage.

5. Ecosystems were classified and mapped at 1:5,000. The map accompanies this report. Site classification was based on the Biogeoclimatic Ecosystem Classification (BEC) system, modified to better reflect the ecological units present in the study area. Fieldwork was conducted in January, February, and May 1995.

6. Forested ecosystems mapped and described are: Garry oak - Oceanspray; Douglas-fir - Arbutus; Douglas-fir - Oniongrass, Douglas-fir - Salal; Douglas-fir - Oregon Grape; Western redcedar - Oregon Grape; Western redcedar - Foamflower; and Western redcedar - Skunk Cabbage. Structural stages are identified. Seral associations are identified where appropriate.

7. Non-forested ecosystems and anthropogenic units mapped and described are: Upland Field, Lowland Field, Saltmarsh, Shoreline, Open Water, Disturbed and Urban. The latter two categories cover areas which have lost all resemblance to natural communities. They were not generally considered further in conservation planning.

8. Wildlife diversity in the study area is limited by the isolation of the area from more extensive natural areas, effectively excluding some of the larger mammals. Bird values and diversity are however relatively high. Older stands with old Douglas-fir veterans, plus moist forests, ponds, and the saltmarsh ecosystem are valuable wildlife habitats supporting a wide range of resident and migratory wildlife species. The adjacent Esquimalt Lagoon is a highly valuable wildlife habitat and is of key significance for migratory waterfowl, as well as for many resident wildlife species and some shorebirds.

9. Natural fires have played a significant role in shaping the present day vegetation in the study area, and fire impact is evident in many stands, especially in the western portion of the area. Fire suppression in recent times may be leading to changes in the structure and composition of some of the vegetation communities, including a decline in Garry oak trees. Pathogens and windthrow appear to have been responsible for small, localised disturbances.

10. None of the area is pristine. Human activity and development, in the form of buildings, roads, fences and clearings, logging operations, military activities, and recreational trails have influenced the entire site to varying degrees. However, some of the forests are in good condition, being relatively natural.

11. A great many introduced species occur on the study site. Often they significantly impact on the natural communities. Several grass species and Scotch broom are the most widespread, and are abundant in open communities and in disturbed areas such as a roadsides. The open, grassy ecosystems are the most vulnerable to invasion. Many other introduced species are also present but are often more localised, or are confined to heavily altered sites.

12. Many rare native plants are confined to Coastal Douglas-Fir ecosystems, but were not detected at Royal Roads. The undetected presence of rarities at Royal Roads is considered to be a fairly small possibility. However, the large number of big Douglas-fir veterans at Royal Roads is a significant biological feature. Other significant features include Sitka Spruce trees, generally uncommon in the CDF, Western hemlock trees, also uncommon in the CDF, and unusually large Pacific Yew trees.

13. The forests provide some of the last relatively large and contiguous natural areas in the Colwood area to provide habitat for a wide variety of wildlife. The ecosystems of Royal Roads also play a pivotal role in maintaining the high wildlife values of the Esquimalt Lagoon.

14. Following analysis of the natural ecosystems, three separate management areas were identified (see accompanying map), and suggested conservation options were developed for each of the areas

Area one:
Within area one, most stands are in fairly good condition, and there are a great many veteran Douglas-fir trees. It is proposed that this relatively contiguous area be protected from future development. Even stands without old vets are in fairly good condition, and offer an opportunity for natural recovery , which is likely to be good. Careful management of road and trail access is needed.

Area two:
This area covers the northern and eastern portions of the property. Stands are relatively young but are in good condition, and could eventually achieve old-growth status. Recreational trails in the area, especially along Cottonwood Creek, need evaluating and some rehabilitation is likely required. The Garry oak communities within the area are in poor condition, and some restoration plus future protection form human activity is needed if they are to maintain any semblance of natural values. The saltmarsh, also in this area, is in good condition, and should be fully protected, together with remaining buffering vegetation.

Area three:
This area is heavily impacted. However, vegetation in this area adjacent to the lagoon and existing ponds should be managed as buffers to protect those habitats. Public access to the foreshore and adjacent stands needs to be strictly controlled. Some revegetation along the foreshore by the lagoon should be strongly considered.

15. Periodic monitoring of sensitive sites should be conducted. In general, any developments promoting further fragmentation should be avoided, and any proposed developments in the area should be carefully reviewed for potential impacts on the more valuable habitats identified and the adjacent Lagoon.

16. A plan to control and monitor invasive introduced species needs to be developed.

Overall, none of the study area is pristine. The ecological integrity of the whole area has already been irreversibly compromised. This area of Royal Roads is relatively small and is subjected to extensive edge effects from existing roads and other developments. The relatively large edge/interior ratio means that forest interior conditions cannot be fully recreated here, and there will always be degradation around the edges.

The site does however include stands and features with high biological value, and provides some good examples of CDFmm ecosystems. Mature Douglas-fir Salal and Douglas-fir Arbutus ecosystems are well represented, and with time some excellent old-growth stands can be expected to develop. As all ecosystems in the CDF are under-represented in protected areas, protection of these relatively natural areas would result in a significant contribution to the preservation of representative examples of coastal Douglas-fir ecosystems. Long-term management must however aim to minimise disturbance and prevent future development of the existing, relatively natural, areas. The site also affords some excellent opportunities for research into the natural functioning of CDF ecosystems. In addition, the role of this area in maintaining the values of the adjacent lagoon is poorly understood, but should not be underestimated.

B - Permit P004-95

Title: Bird Surveys of Old-Growth Forests

Author: Ken Morgan and Michael Ryan

Organization: Environment Canada
Canadian Wildlife Service.
5421 Robertson Road, R.R. #1
Delta, B.C. V4K 3N2

Location: Mary Hill Battery

Project Overview:

The purpose of this study was to monitor the use of the forested areas within Mary Hill Battery by passerines and other birds. There were two components to the study : Fortnightly Surveys to determine the relative abundance and density of birds; and the collection of foraging behaviour data.

As part of the study a vegetation inventory of the bird study transect lines was carried out. The results of this study are given in the report - Morgan, Ken and Ryan, Mike. 1995. "Vegetation Inventory of Bird Survey Transect Lines at Mary Hill Battery (CFB Esquimalt)" IN K.H. Morgan (compiler). 1995. Baseline Inventories of Rare Species and Ecosystems of Department of National Defence Properties of Southern Vancouver Island, Environment Canada, Canadian Wildlife Service, Delta B.C. Pages 69 - 88.

C - Permit P007-95

Title: Garry Oak (Quercus garryana) Regeneration

Author: Pam Krannitz

Organization: Environment Canada
Canadian Wildlife Service
5421 Robertson Rd.
R R #1 Delta, B.C.
V4K 3N2

Tel. No.: (604) 946-8546

Fax. No.: (604) 946-7022

Location: Mary Hill Battery
Rocky Point
Nanoose TX Site
Albert Head (accommodation)

Project Overview:

The size distributions of Garry oak (Quercus garryana) seedlings and juveniles labelled and measured in 1993 differed between sites. Specifically, there was a broad range of sizes and ages for seedlings and juveniles at both Mary Hill Battery and Rocky Point, including older and larger juveniles, whereas at site Nanoose there were only many very young and small seedlings, primarily one-year-olds. For the last two seasons, we have continued to follow growth and survival of the 2800 individuals labelled in 1993 to determine whether the observed site differences were attributable to differential mortality.

START DATE: May 31, 1995 COMPLETION DATE: June 14, 1995

Objectives:

The overall goal of this research program is to learn how the ecosystem functions so that management decisions can be made that result in the conservation of the ecosystem. Objective for the 1995 field season was to determine whether size distributions observed in 1993 at the three sites were reflected in the probability of survival from one year to the next of both seedlings and juveniles.

Accomplishments to Date of the Project:

a) **Highlights of Findings:**

Size distribution and insect pests from 1993 data

Nanoose Hill had few juveniles over the age of three years (less than 10% of all seedlings/juveniles sampled), and three year-olds were not bigger (median = 0.06 cm^3) than seedlings germinated in the same year (median = 0.07 cm^3). Jumping gall wasp (Neuroterus saltarius) was not present and the other insect pests were not in abundance (up to 3% of those sampled). However, herbivory was an important factor (70% showed some level of herbivory); grasshoppers were predominant at the site, but we cannot link them directly to the herbivory observed.

At **Mary Hill, in the meadow**, there were many large juveniles (up to 50 cm^3). The ages of 25 % of the seedlings/juveniles sampled at this site could not be determined because they had suffered dieback or browsing; they were on average larger than those with known ages (median sizes = 0.91 versus 0.20 cm^3). Three year-old juveniles were much larger (median = 0.16 cm^3) than seedlings germinated in the same year (median = 0.04 cm^3). Damage from browsing was the most significant in this site (37 % of those sampled), but may be simply attributable to the preponderance of older individuals. At this site, many individuals (10.8%) exhibited a creeping form, because a thick mat of dead grass covered the soil. Herbivory was experienced by almost 40 % of those sampled, and jumping gall wasp infested over 20 %. Other insect pests were not abundant (up to 7%).

On the **rocky outcrop, at Mary Hill**, the results were not unlike those found at the meadow. Differences: 1) not as many older juveniles and most individuals could be aged, 2) slightly smaller three year-old juveniles (median = 0.14 cm^3), 3) fewer jumping gall wasp infestations (only 8.2 % of those sampled), and 4) leaf miners were more abundant (15 %).

Rocky Point, at both the coast and under the closed canopy, was intermediate between Nanoose Hill and Mary Hill in terms of age and size distributions. This was the only site at which "tarspot" was present (3 % of those sampled) whereas herbivory was less prevalent at this site (just over 20 %). Leaf miners were present on about 10 % of the individuals sampled and jumping gall wasp was present on about 15 %.

Survival from 1993 to 1995

Survivorship at Nanoose reflected the paucity of larger juveniles observed in 1993: almost 50% of the labelled seedlings died between 1993 and 1994, and of those survivors, 50% died again between 1994 and 1995. Similarly, the broad size distributions found both at Mary Hill and Rocky Point, were also reflected in higher survival rates of labelled seedlings and juveniles: 1.4% to 14.3% mortality per transect between 1993 and 1994, and 0% to 27.5% between 1994 and 1995.

What does this mean for the conservation of Garry oak ecosystems?

At Mary Hill the establishment of young trees was observed in the proximity to large, old (>1m in diam.) individuals. At Rocky Point, the majority of the Garry Oak habitat is already a closed canopy. The importance of the open Garry oak savannah habitat to the conservation of native flowering plants such as camas and chocolate lilies needs to be taken into consideration when thinking about the need for Garry oak regeneration. Only a few Garry oak trees are needed to create a savannah habitat. Current regeneration rates at Mary Hill and Rocky Point may already be exceeding that need. A more in-depth analysis of the results from 1994 and 1995, may bring into focus factors associated with the great mortality of seedlings at Nanoose. An initial cursory glance suggests that many seedlings suffered from desiccation at that site, whereas at Rocky Point and Mary Hill browsing of stem tips was much more prevalent.

b) **Research Activities:**

Seedlings and juveniles were initially sampled from June 14 to July 23, 1993, in 2.5 m wide transects (4m wide at Nanoose Hill) until several hundred were found per site: Nanoose Hill - 1.94 km, Rocky Point (closed canopy) - 259 m, Rocky Point (coastal) - 457 m, Mary Hill (meadow) - 145 m, Mary Hill (outcrop) - 302 m. Transects were 50 m apart at all sites except along the coast at Rocky Point, where the transects went parallel to the coast through areas that contained patches of Garry oak. In 1994 transects and labelled individuals were revisited between June 7 to July 13, and in 1995 between May 31 and June 13.

We measured basal diameter and total branch length, to provide an estimate of size, which was calculated as the volume of a cone of those dimensions. Age in 1993 was determined from growth increments indicated by bud scale scars and presence of an attached acorn indicated seedlings in their first year of growth. Some individuals could not be aged: they had the upper portion of the shoot removed, either by browsing or dieback.

Each year potential factors associated with seedling health was noted: 1) herbivory, 2) presence of leaf miners, 3) presence of leaf curlers, 4) presence of jumping gall wasp, 5) presence of the gametophyte generation of the jumping gall wasp, 6) "brown spots", 7) tarspot, 8) mechanical damage, and 10) browsing.
The size and health data for 1994 and 1995 have not yet been fully analyzed, and are not included in this report.

c) **Extension or Demonstration:**

Participated in two poster sessions in 1994: the Ministry of Forest's Biodiversity Poster Session (Penticton, BC), and Ecology and management of B.C. hardwoods (Richmond, BC).

D - Permit P008-95

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

Author: Marilyn Fuchs

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

Location: Mary Hill Battery and Rocky Point

Project Overview:

Little is known about reproductive processes of Garry oaks, the dominant tree in a rare and severely threatened ecosystem in British Columbia. This study describes acorn production in two Garry oak stands. The study also investigated the role of Steller's jays, who hoard acorns for winter food by burying them in the ground, in oak dispersal and seedling establishment. This was accomplished by: 1) observing food hoarding behaviour, and measuring burial condition and habitat attributes at hoarding locations; 2) planting acorns at different burial depths and in different habitats, and measuring germination and emergence rates; and 3) comparing results of plantings with jay hoarding habits. The report "Garry Oak Acorns: Production, Dispersal, Germination, Emergence and the Role of Steller's Jays" follows.

PROGRESS REPORT

Submitted To The DND Forest Management Committee by Marilyn Fuchs

December 16, 1995

GARRY OAK ACORNS: PRODUCTION, DISPERSAL, GERMINATION, EMERGENCE, AND THE ROLE OF STELLER'S JAYS

Objectives:

1. To investigate production and damage levels to acorns in 1 Garry oak stand in each of 2 study sites (Mary Hill and Rocky Point).
2. To assess the role of Steller's jays in dispersal and establishment of Garry oaks.

Methods:

- Assign a visually assessed production rank for all trees in the 2 study sites. Count and measure acorns from a stratified sample of trees, and measure a number of tree canopy attributes. Seek a relationship between one or more of these attributes, production rank, and trap collection that can be used to estimate overall production in the study sites and applied in a wider context.
- Observe Steller's jay hoarding activity. Measure acorn transport distances, distance between hoarded acorns, acorn burial depth, size, condition, and orientation, burial substrate, habitat type, and vegetative cover at herb, shrub, and tree layers.
- Test for selective harvesting by jays by comparing size and condition of hoarded acorns with those collected in seed traps.
- Measure habitat throughout study sites at 25m intervals along transects. Test for selectivity of hoarding habitat by comparing habitat at hoarding locations with 'available' habitat as measured along transects.
- Check hoarding locations (marked in 1st year) in the 2nd year to ascertain survival, germination, and emergence rates of hoarded acorns.
- Plant acorns at different depths and in different habitats to investigate the effect of these factors upon acorn predation, germination, and seedling emergence. Choose habitats to reflect those largely available and those apparently selected by the jays for hoarding. Evaluate planting results in terms of depth and habitat used by jays to infer impact of hoarding upon regeneration of the oaks.

Field activities completed, by year:

1994:

- Numbered and ranked all oak trees in study sites (590 trees).
- Constructed and installed seed traps under a stratified sample of trees (12 trees per site, 3 traps per tree).
- Collected acorns weekly from traps. Weighed, measured, and assessed damage (insect, vertebrate, fungus, other) to acorns.
- Measured canopy attributes for all trap trees.
- Observed 311 hoarding events. Measured attributes of hoarded acorns (for 154 hoarded acorns found) and hoarding habitat for all hoards observed. Recorded transport distances for all transport flights observed.
- Planted 2700 acorns at 3 different depths in 7 (Mary Hill) or 8 (Rocky Point) different habitats (split-plot, completely randomized design). Habitats include: oak canopy, oak edge, conifer canopy, conifer edge, shrub, herb, small clump of oak, arbutus, and

Douglas-fir saplings (MH only), riparian (RP only), and conifer sapling patch (RP only).

1995:

- Ranked and measured canopy density for all oak trees in study sites
- Re-installed seed traps under a stratified sample of trees, selected to reflect a range of canopy densities for each production rank.
- Collected and measured acorns weekly.
- Measured canopy attributes for all trap trees, all high-ranking trees, and a random sample of low- and non-producers.
- Checked previous years' observed hoards.
- Measured habitat along transects at 25m intervals: 356 points at Mary Hill and 409 at Rocky Point.
- Checked planted acorns in June and October.
- Because there were only 2-3 jays at each study site this year (as opposed to perhaps 25-50 or more in 1994), hoarding observations were not repeated.

Preliminary Results

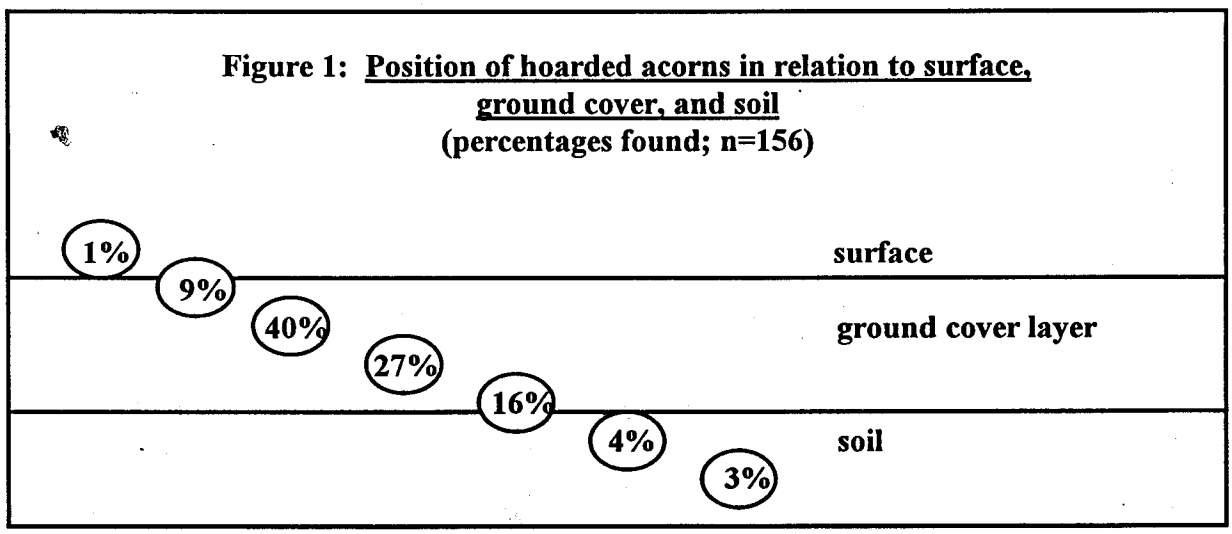
HOARDING ACTIVITY

Burial Depth

Most acorns (74%) were buried on their side. 18% had their pointy end down, and the remainder had the pointy end up.

The vast majority of hoarded acorns (76%) were placed within the 'ground cover' layer (*e.g.*, needles, leaf litter, moss; Figure 1). 16% were partially buried in the soil, while only 7% were fully buried. Few acorns were left fully (1%) or partially (9%) uncovered.

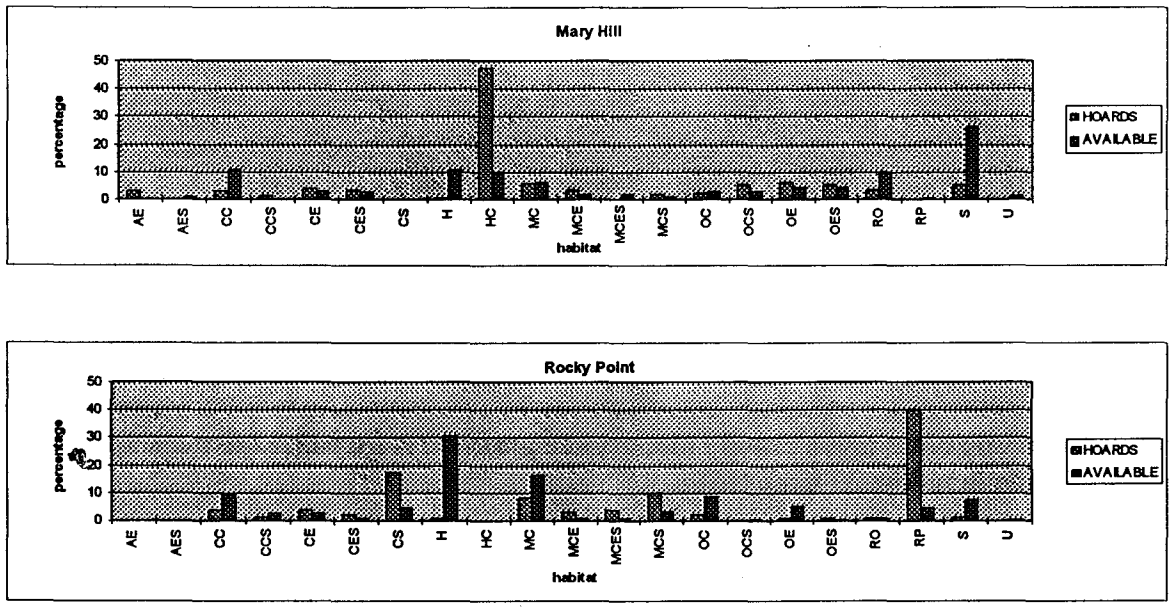
Figure 1: Position of hoarded acorns in relation to surface, ground cover, and soil (percentages found; n=156)



Habitat

Jays displayed marked preferences for hoarding habitat (Figure 2). At Mary Hill, 47% of the hoards were in 'HC' habitat ("heterogeneous clumps" of overlapping canopies of oak, Douglas-fir and arbutus), while this habitat type comprised only 10% of the study area. At Rocky point, 2 different habitat types were preferred: conifer sapling patches (hoards 17%; availability 5%) and riparian (40% and 4% respectively). At both sites, conifer canopy, herb, and shrub habitats were available in greater proportion than they were used.

Figure 2: Comparison of use and availability of habitat types. AE=arbutus edge; AES=arbutus edge with shrub; CC=conifer canopy; CCS=conifer canopy with shrub; CE=conifer edge; CES=conifer edge with shrub; CS=conifer sapling patch; H=herb; HC=heterogeneous clump of oak, Douglas-fir saplings, and arbutus; MC=mixed canopy; MCE=mixed canopy edge; MCES=mixed canopy edge with shrub; MCS=mixed canopy with shrub; OC=oak canopy; OCS=oak canopy with shrub; OE=oak edge; OES=oak edge with shrub; RO=rocky outcrop; RP=riparian; U=other. Mary Hill: hoards n=177, available n=356. Rocky Point: hoards n=134, available n=409.

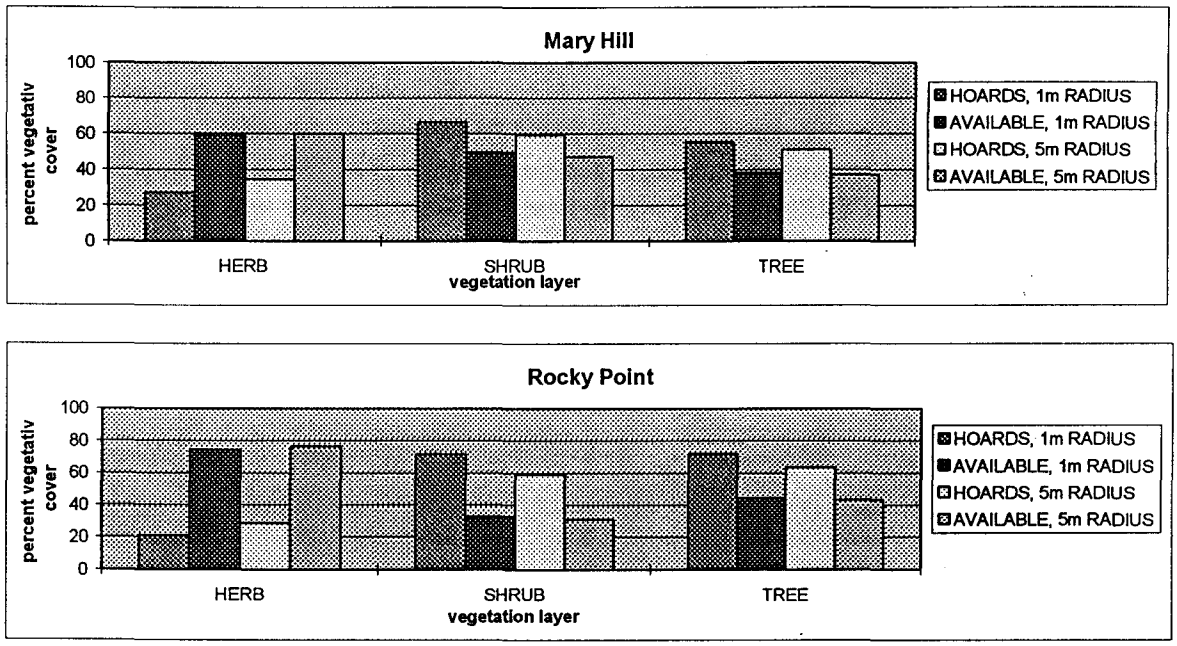


Percent Vegetative Cover

Jays chose hoarding locations characterized by less vegetative cover in the herb layer (21-35%) and more cover in the shrub (59-72%) and tree (51-72%) layers than represented in the study area as a whole (herb: 60-74%; shrub: 31-50%; tree: 37-45%;

Figure 3). Low rates of herb cover may reflect selection for this characteristic *per se* or may be a consequence of selection for dense cover in layers above, or *vice versa*. Selectivity was more pronounced at a 1m radius than at 5m radius for all 3 layers. This is evidenced by the greater difference between hoard and available measures at the smaller radius.

Figure 3: Comparison of average amount of vegetation covering hoarding versus available locations. Measurements taken for 3 vegetation layers (herb: <1m high; shrub: 1-<5m high; tree: >=5m high) and for circles of 1m and 5m radii. Mary Hill: hoards n=174, available n=356. Rocky Point: hoards n=133, available n=409.

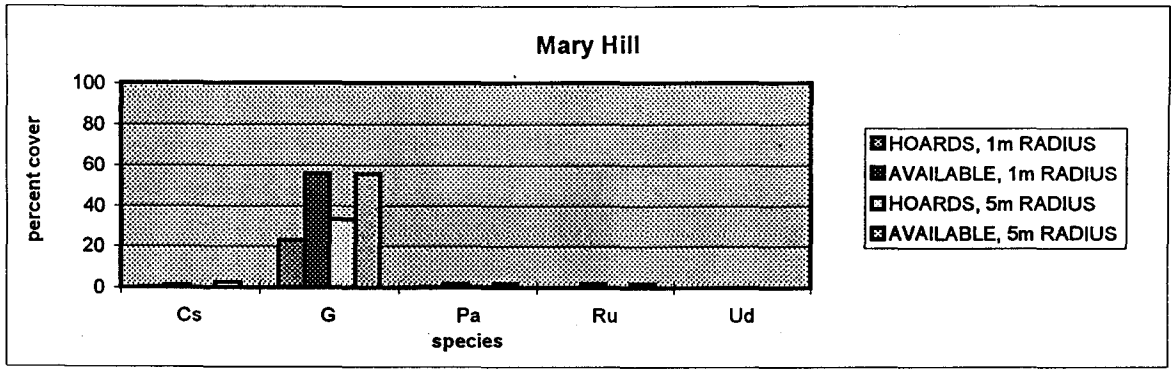


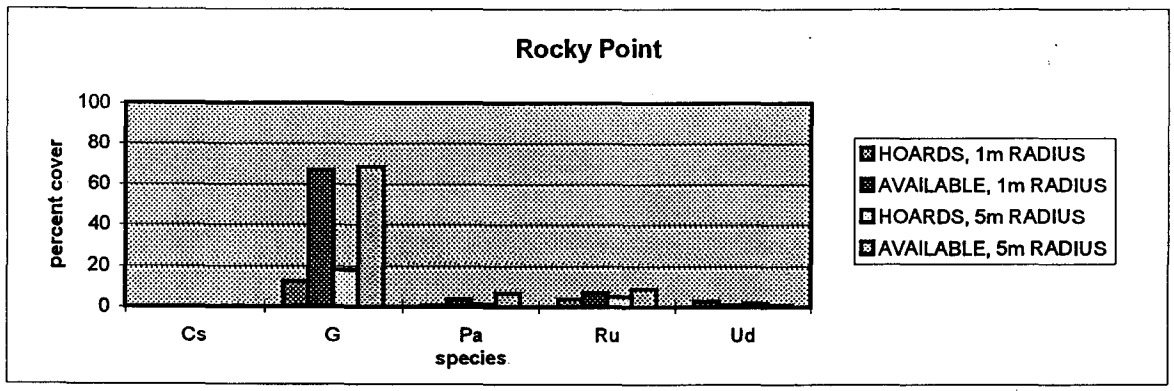
A consideration of the type of vegetation in each layer helps to illustrate the preferences of the jays, particularly in the shrub and tree layers. As with total vegetative cover discussed above, jays showed more marked preferences for individual plant species at 1m than at 5m radius (Figures 4-6).

Herb Layer

For both sites, the vast majority of the herb layer cover in both sites was comprised of grass (55-68%; Figure 4). Measurements were made during August and September, when drought conditions are typical and many herbaceous species disappear. Jays avoided grassy sites, particularly at Rocky Point, where grass cover at 1m radius averaged only 12%. Jays also avoided sites with bracken fern and trailing rubus. The Rocky Point nettle results for hoards represent very few actual sites with nettle present: for 1m radius, 3 hoards with 90 %cover; for 5m radius, 7 hoards, with cover ranging from 15 to 50%.

Figure 4: Comparison of average percent cover for selected species* in the herb layer (<1m high) in hoarding versus available locations. Measurements taken for circles of 1m and 5m radii. All species comprising at least 2% of any category are included. Cs=*Cytisus scoparius* (Scotch broom); G=grass (*not designated to species); Pa=*Pteridium aquilinum* (bracken fern); Ru=*Rubus ursinus* (trailing rubus); Ud=*Urtica dioica* (stinging nettle). Mary Hill: hoards n=171, available n=356. Rocky Point: hoards n=132, available n=409.



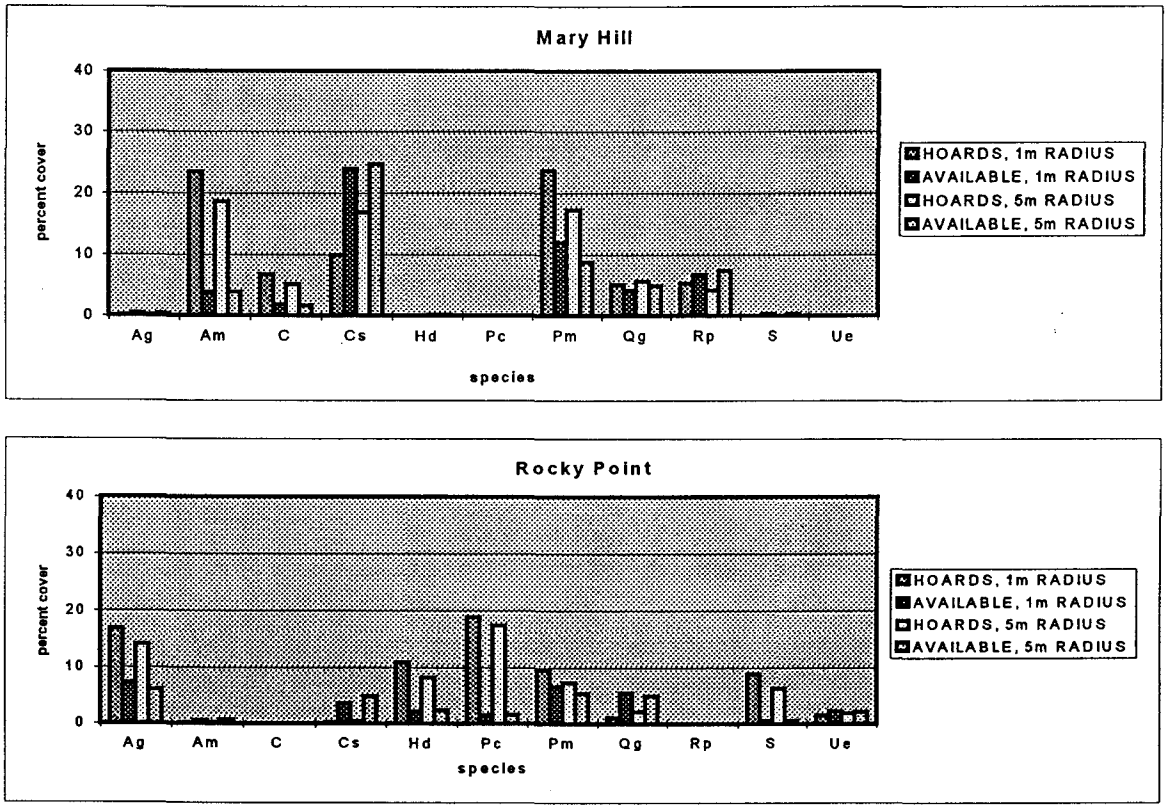


Shrub Layer

At Mary Hill, jays show extremely high preferences for arbutus in the shrub layer (23% and 19% cover for hoards at 1 and 5m radius, versus 4% available; Figure 5). They also select locations with Douglas-fir in the shrub layer (24 and 17% cover used; 12 and 9% available.) On the other hand, broom covers 24-25% of the site, yet hoards have only 10% (1m) and 17% (5m) broom cover. At Rocky Point, the jays showed marked preferences for habitats with grand fir, ocean spray, Pacific ninebark, and willow cover in the shrub layer. These species covered 2 to 17 as much area of hoarding locations as the study site as a whole. In comparison, broom and Garry oak were present much more than they were selected.

At both sites, plant species selected for in the shrub layer share the characteristic of providing extremely dense cover, often approaching 100% canopy closure. In fact, the hoarding locations often appeared almost cavernous. Those species more available then used (broom, oak) tend towards more open canopies. This suggests that structure, in terms of shrub layer canopy closure, may be a key factor in jay hoarding habitat selection.

Figure 5: Comparison of average percent cover for selected species in the shrub layer (1-<5m high) in hoarding versus available locations. Measurements taken for circles of 1m and 5m radii. All species comprising at least 4% of any category are included. Ag=*Abies grandis* (grand fir); Am=*Arbutus menziesii* (arbutus); C=*Crataegus* sp. (hawthorn); Cs=*Cytisus scoparius* (Scotch broom); Hd=*Holodiscus discolor* (ocean spray); Pc=*Physocarpus capitatus* (Pacific ninebark); Pm=*Pseudotsuga menziesii* (Douglas-fir); Qg=*Quercus garryana* (Garry oak); Rp=*Rubus procerus* (Himalayan blackberry); S=*Salix sp.* (willow); Ue=*Ulex europaeus* (gorse). Mary Hill: hoards n=175, available n=356. Rocky Point: hoards n=134, available n=409.

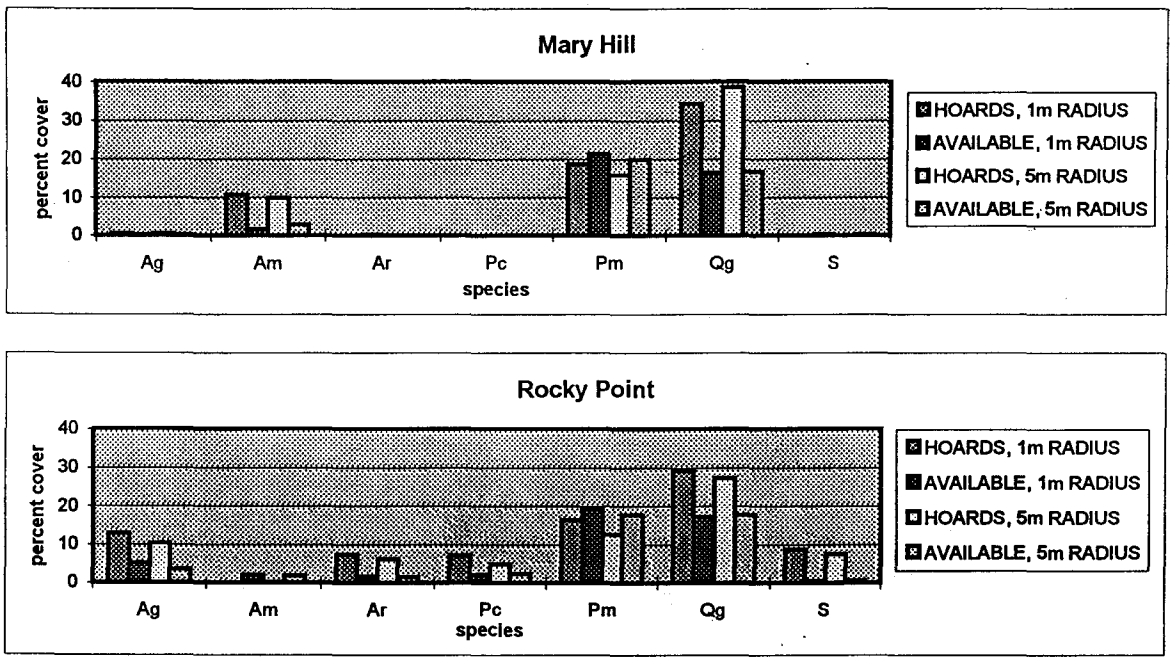


Tree Layer

At both sites, jays appeared to generally select for all species in the tree layer, except for Douglas-fir, which they seemed to avoid (Figure 6). However, this information should be considered in conjunction with that of habitat types illustrated in Figure 2. Much of the Garry oak covering hoarding locations was present in "HC" (dense clumps), conifer sapling, and riparian patches, habitats intensively used by the jays. Oak canopy and oak edge habitats *per se* tended to be used slightly more (Mary Hill) or less (Rocky Point) than available. The majority of the Douglas-fir tree cover was present in conifer and mixed canopy habitats, which jays used at lower rates than they were available. Grand fir at Rocky Point comprised a large proportion of the sapling population, for example in "CS" habitats, but often extended into the tree layer. Much of the arbutus at Mary Hill was present in "HC" locations, and willow grows in riparian areas, both habitats heavily used by the jays. Both of these plant species tend to produce dense shrub-layer vegetation

even when they do extend up into the tree layer. Overall, it appears to be characteristics of the shrub layer or perhaps other features of the habitat as a whole that dominated jay hoarding habitat selection. Jays tended to hop up through trees before flying away from hoarding locations, so tree cover appeared to be important to them, but characteristics of individual tree species may not have played a major role.

Figure 6: Comparison of average percent cover for selected species in the tree layer (≥ 5m high) in hoarding versus available locations. Measurements taken for circles of 1m and 5m radii. All species comprising at least 2% of any category are included. Ag=*Abies grandis* (grand fir); Am=*Arbutus menziesii* (arbutus); Ar=*Alnus rubra* (red alder); Pc=*Pinus contorta* (shore pine); Pm=*Pseudotsuga menziesii* (Douglas-fir); Qg=*Quercus garryana* (Garry oak); S=*Salix sp.* (willow.) Mary Hill: hoards n=175, available n=356. Rocky Point: hoards n=134, available n=409.



Survival of Hoarded Acorns

Out of the 156 hoarded acorns found in 1994, 10 could not be relocated at all because the flagging tape marking the location was missing. Of the remainder, only 2 produced seedlings in 1995. All of the other acorns except 1 had disappeared, probably either recovered by the jays themselves or predated by another species.

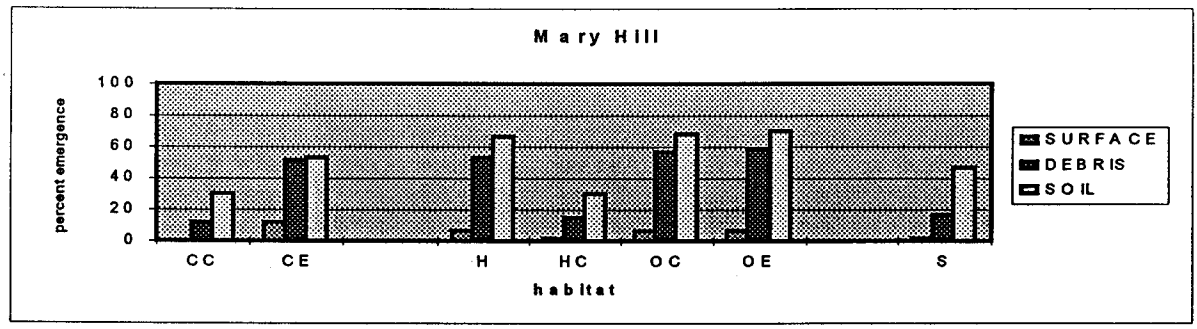
PLANTING EXPERIMENT

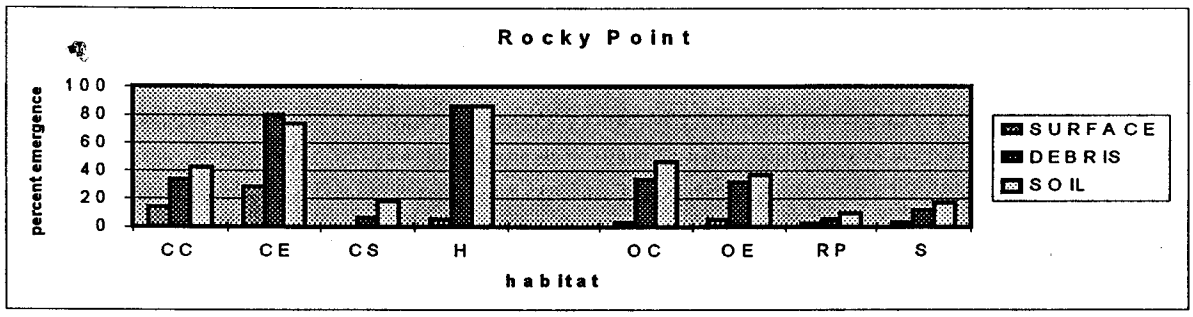
Percentage of planted acorns that emerged as seedlings varied greatly according to both burial depth and habitat (Figure 7). At both sites, acorns planted on the surface produced very small numbers of seedlings (0-28%). A larger proportion of acorns planted in debris emerged as acorns, ranging from a low of 5 to a high of 87%, both in habitats at

Rocky Point. In all habitats except one, acorns buried in the soil produced seedlings at equal or slightly higher rates than acorns buried in debris.

The effect of habitat was also pronounced. Emergence rates in herb habitat were among the highest at both sites (53-87% for debris and soil burial). Conifer edge rates were also relatively high (52-80% for debris and soil), while oak canopy and oak edge rates were slightly higher than herb rates at Mary Hill but lower than conifer edge rates at Rocky Point. In both sites, conifer canopy and shrub habitats produced relatively few seedlings. Most pronounced, however, were the low emergence rates for those habitats used in greatest proportion by the jays. This was particularly true at Rocky Point, where, even for acorns buried in the soil, emergence rates were only 18% in conifer sapling patches and 10% in riparian habitat. At Mary Hill, acorns in the preferred habitat (dense clumps) fared slightly better, with an emergence rate of 30% for those buried in the soil.

Figure 7: Percentage of acorns planted in October 1994 that emerged as seedlings in 1995. Acorns were planted at different depths and in different habitats. CC=conifer canopy; CE=conifer edge; CS=conifer sapling patch; H=herb (grass); HC=dense clump of arbutus, Garry oak, and Douglas-fir saplings; OC=oak canopy; OE=oak edge; RP=riparian; S=shrub (broom). For each habitat and burial depth combination, n=60 (6 planting plots per habitat type per site; 7 habitat types in Mary Hill and 8 in Rocky Point; 10 acorns of each burial depth in each planting plot.)

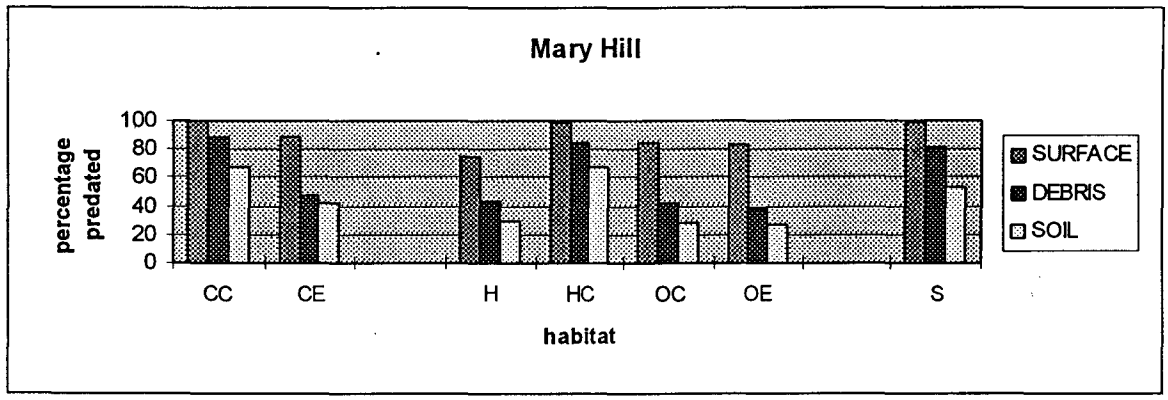


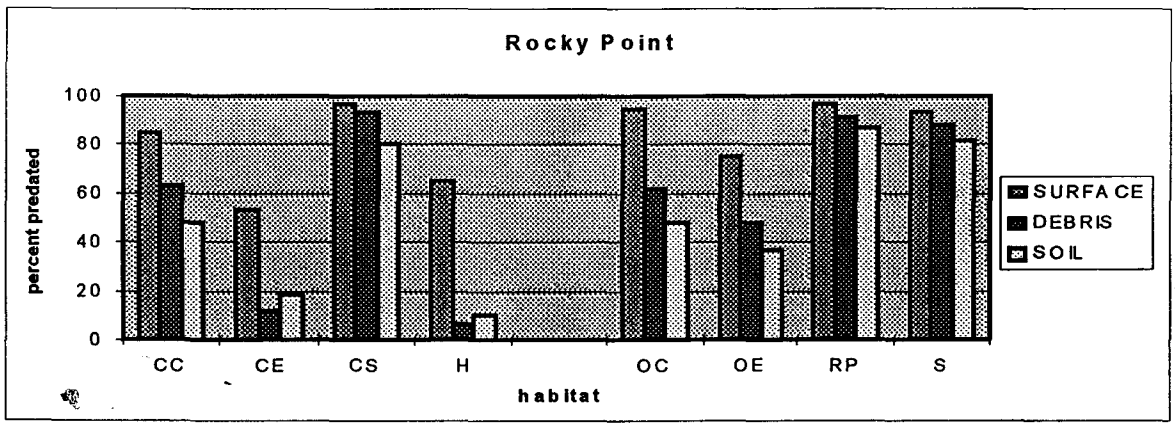


Where acorns did not produce seedlings, the ground was searched to determine possible causes. In the vast majority of cases, the acorn had disappeared (Figure 8). Predation upon the acorn thus appears to be the primary mechanism that prevented seedling production. Surface acorns were predated at extremely high rates (low of 65%, in herb plots at Rocky Point, to 100% in conifer canopy plots at Mary Hill.) For all burial

depths, predation rates in habitats preferred by the jays were among the highest, although conifer canopy and shrub plots also suffered extremely high rates.

Figure 8: Percentage of acorns planted in October 1994 that suffered apparent predation. Acorns were planted at different depths and in different habitats. CC=conifer canopy; CE=conifer edge; CS=conifer sapling patch; H=herb (grass); HC=dense clump of arbutus, Garry oak, and Douglas-fir saplings; OC=oak canopy; OE=oak edge; RP=riparian; S=shrub (broom). For each habitat and burial depth combination, n=60 (6 planting plots per habitat type per site; 7 habitat types in Mary Hill and 8 in Rocky Point; 10 acorns of each burial depth in each planting plot.)





Summary

- Steller's jays hoarded acorns primarily (76%) in the ground cover layer. 23% were fully or partly buried in the soil.
- Steller's jays showed marked preferences for specific habitat types: dense clumps of arbutus, Garry oak, and Douglas-fir saplings (Mary Hill), conifer sapling patches (Rocky Point), and riparian (Rocky Point).
- Jays selected hoarding locations with relatively little herb cover, but with more than average cover in the shrub and tree layers.
- Jays avoided grassy sites, and chose sites with shrubs producing extremely closed canopies.

- Vegetative structure in the shrub layer or other habitat characteristics appear to dominate jay habitat selection, rather than characteristics of individual tree species.
- Only 2 out of 156 hoarded acorns produced seedlings the following year. Predation appeared to be the main mortality factor.
- Acorns experimentally planted on the surface produced relatively few seedlings, while those buried within the debris layer and in the soil produced many more.
- Acorns experimentally planted in herb (grass) habitats and conifer edge habitats had high seedling emergence rates. Acorns planted in conifer canopy and shrub (broom)habitats, and in those habitats preferred by the jays, fared poorly.
- Predation appeared to be the primary mortality factor for those acorns that did not produce seedlings.

E - Permit P011-95

Title: Migrating Raptors

Author: Michael G. Shepard

Organization: Wildlife Branch
Ministry of the Environment
780 Blanshard Street
Victoria, B.C. V8V 1X5

Location: Rocky Point

Project Overview:

Informal counts of raptors in the Becher Bay headlands area of southern Vancouver Island have been made by naturalists for many years. In the spring of 1995, a compilation of this data was begun. The author obtained summaries of raptor observations from Victoria area naturalists, as well as using data from the 1994 fall migration monitoring program at Rocky Point. At the time of publication, insufficient information was available to present a detailed summary, however results from 1994 are discussed briefly in this paper.

A separate paper on recommendations for future monitoring of raptors was also prepared. This report discuss issues regarding monitoring raptors at the Becher Bay headlands, suggests a monitoring protocol, and outlines areas for further study.

These two papers are given in the reports Shepard, Michael G. 1995. "Preliminary Report on Raptor Observations Reported in the Becher Bay Headlands Area" and Shepard, Michael G. 1995. "Becher Bay Headlands Raptor Monitoring Protocol" IN K.H. Morgan (compiler). 1995 Baseline Inventories of Rare Species and Ecosystems of Department of National Defence Properties of Southern Vancouver Island. Environment Canada, Canadian Wildlife Service, Delta, B.C. Pages 41 - 52.

F - Permit P012-95

Title: Rare Plants Inventory

Author: Adolf Ceska and Oldriska Ceska

Organization: Royal B.C. Museum
675 Belleville Street
Victoria, B.C. V8V 1X4

Location: Albert Head, Ballenas Island, CFMETR, Mary Hill Battery, Rocky Point and Winchelsea Island

Project Overview:

Vegetation surveys were carried out on the six properties between April 19 and June 1, 1996. Rare Plant species were noted when they occurred

This paper is given in the report Ceska, Adolf and Ceska, Oldriska. 1995. "Rare Plants on Some Department of National Defence Properties on Vancouver Island" IN K.H. Morgan (compiler). 1995. Baseline Inventories of Rare Species and Ecosystems of Department of National Defence Properties of Southern Vancouver Island. Environment Canada, Canadian Wildlife Service, Delta, B.C. Pages 65 - 68.

G - Permit P013-95

Title: Inventory/Map Small Wetlands

Author: Carmen Cadrin

Organization: B.C. Conservation Data Centre
Wildlife Branch
Ministry of the Environment
780 Blanshard Street
Victoria, B.C. V8V 1X5

Location: Mary Hill Battery and Rocky Point

Project Overview:

An inventory survey was carried out to determine the location of wetland ecosystems within the DND properties at CFAD Rocky Point and Mary Hill Battery, and to provide detailed classification and descriptions which can direct appropriate management objectives in co-operation with the Sensitive Ecosystem Inventory, the Conservation Data Centre identified the non-forested Ecosystems through photo interpretation. As there are several smaller important wetlands on the property additional interpretation was carried out to include these sites. Where possible sites were visited to collect relevant information on Vegetation, soil Type, moisture and nutrient regime, hydrology, level of disturbance and adjacent land use. This information was used to determine the ecosystem classification for each site.

This paper is given in the report Cadrin, Carmen. 1995. "Wetland and Garry Oak Ecosystems of CFAD Rocky Point and Mary Hill Battery" IN K.H. Morgan (compiler). 1995. Baseline Inventories of Rare Species and Ecosystems of Department of National Defence Properties of Southern Vancouver Island. Environment Canada, Canadian Wildlife Service, Delta, B.C. Pages 89 - 96.

H - Permit P014-95

Title: Detailed Garry Oak Ecosystem Mapping

Author: Carmen Cadrin

Organization: B.C. Conservation Data Centre
Wildlife Branch
Ministry of the Environment
780 Blanshard Street
Victoria, B.C. V8V 1X5

Location: Mary Hill Battery and Rocky Point

Project Overview:

An inventory survey was carried out to determine the location of Garry oak ecosystems within the DND properties at CFAD Rocky Point and Mary Hill Battery, and to provide detailed classification and descriptions which can direct appropriate management objectives in co-operation with the Sensitive Ecosystem Inventory, the Conservation Data Centre identified the non-forested Ecosystems through photo interpretation. Where possible sites were visited to collect relevant information on Vegetation, soil type, moisture and nutrient regime, hydrology, level of disturbance and adjacent land use. This information was used to determine the ecosystem classification for each site.

Information from this study was combined with that for the wetland study Permit G - Permit P013-95 and is combined in a single report - Cadrin, Carmen. 1995. "Wetland and Garry Oak Ecosystems of CFAD Rocky Point and Mary Hill Battery" IN K.H. Morgan (compiler). 1995. Baseline Inventories of Rare Species and Ecosystems of Department of National Defence Properties of Southern Vancouver Island. Environment Canada, Canadian Wildlife Service, Delta, B.C. Pages 89 - 96.

I - Permit P015-95

Title: Rare Butterfly Inventory

Author: Jon Shepard

Organization: Wildlife Branch
Ministry of the Environment
780 Blanshard Street
Victoria, B.C. V8V 1X5

Location: Rocky Point and CFMETR.

Project Overview:

A survey of rare butterflies was carried out at Rocky Point and CFMETR, Nanoose Bay in the spring and early summer of 1995. Moths were sampled using a black light collecting method.

This paper is given in the report Shepard, Jon. 1995. "Rare Butterflies of Department of National Defence" IN K.H. Morgan (compiler). 1995. Baseline Inventories of Rare Species and Ecosystems of Department of National Defence Properties of Southern Vancouver Island. Environment Canada, Canadian Wildlife Service, Delta, B.C. Pages 53 - 54.

J - Permit P016-95

Title: Selected Invertebrate Inventory: Robber Flies and Freshwater Crustacea

Author: Rob Cannings

Organization: Royal British Columbia Museum

Location: Rocky Point

Project Overview:

The Invertebrate Inventory Project was a sub-component of an ongoing research program initiated in July, 1994 by N. Winchester (University of Victoria). This larger project has its own goals and objectives and is established under its own permits.

The project was based at the Church Hill canopy station located on the Department of National Defence (DND) property, Rocky Point, Victoria. This site is located in a dry coastal old-growth Douglas-fir stand. A Garry Oak study site, adjacent to the canopy station, was included in the project. Representative freshwater habitats located in these forest sites were also be studied.

The community structure of arthropods of the forest canopy and floor in the coastal old-growth forests of Vancouver Island is virtually unknown. A number of types of old-growth forest, including the dry Douglas-fir forests of the southwestern coast, are rapidly disappearing. Conservation of biological diversity is a major environmental issue, and this study area has a high priority with respect to biodiversity research, conservation area planning, and other land-use planning. The reasons for maintaining biological diversity have been clearly identified. Results from the first three years of study in the Carmanah valley and one year of research at the Rocky Point canopy station support the theory that a unique old-growth forest community exists. Several new species specific to microhabitats within these forest systems have been discovered. The study at the DND site offers an opportunity to sample target groups, highlight rare species, and relate this information to questions concerning endemism, threatened habitats and conservation.

START DATE: 15 March 1995 COMPLETION DATE: 31 December 1995

Objectives:

1. To sample, prepare, and identify a representative collection of Robber Flies (Insecta: Diptera: Asilidae), Cladocera (Crustacea: Cladocera)
2. To assess the status of the representative species.

Methodology

The sampling program took into account the recommendations made in the 1991-94 Carmanah canopy studies and the 1994 Rocky Point study. The sample area included the canopy and adjacent ground sites (e.g., ground sites, Garry Oak site, freshwater habitats). Sampling methodologies followed the recommendations of Winchester and Scudder (1994) outlined in "Methodology for sampling Terrestrial Arthropods in B.C.".

In the Douglas-fir forest site (canopy site) three malaise traps (catching flying insects) were placed in each of five trees at approximately 30m above the ground. Three additional traps were set on the forest floor around each of these trees. At each of the five forest floor trapping sites two pan traps and three pitfall traps (catching ground dwelling species, among others) were placed near each forest floor malaise trap. Three flight intercept traps were set in the Douglas-fir habitat and a single malaise trap was set up on an open rocky knoll in this same area.

Two sites were chosen in the Garry Oak woodland, one among trees, the other in an open area. In each of these habitats, two malaise and four pan traps were set. Two flight intercept traps were included, one on the ground, another 12m high in a tree.

Accomplishments of the Project

Highlights of Findings

This study of the Rocky Point robber fly (Diptera: Asilidae) assemblage depended on a subsample of the immense collections made in N. Winchester's ongoing general inventory of the insects of the area. All the robber flies were extracted from the samples. The 116 specimens representing 11 species were collected between 22 June 1994 and 21 June 1995 in malaise traps placed in Garry Oak woodland and Douglas-fir forest sites. These robber flies represent the only sample extracted from the alcohol residues of these traps and identified for the purposes of this project.

The following annotated list of species outlines the number of specimens collected, the range of collection dates, relative abundance, habitat, and geographic status in British Columbia.

A. Annotated Species List

Subfamily Dasypogoninae

Cyrtopogon aurifex Osten Sacken. (16%, 9&) Common, 4 June -22 August, most specimens from late June through July. Douglas-fir site; captured in malaise traps on ground and in canopy (34m). Western Montane species, B.C. records mostly from Coast and Cascade mountains. Only previous record from Vancouver Island (1888) does not give details. These represent first records from below 1000m elevation.

Eudioctria sackeni (Williston). (2%, 2&) Uncommon, 21 June - 8 August; captured in Douglas-fir site and Garry Oak (open) site. Western Montane species, widespread in southern B.C.

Dicolonus simplex Loew. (1%) Uncommon; one specimen collected from Garry Oak (open) site, 21 June 1995. This is a late record; most are from April and May. Pacific Coastal species. Known in Canada only from the Garry Oak meadows of the Gulf Islands and Victoria region.

Subfamily Laphriinae

Laphria asackeni Wilcox. (1&) Uncommon; one specimen captured on the open rocky knoll in the Douglas-fir site, 4 June 1995. Western Montane species, widespread in southern B.C.

Laphria asturina (Bromley). (4%, 2&) 22 May - 11 July. Uncommon; collected only in the Douglas-fir site. Western Montane species; first record for coastal B.C.

Laphria columbica Walker. (3%, 4&) 21 June - 22 August. Uncommon; collected in both the Douglas-fir and Garry Oak (open) sites. Western Montane species widespread in southern B.C.

Laphria fernaldi (Back). (25%, 8&) 4 June - 22 August. Common; collected in both the Douglas-fir (forest and open knoll) and Garry Oak (open) sites. In canopy trap in Douglas-fir (34m). Western Montane species, most common and widespread Laphria species in B.C.

Laphria ferox Williston. (1%, 2&) Uncommon; one female on 4 May 1995, other two specimens between 9 August and 5 September. Found only in the Douglas-fir site, but in both the forest and open knoll sites. Western Montane species widespread in southern B.C.

Laphria ventralis Williston. (3&) 25 July - 22 August. Uncommon; collected in the Douglas-fir site. Pacific Coastal species. Restricted in Canada to dry forests of Victoria area and Gulf Islands.

Subfamily Asilinae

Machimus occidentalis (Hine). (4%, 3&) 22 May - 11 July. Uncommon; collected only on the open knoll in the Douglas-fir site. Dry forests and grasslands of South Coast and Southern Interior.

Neomochtherus willistoni (Hine). (9%, 17&) 22 August - 10 October. Common; found in Douglas-fir sites (both forest and open knoll) and in both Garry Oak woodland and open sites. Dry forests and

grasslands of South Coast and Southern Interior. Mostly late summer, when it replaces spring/early summer flying Machimus.

B. Site Lists

1. Douglas-fir Canopy Site

a) Tree malaise traps (34m): Cyrtopogon aurifex, Laphria fernaldi

b) Ground malaise traps: Cyrtopogon aurifex, Eudioctria sackeni, Laphria asturina, L. columbica, L. fernaldi, L. ferox, L. ventralis, Neomochtherus willistoni.

c) Open knoll malaise trap: Cyrtopogon aurifex, Laphria asackeni, L. fernaldi, L ferox (net), Machimus occidentalis, Neomochtherus willistoni.

2. Garry Oak Site

a) Wooded site: Neomochtherus willistoni.

b) Open site: Eudioctria sackeni, Dicolonus simplex, Laphria columbica, L. fernaldi, Neomochtherus willistoni.

Because of the small numbers of specimens collected and the short collection period, results must be considered preliminary. Several more years of trapping and other collecting are required before the list of species approaches completion. Several rare species, e.g. Nicocles rufus and Scleropogon bradleyi, were not collected. I estimate that at least twenty species inhabit this mixture of environments at Rocky Point.

Several species were restricted to Douglas-fir site: Cyrtopogon aurifex, L. asackeni, Laphria asturina, L. ferox, L. ventralis, and Machimus occidentalis. Machimus would be expected to occur also at the Garry Oak site, along with its relative Neomochtherus willistoni. Both also live in grasslands of the southern Interior of the province. The others are typical conifer forest dwellers, normally restricted to fir, spruce and pine woods of various sorts, including subalpine situations. Laphria ventralis is an exception, being restricted to the Douglas-fir/Arbutus community on southern Vancouver Island and the Gulf Islands. The records of Cyrtopogon aurifex are the first for the coastal Douglas-fir zone.

Dicolonus simplex was collected only in the open Garry Oak site. This is a characteristic species of Garry Oak meadows in the spring. Although it is not rare, its distribution, like that of Laphria ventralis is very restricted in Canada.

Extension and Demonstration

Results of this project were reported in the final report of the multidisciplinary inventory project run on National Defence Properties in 1995:

Morgan, K.H.(compiler). 1995. Baseline inventories of rare species and ecosystems of Department of National Defence properties of Southern Vancouver Island. Canadian Wildlife Service, Environment Canada. Delta, B.C. 120 pp.

See this published report for the findings of Gordon Green regarding the Cladoceran fauna surveyed in the project.

A scientific paper on the robber fly fauna of the Rocky Point area will be published in the Journal of the Entomological Society of British Columbia after more specimens are collected in the larger project (Winchester).

Rob Cannings
February 1996

K - Permit P019-95

Title: Film Turkey Vultures

Author: Susan Wilkey

Organization: White Bear Productions
#3 - 1441 Store Street
Victoria, B.C. V8N 3J6

Location: Rocky Point

Project Overview:

The purpose of this project was to obtain film footage of turkey vultures at Rocky Point. The film footage thus obtained was used on one of the half hour television episodes for the "Investigators of the Last Frontier".

"The Investigators of the Last Frontier" is a 13-part half hour series originating from the B.C. Royal Museum. This series explores the realms of science, history and nature through stories that spring from the millions of artifacts in the museum. One of the segments was be on Eagle and turkey vultures.

No formal written final report was prepared. The video of the film footage is considered to be the final report.

L - Permit P020-95

Title: Film Interview Bat Habitat

Author: John Thomson

Organization: Woodfall Communications Ins.
3517 West 22 Avenue
Vancouver, B.C. V6S 1J4

Location: Rocky Point

Project Overview:

The purpose of this project was to videotape and interview with Mark Brigham in a bat habitat for the television program "@Discovery.CA" on the Discovery Channel. The filmed interview will be used as part of a television report on the significance of bats in old growth forests.

No formal written final report was prepared. The video of the film footage is considered to be the final report.

Appendix 5

Annual reports for Projects Worked on in 1995

A - Permit P002-95

Title: Proposal to Establish Permanent Smithsonian/Man and the Biosphere (SI/MAB) Ecological Monitoring Plots at the Rocky Point Department of National Defence Lands

Author: Trudy Chatwin

Organization: Fisheries and Wildlife
Ministry of Environment, Lands and Parks
2526 Kenworth Road
Nanaimo B.C. V9T 4P7

Location: Rocky Point.

Project Overview:

The objective of the project is to establish two permanent Smithsonian Institute/Man and the Biosphere CSI/MAB) ecological monitoring plots in a coastal Douglas-fir old-growth forest and a Garry oak stand. The project involved the set-up, measurement, and description of two, one hectare permanently marked plots for long term ecological monitoring. All woody vegetation was to be measured. Additional ecological description of soil and understory vegetation will be made. Climatic monitoring equipment will be set up in the plot.

The Measurement of the two SI/MAB plots is a cooperative effort under the Ecological Monitoring Assessment Network (EMAN) of Environment Canada, The Wildlife Br. Of the B.C. Ministry of Environment, Lands and Parks, The Smithsonian Man and the Biosphere Program.

The Douglas-fir old-growth plot was established and measurements made. The Garry oak plot is to be established in 1996. The report on this project "Establishment and Monitoring of Permanent Ecological Plots at the Rocky Point Department of National Defence Lands" follows.

Project Report
Establishment and Monitoring of Permanent Ecological Plots at the Rocky Point Department of Defence Lands

Submitted by:
Trudy Chatwin and Tara Martin
Endangered Species Specialist
2569 Kenworth Road
Nanaimo, BC, Canada
V9T 4P7

January 30, 1996

Title:
Establishment and monitoring of permanent ecological monitoring plots in a Coastal Douglas-Fir Old-growth forest and Garry-oak stand in the Rocky Point Military Reserve.

Project Leader:
Trudy Chatwin, Fisheries and Wildlife, Ministry of Environment, Lands and Parks, 2526 Kenworth Rd, Nanaimo, B.C., V9T 4P7 phone; (604) 751-3150

Location and Study Area Description:
Rocky point Naval Establishment, west of Victoria, B.C., Canada

The Coastal Douglas-fir plot (Figure 1 and 2) is located adjacent to Church Hill)Lat. 48 18' 50", Long. 123 32'33") (UTM 10U Easting 4599, Northing 53524) surrounding the Lester B. Pearson/UVIC canopy research site in an old-growth Douglas-fir-Salal community. This site is located in the Coastal Douglas Fir Moist Marime Biogeoclimatic Zone, (Meidinger and Pojar, 1991) in the Georgia Basin Ecoregion, Nanaimo Lowlands Ecosection, Site Series 4.

The Garry-oak plot (Figure 1 and 3) is located in the vicinity of Fossil Point and Cape Calver(Lat. 48 19'20", Lon. 123 32'33") (UTM 10U Easting 4599, Northing 53524) in polygon 120 on a Garry-oak Brome community.

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

It is expected that 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 characterised by bedrock outcrops, shallow soils and greater exposure to wind and is therefore subject to greater extremes in temperatures.

Study Description and Rational:
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 (November 1994 draft) Goal #2 "To improve our understanding of ecosystems and increases our resource management capability" recommends the enhancement of biological inventory efforts especially in threatened ecosystems. As well, Environment Canada under the auspice of EMAN (Ecological Monitoring Assessment Network) has been directed to establish a series of log-term ecological monitoring stations across Canada.

In 1986 the Smithsonian Institution joined with the Man and the Biosphere program of UNESCO to create the SI/MAB Biodiversity Program. The SI/MAB program focusses on problems associated with maintaining global forest biodiversity, emphasizing practical applications of

research in achieving sustainable resource management. SI/MAB has established a global network of over 100 permanent long-term biodiversity monitoring plots in biospheres reserves and other areas centering on habitats that are richest in biodiversity. These plots are established using a consistent protocol, and data is reported and published in a timely manner.

As Rocky Point Naval Establishement lies withinn the threatened Coastal Douglas-fir Biogeoclimatic Zone and has excellent representative Douglas-fir and Garry-oak community types it provides an ideal site for the establishment and monitoring of permanent SI/MAB /EMAN biological monitoring plots. The restricted entry to the reserves and the association with the arthropod, migratory bird, bat and Garry-oak research lend additional credence and value to having a long-term SI/MAB plot located at Rocky Point.

The measurement and monitoring of the two Smithsonian Man and the Biosphere plots is a cooperative effort under the Ecological Monitoring Assessment Network (EMAN) of Environment Canada, the Wildlife Branch of B.C. Ministry of Environment, Lands and Parks, the Smithsonian Man and the Biosphere Program. Field and funding raising assistance has been provided by the Canadian Department of Defence, Forestry Canada, Tara Martin, and Lucas Diett.

To date, we have set up, measured and described the Douglas-fir plot. A forest profile illustrating the horizontal and vertical structure of the forest has been completed. As well, the measurements taken on DBH, height of tree, height of canopy, species, and wildlife status of the trees has been entered into BioMon, a data base set up for these plots. The results are currently being written up and will be ready for presentation shortly. A dozen representative trees were chosen a random and aged. Accurate ages were achieved for several trees with DBH<=0.5m, however due to the length of the increment borer we were unable to get precise measurement for the large Douglas-firs and will repeat the procedure with a longer borer.

Our next step is to set up and measure the Garry-oak plot and continue our monitoring and ground checking of the Douglas-fir plot. All woody vegetation with a DBH >= 0.04m in the Garry-oak plot will be measured and marked permanently. Additional ecological monitoring description of forest canopy characteristics, soil, coarse woody debris, lichen biomass, amphibian counts, herbaceous layer, and aging will be made. Climate monitoring equipment is to be set up in the plot by Environment Canada.

Objectives of the Work

1. To monitor the SI/MAB permanent plot in an old-growth Coastal Douglas-fir forest at Church Hill.
2. To establish a SI/MAB permanent plot in a Garry-oak ecosystem near Calver Point.

3. To obtain forest structure and composition information on these two plots which will be compared in a world-wide system of 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.

4. To establish a long-term monitoring protocol that will detect trends, such as patterns of recruitment, mortality, and regeneration of forest trees. The baseline climate and abiotic information, in combination with the vegetation information will help determine the past, present, and future viability of the Garry-oak and Douglas-fir ecosystem. The monitoring program will define the natural limits of change in relatively unmodified ecosystems on the threatened South East coast of Vancouver Island.

General Approach and Methodology:
Specific protocol instructions for setting up the Smithsonian Man and the Biosphere ecological Monitoring plots are provided by Dallmeier and Comisky 1994 "Methodology for the Establishment of Permanent Plots." (See Appendix 1).

Basic Steps for establishing the 1 ha plot in the Garry-oak ecosystem.
1. Plot located generally using forest cover maps and logistical considerations.
2.The 1 ha plot is surveyed and marked into 25- 20 by 20m quadrats with slope corrections.
3.The woody vegetation including wildlife trees (over 0.04m DBH) in each quadrat is identified, mapped with range finders, tagged (with aluminum tags or plastic coated wire) and measured (DBH, height, height of canopy). See Appendix 2 for plot description sheet.
4.Description of soil, and understory plants will take place using protocol set out in Appendix 1.
5.A profile transect, including canopy dimensions will be undertaken for the Garry-oak plot along a 10 metre transect.
6.Data will be entered into BioMon program and a paper will be written

Results and Progress to January 30 1996:
Measurements on the Douglas-fir plot in Church Hill were completed in November 1995. The data was then entered into BioMon and is now being analyzed. After the completion of ground checking and verification of results a report on the findings will be produced. A profile showing the horizontal and vertical structure of the forest was completed and presented with preliminary data in January 1996 at the National Meeting on Ecological Monitoring and Assessment Network, in Halifax. Aging of several representative trees was also completed, however further aging will have to be done using a longer increment borer.

To date, the Garry-oak plot has been chosen and surveyed and is now ready for measurements to begin.

Vegetation Description of Douglas-fir Old growth plot in Church Hill:
The main coniferous tree species of the plot are Douglas-fir *(Pseudotsuga menziesii)* and Grand Fir (*Abies grandis*). Shore Pine (*Pinus contorta*), and Western Hemlock (*Tsuga Heterphylla*) are

also common. Deciduous tree species are less frequent yet include Red Alder (*Alnus rubra*), Bitter Cherry (*Prunis emarginata*), and Service Berry (*Amelanchier alnifolia*). A dense understory of Salal (*Gaultheria shallon*) interspersed Ocean Spray (*Holodius discolor*) and Sword fern (*Polystichum munitum*) characterise the plot. In total there were 13 tree/shrub species representing 8 families in the 1ha plot. The tallest tree was a Douglas-fir reaching 55 metes with a DBH of 1.4 metres.

End Product and Proposed Work:
This years project will lead to the write up of the results from the baseline data collected on the Douglas-fir plot and the establishment of a second Smithsonian Man and the Biosphere plot in the Garry-oak ecosystem. It is hoped that the measurements for the Garry-oak plot will be completed by the March 1996, so that analysis and write up can begin. It is also hoped that this information combined with data from the climate station promised by Environment Canada will assist other research in the area such as the arthropod, bat and migratory bird studies.

Extension and Demonstration
Potential tours would be done in conjunction with the Canopy Arthropod research team and any other research in the Rocky Point site. This work has been written up in Biodivesity News No.4 Spring/Summer 1995 (a Smithsonian Publication), and "Baseline Inventories of Rare Species and Ecosystems of Department of National Defence Properties of Southern Vancouver Island,"(November 1 1995, Canadian Wildlife Service). The project was also presented at the 1996 National Science meeting (EMAN) conference held in Halifax in January 1996.

Budget Information
Costs for this project in 1996 are related to equipment and surveying cost, personnel will be salaried or volunteer. Our principal funding ($3000) is to come from Environment Canada (EMAN) which will cover the expenses of field Ecologist Tara Martin and research assistant Lucas Diett and expenenses occured by Trudy Chatwin in getting the plot surveyed..

Tara Martin and Lucas Diett will carry out the principal inventory, and data entry and analysis. Trudy Chatwin will be responsible for the supervision of personnel associated with the project.

Survey cost Garry-oak (2 person team for 1 plot and equipment) - 1.5 days	$600
Equipment for vegetation inventory	$100
DBH tapes, clinometers, 50m tape	
Tree tags (700) 4" nails, plastic coated wire,	
white calking, data sheets, data folder	
Plot measurements (2 people- 5 days)	$1000
Data Entry and write up (1 person - 4 days)	$500
Total estimate for Garry-oak for 1996	$2200

Project Members
Trudy Chatwin -Project Leader- Fisheries and Wildlife Nanaimo
Tara Martin - Field Ecologist and Technical Contact
Michael Dunn - Canadian Wildlife Service
Don Eastman - Wildlife Branch , B.C. Ministry of Environment, Lands and Parks
Lucas Diett- Research assistant
Simon Franklin- Student University of Victoria

Milestones Time Frame
Douglas-fir Plot

Activities	Time needed	Personnel required	Date
Ground Checking	1 day	2 person team	Feb 1996
Data analysis and Writeup	4 days	1 person	Feb-Mar 1996
Herbaceous Layer	3 weeks	2 person team	April 1996
Additional measurements, (aging, lichen biomass, soil, etc.)			May 1996
Garry-Oak plot			
Plot measurements	2 week	2 person team	Feb 1996
Data Entry into BioMon	1 week	1 person	Feb 1996
Ground checking	2 days	2 person team	Feb-Mar 1996
Analysis and Write up	2 weeks	1 person	April 1996
Additional measurements profile, soil pit, lichen biomass, etc...			May-July 1996

Recommendations
Working on the monitoring and establishment of the permanent plots has thus far been a rewarding experience. The security of the area provides some limitations for entry but this is more than made up by the value this security provides for the long-term monitoring. The plot provides excellent training and research opportunities for ecology, biology and geography students and we hope to coordinate with them in the future.

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

Meidinger, D., Pojar.J.,(1991) Ecosystems of British Columbia, Resarch Branch Ministry of Forests, Victoria B.C.

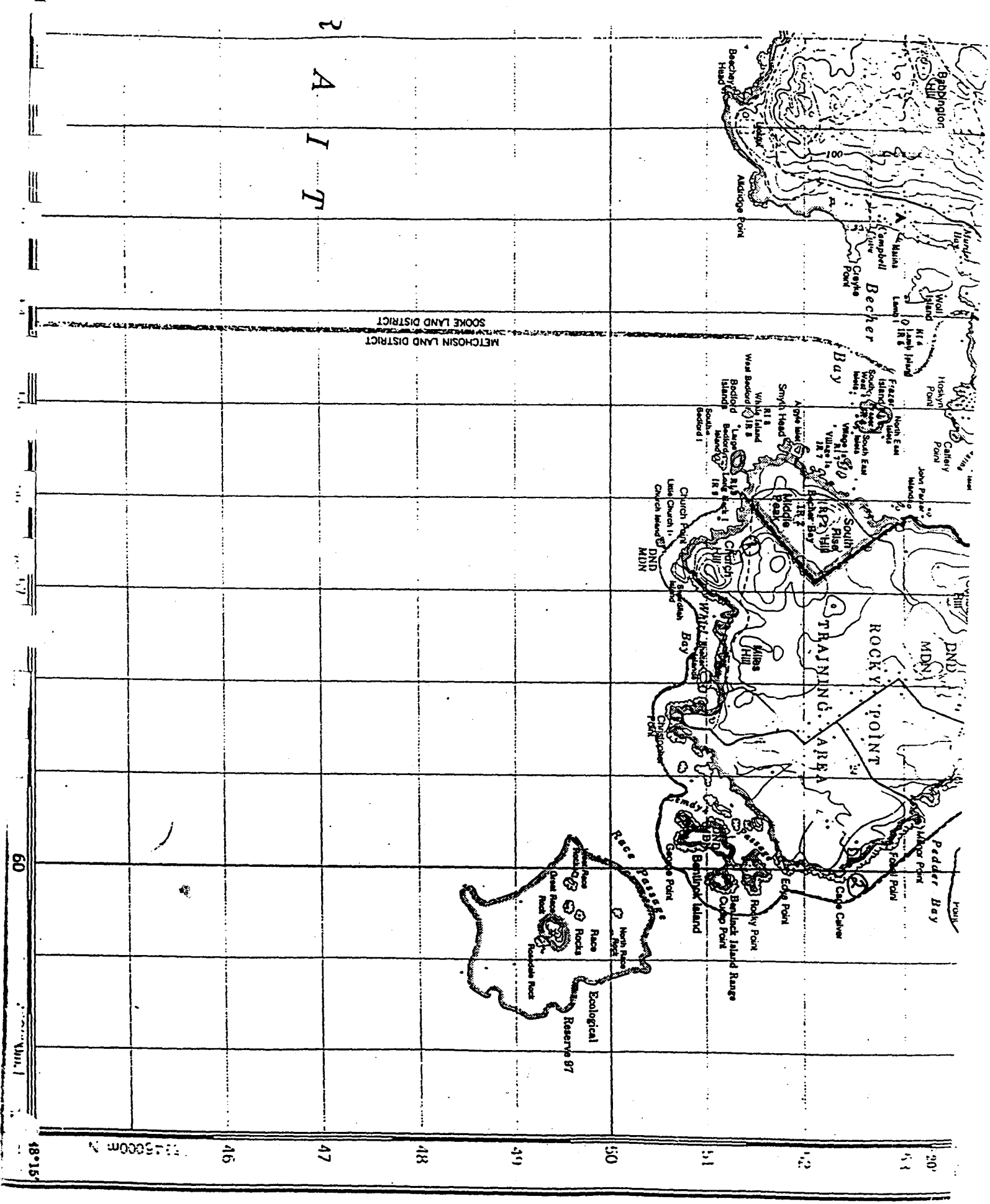


Figure 1. Location of the Church Hill (1) and Calver Point (2) SI/MAB Permanent Ecological Monitoring Plots at Rocky Point Department of Defence Lands

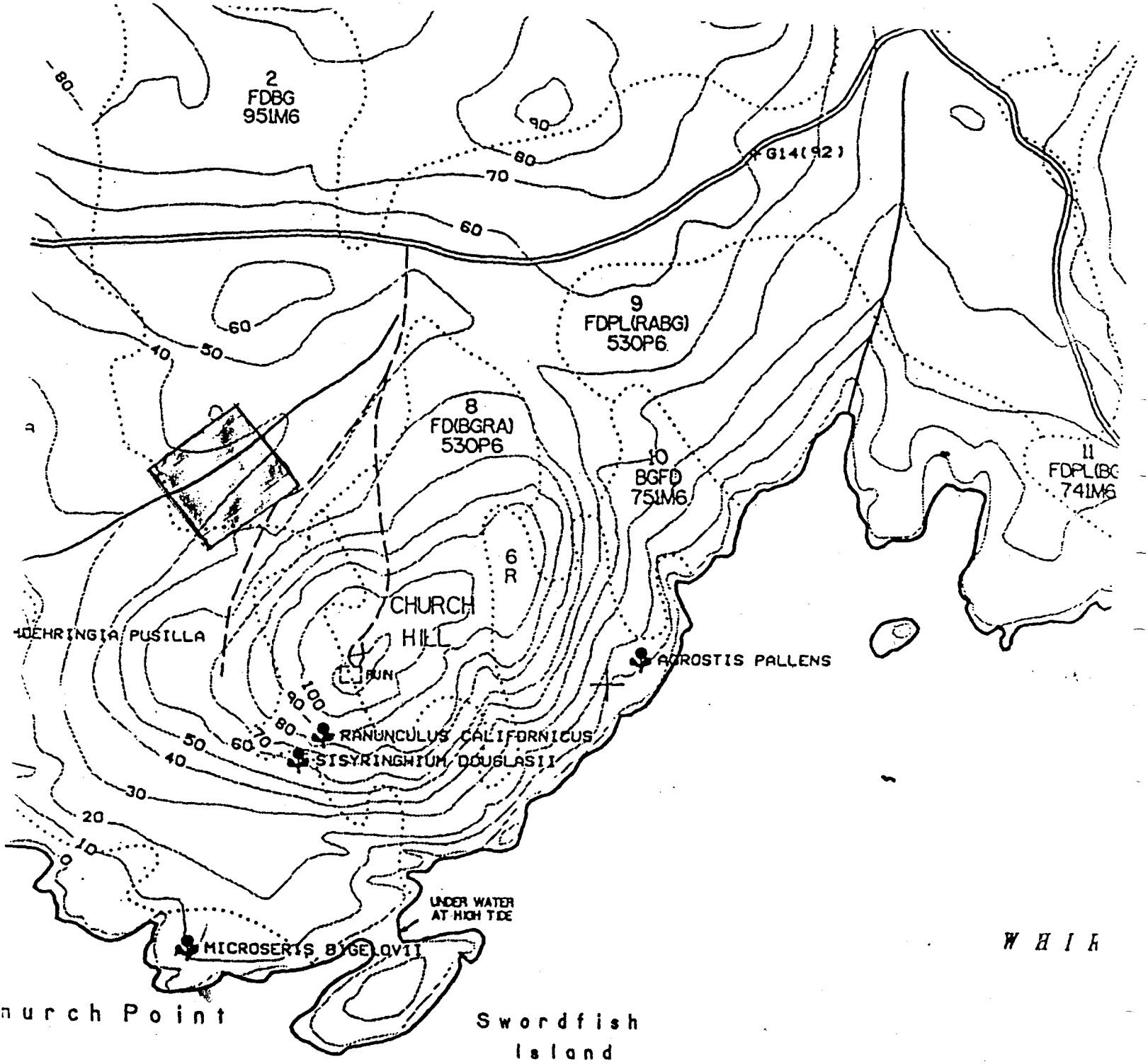


Figure 2. Location of the Church Hill Old-growth Douglas-fir SI/MAB plot

Figure 3. Approximate location for the Calver Point Garry-oak woodland SI/MAB plot

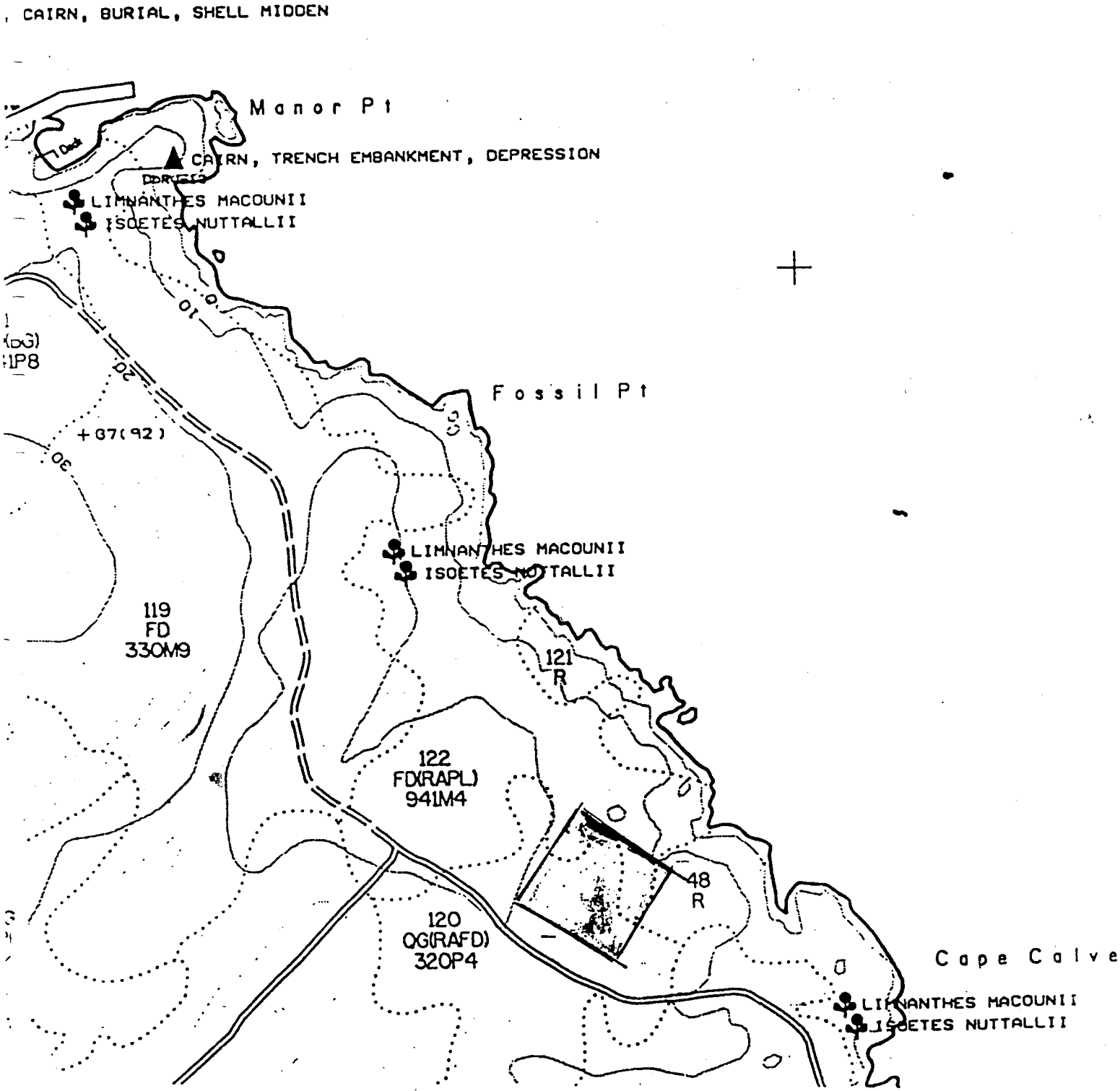
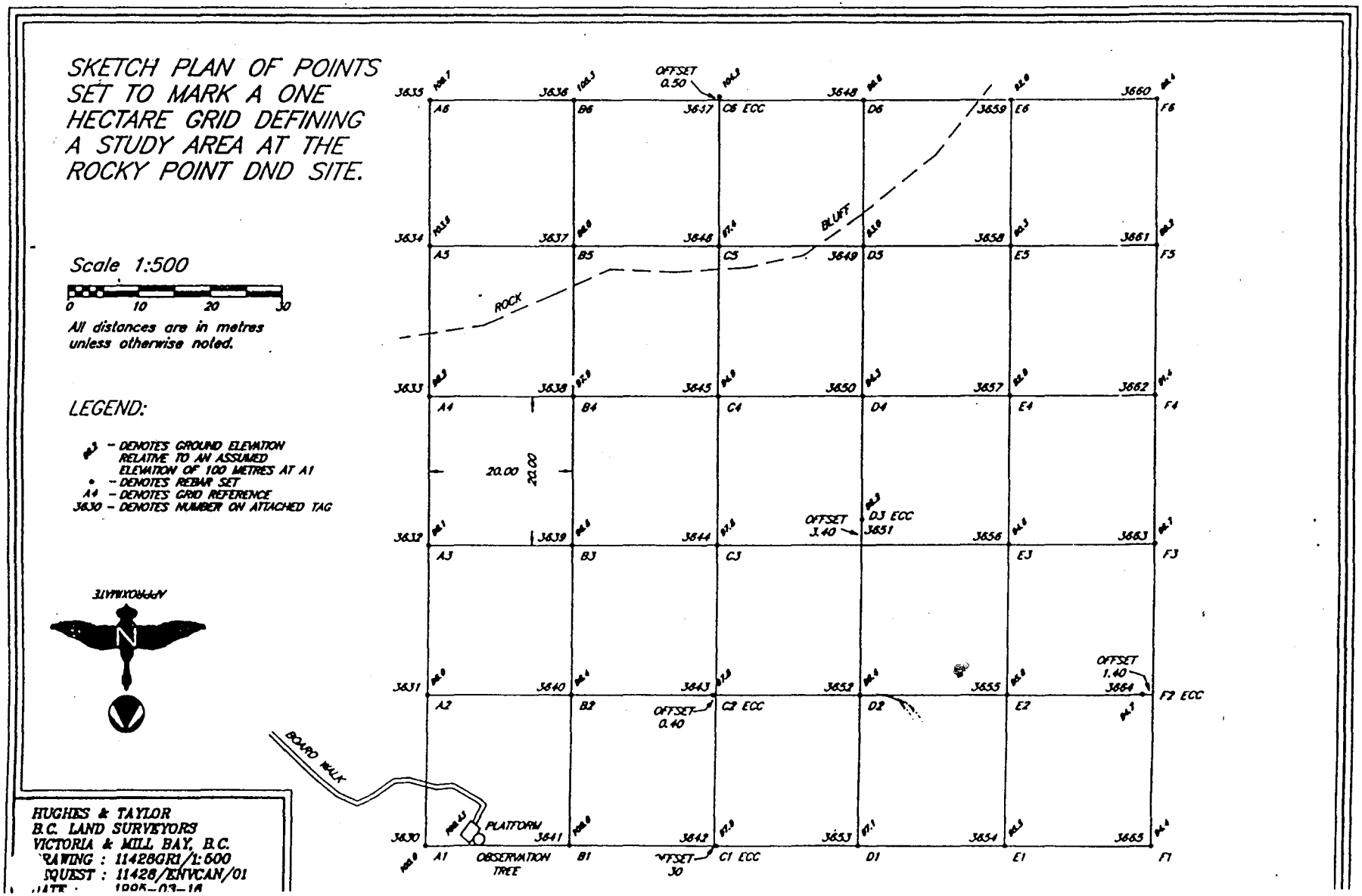


Figure 4. Plan of Points to mark 1 hectare SI/MAB Plot at Church Hill Coastal Douglas Fir Site



Appendix 1

Trudy Chatsom

SMITHSONIAN INSTITUTION/MAN AND THE BIOSPHERE

Methodology for the Establishment of Permanent Plots Biodiversity Measuring and Monitoring Course 1994

Francisco Dallmeier
and
James Comiskey

THE SMITHSONIAN INSTITUTION/MAN AND THE BIOSPHERE
BIOLOGICAL DIVERSITY PROGRAM
Washington, D.C.

Methodology for the establishment of permanent plots

A. Surveying and numbering plots

In the one-hectare configuration used for SI/MAB permanent plots, the area is surveyed in a horizontal plane using a theodolite. This method is consistent with research initiatives in other SI/MAB plots throughout the neo-tropics. It is essential that the original establishment of the plots be carried out as accurately as possible to ensure that future researchers know the exact location and dimensions. The one-hectare plot is divided into 25 quadrats, each 20 x 20 meters in size (Fig. 1). Generally, 20 meters is the longest distance that can be accurately surveyed in a dense forest.

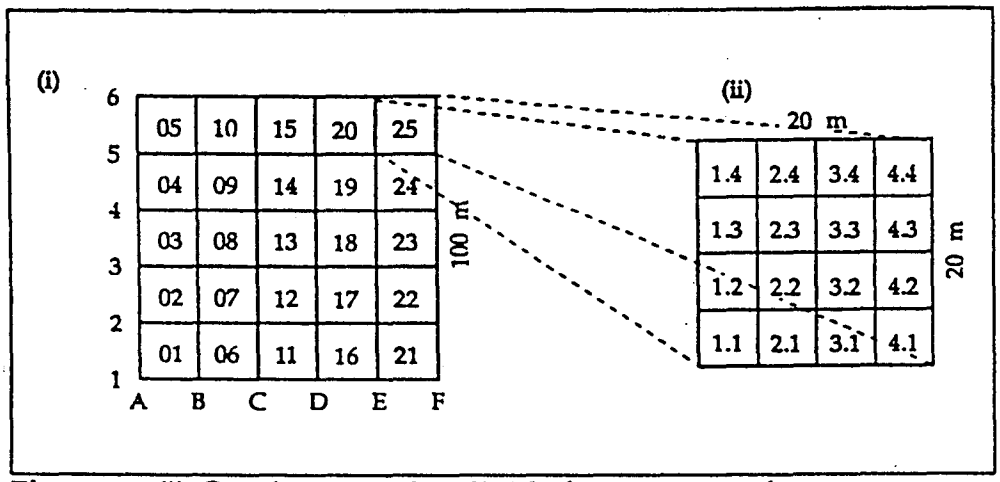


Figure 1 (i) One-hectare plot divided into 25 quadrats.
(ii) One 20 x 20 m quadrat divided into 16 quadrats.

Surveying to establish quadrat corners proceeds from the center of the plot outward to eliminate errors. A row of quadrats is built north to south along the center line from its midpoint; new quadrats are then added westward until rows two and three are completed. The next step is to finish the center row before moving to the eastern portion of the plot and establishing the remaining quadrats. This methodology is further elaborated in Dallmeier *et al.* 1992.

To begin the survey, researchers set up a tripod-mounted theodolite and level it using a plumb-bob positioned over the center of the first corner stake. We avoided taking measurements in close proximity to metal objects such as belt buckles, jewelry, glasses or wristwatches that tend to cause errors in the magnetic reading of the theodolite and compass.

Corrections for slope are made, ensuring that each of the quadrats contains 400 square meters regardless of topography. Calculations used are fully described in Dallmeier *et al.* 1992. The equations used are as follows:

Slope Correction=1/cos arctan (%slope/100)

The quadrats are permanently marked at each of their corners with aluminum or plastic stakes and tagged with a letter and number to differentiate their location within the plot. Marking starts at the baseline, which is the north/south border on the east side of the plot. All stakes protrude well above the forest floor to increase visibility. Red stakes are used for the plot corners and white for marking the quadrats.

During the survey of each quadrat, additional stakes are set every 5 meters using a metric tape. This delineates the 16 subquadrats (each 5 x 5 meters in size) within the 20 x 20 meter sampling units. Setting the additional stakes at the same time surveying is conducted eases the task of making necessary corrections for slope. All 16 subquadrats are allocated a number (Dallmeier *et al.* 1992).

Before continuing the survey, string is tied along the borders of the quadrats. This helps in locating trees within each specific allocated area.

i. Equipment requirements

1 theodolite
1 surveying pole
2 field notepads
2 additional weights
2 fifty meter-metric measuring tapes
36 stakes
String to mark 20 x 20-meter quadrats
String to mark 5 x 5-meter subquadrats
1 compass
1 scientific calculator and extra batteries
2 rolls red flagging tape

B. Tree tagging, measurement and identification

Tree tagging and identification begins as soon as the corner stakes of the quadrats are set and the strings tied. The process includes locating all trees with a diameter of 4 centimeters at breast height (dbh), then measuring, marking and identifying the species. To accomplish these tasks, a team of three individuals walks the quadrat, starting at the left corner baseline of each quadrat and moving in concentric clockwise circles of decreasing size to the center of the quadrat. The dbh should be

measured with a diametric tape, avoiding any protrusions on the trunk. Smaller trees may be measured with calipers. The field form (Appendix 1) provides spaces to record all the measurements taken in the field -- tree number and stem number for trees having more than one stem at the point of measurement; point of measurement if other than at breast height (1.3 meters); line number, A and B location measurements (see next section); the diameter of the stem; the height of the tallest branch; status of the tree; and notes of other pertinent information. Where a tree has several multiple stems, all stems with a diameter greater than one centimeter should be measured and tagged, the stem numbering should proceed from the largest to the smallest. Each specimen is identified in the field if possible, and herbarium specimens collected. In some cases subsequent visits by a botanist are required to complete species identification.

The aluminum label faces outward, oriented toward the baseline of the plot and set with a nail 20 cm above the point of measurement. Aluminum nails work best to set the tags, although steel nails may be needed for extremely hard wood. The nail is driven to angle down and just far enough in so that it will not fall out when pulled or when bark falls off, leaving enough room for the tree to grow before "eating" the tag. The nails thus serve as a general guide for future measurements.

Each individual tree is tagged with a different number consisting of a sequence of three double digits. Using (01-24-09) as an example, the first two numbers (01) designate the plot number. The second set (24) identifies the quadrat within the plot, and the last two numbers (09) represent an individual tree within the quadrat. No other tree receives this number. As mentioned above, where a tree has multiple stems each stem tag should have an additional number. In the case of stem (01-24-09-2), the last digit indicates the stem number, the "2" marking the second largest stem of the tree. The tree numbers start at 1 in each quadrat and continue until the last tree is labeled.

i. Equipment requirements

2 dbh tapes
10 cans of red spray paint per hectare
800 aluminum tags and 2" nails
25 data sheets

C. Tree mapping

In addition to measuring and identifying trees in the quadrats, SI/MAB researchers map each tree to the nearest centimeter. A mapping team of six people uses measuring tapes of 50 meters, or automatic range finders, and a dbh tape to accomplish this task. The tree is located by one person known as the "tree locator." Another person holds a colored flag pole to mark the tree's location while two additional people measure line A and two others measure line B, (where rangefinders are used, only one person is required for each of these measurements). These lines denote the diagonal distance from a left quadrat corner (line A) to the tree being measured and from a right corner (line B) to the same tree (Fig. 7). The lines also allow measurements from any of the four sides of the quadrat. The coordinate corners are denoted by their intersecting boundary lines (quadrat boundary lines are numbered in clockwise sequence from one to four, starting at the baseline).

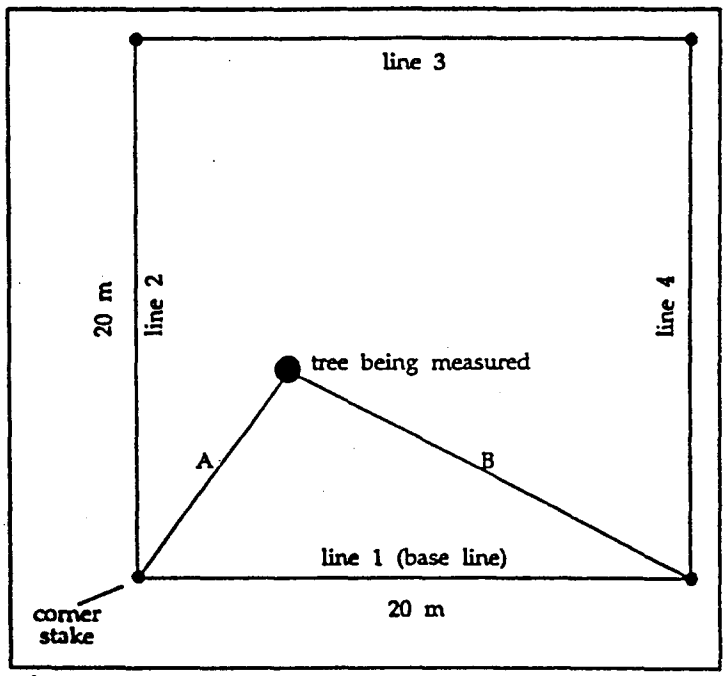


Figure 2 Tree Mapping

This system, although designed for 20 x 20-meter quadrats, is also practical for use in 5 x 5-meter subquadrats where two people can map all vegetation at least one centimeter dbh. Further applications of this methodology are discussed in Dallmeier 1992.

i. Equipment requirements

50 data sheets per hectare
6 fifty-meter measuring tapes
2 dbh tapes

Appendix 2

International Network of Biodiversity Monitoring Plots

CHURCH HILL

PLOT: 1 QUADRAT: 5

NAME: DATE:

top/crown/bottom %

Wildlife Branch
Ministry of Environment, Lands, and Parks
780 Blanshard Street
Victoria, British Columbia V8V1X4

Smithsonian Institution/MAB
Biological Diversity Program
1100 Jefferson Drive, SW, Suite 3123
Washinghton, D.C. 20560

Tree	Species	Line	AG (m) SAM	BG (m) TRUDY/CAREW	DBH(m)	~~Height~~ Horizontal DIST.(m)	Status	Notes
01-05-01	Doug Fir	6	AG 19.89	AS 2.66	.39	23m	LS	*84/170/-10
-02	Doug Fir	6	AG 18.57	AS 5.04	.60	26	LS	95/51/-12
-03	Doug Fir	6	AG 19.21	AS 2.32	.17	—	DS	actual height 6m
-04	Ocean Spray	6	AG 17.16	AS 3.88	.06	—	LS	" " 5m
05	Ocean Spray	6	AG 17.26	AS 4.05	.06	—	LS	" " 6cm
06	Doug Fir	6	AG 15.35	AS 5.61	.86	18	DS	68/-2 notveg
07	Doug Fir	6	AG 10.95	AS 9.77	.24	23	LS	91/52/3
08	Doug Fir	6	AG 11.30	AS 9.96	.34	21	DS	72/-1 no tr crow
09	Doug Fir	6	AG 12.24	AS 9.71	.46	23	LS	104/161/-6
10	ABGR	6	6.96	17.9 BG	.18	27.0	LS	45/28/-11
11	PSME	6	4.98	19.7 BG	.31	17.08	LS	91/54/-26
12	PSME	6	4.11	16.56 BG	.43	20.52	LS	90/28/-357
13	PSME	6	0	20 BG	.43	22.68	LS	94/41/-16 on the lin
14	PSME	6	6.16	14.22 BG	.83	4.19	DS	20/NA/-10 7727-
15	PSME	6	14.38	6.20 BG	.28	9.38	LS	95/50/-40 30% lean
16	PSME	6	19.52	6.08 BG	.43	17.27	LS	98/29/-42
X	ABGR	6	18.84	4.87 BG	.01	~~R~~	LL	1.8m high
17	PSME	6	24.21	13.00 BG	.39	25.78	LS	69/20/-27
18	PSME	6	N/A	18.20 G	.57	30.22	LS	75/25/-31 on B
19	PSME	6	N/A	7.45 G	.15	N/A	DL	2.3m high on B

D. SI/ MAB Biological Monitoring System (BioMon)

BioMon requires an IBM-compatible computer with a hard drive, a minimum of 2 megabytes RAM and one floppy disk drive. A portable dot-matrix printer is also needed. The menu-driven system, based on the Paradox database, allows the user to enter the data collected in the field and to access any other relevant information pertaining to the data in question.

Data collected in the field are entered on pre-printed forms, Appendix 1. This hard copy is necessary for backup and archival purposes at the research site and SI/MAB offices, acting as a cross-reference for information entered into BioMon at the base camp. One form is allocated to each quadrat within the plot.

Once data has been collected, it is entered into BioMon as discussed in the "BioMon Guide". On completion of data entry, the information is easily viewed and edited, so that more information can be added or corrections made. Sections of the data may also be printed, providing a hard copy of the database content. Maps of the quadrats may be printed for field verification.

Following data verification, researchers can obtain an array of basic calculations for each site, including the number of species, and their relative density, dominance, and frequency. The program can also produce distribution maps for selected species within the plot. This ability to provide basic analyses while still in the field is a major benefit of BioMon. Researchers can conduct further investigations on site to help in immediate interpretation of the information.

B - Permit P003-95

Title: Migration monitoring of neotropical landbirds.

Author: Rhonda Millikin

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

Location: Southeastern corner of CFAD Rocky Point, centered at Building 100.

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.

START DATE: July 7, 1995 COMPLETION DATE: September 30, 1995

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.

Migration volume does not differ between spring and fall. An average of 36.0 birds of 10.9 species per day were banded in spring versus 31.4 birds of 12.3 species per day in fall. This was substantiated with the visual results; a total of 7656 birds of 121 species were observed using the site during 24 days in the spring and 7919 birds of 119 species were observed over 23 days in the fall. Consistently, the predominant species are: Lincoln's sparrow, Savannah sparrow and Orange-crowned warbler.

The capture rate at Rocky Point (0.3 birds per net hour) is consistent with other migration stations in British Columbia.

b. Research Activities:

A radar monitoring system was developed to include a marine radar mounted on top of a camper, coupled with a remote microphone, both of which are down-loaded to a VCR and the entire system is powered by batteries. Data recorded is direction, number and grouping (thrush, warbler, sparrow, waterbird, etc.) of birds.

Peak nocturnal migration activity in the spring was between 2400 and 0100 hours, whereas peak activity in the fall was at dusk and dawn. Weather patterns fascilitating migration flight were consistent spring and fall; migration activity was greatest with no wind or following winds. Opposing winds forced birds off their flight path; in spring, northwesterly winds forced birds up the east side of Vancouver Island and in the fall, birds headed almost directly east. In the fall only, we observed a reverse migration towards dawn, where birds were observed to head north instead of south, presumably because there was not enough time to cross the Juan de Fuca strait before light.

c. Extension and Demonstration:

Presentations given to Victoria volunteers and Delta Naturalists.

C - Permit P005-95

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

Author: Dr. A. K. Mitchell (604) 363-0786

Organization: Pacific Forestry Centre
506 W. Burnside Rd.
Victoria, B.C. V8Z 4N9
(604) 363-0786

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

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.

START DATE: 1993 COMPLETION DATE: 1997

Objectives

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

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

Accomplishments to Date

a) Highlights of findings

Activities in 1995 centered around detecting environmental stresses on Pacific yews in natural stands. Monthly 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). In addition tree and soil water status measurements were conducted.

Both tree and soil water stress were evident at all the locations. Tree water potentials were as low as -3.0 MPa and soil moisture contents declined to as low as 4% volumetric water content. This was indicative of great drought tolerance capacity in the trees, probably as a result of tight closure of the stomata and withdrawl of water from the stems and branches to replace that lost through the cuticles of the leaves.

In shady understorey environments, Pacific yews must maintain a positive balance between the carbon spent in growth and that accrued in photosynthesis to survive and grow. This is accomplished 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, chlorophyll fluorescence, and foliar nutrient levels.

Photosynthesis rates were reduced primarily as a result of low light levels in the understorey and not as a result of water stress. The capacity of the trees to capture light energy was reduced by drought in August. Chlorophyll fluorescence was a sensitive indicator of water stress and may be more useful than other measures in detecting whether the trees are under stress.

b) Research Activities

1. Plot establishment

Three study sites were chosen in the Coastal Douglas-fir (CDF) biogeoclimatic zone on southern Vancouver Island. Plots were then established at Rocky Point, Royal Roads, and Colwood Fuel Depot (DND property) in which three male and three female trees were selected for physiological measurements. Adjacent to the sample trees, neutron probe tubes were installed at all 3 sites (one tube installed at the base

of each tree, 18 tubes in all). Dendrometer bands were installed on all the sample trees so that increments in growth could be followed throughout the season.

2. Physiological measurements

Photosynthesis was measured monthly on 3 trees at each site. Both current-year and 1-year-old foliage (6 measurements per tree) will be 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 on all 6 trees at each site. Current-year and 1-year-old shoots will be analysed on 12 shoots per tree (6 current-year, 6 1-year-old) using a CF-1000 (P.K. Morgan, Andover, MA).

Tree water stress was measured monthly on each of the 6 trees at the 3 sites using a pressure chamber to determine xylem water potential of 2 shoots (mid-crown) from each tree. Shoots were sampled in the morning and the afternoon to account for diurnal fluctuations in tree water potentials.

Foliar nitrogen concentrations of current-year and 1-year-old shoots on all sample trees (18 trees) were measured at two selected times before (April) and after (July) shoot elongation.

3. Environmental measurements

Soil moisture content was measured at each of the 6 trees at each site using a neutron hydroprobe. Soil moisture (%) will be measured at 10, 20, 30, and 50 cm depths. Dendrometer band readings will be taken in conjunction with the soil and tree water stress measurements.

Light measurements were made at monthly intervals at each sample tree to characterize the variation in incident radiation over the growing season.

4. 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:

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 Defence (DND) land on South Vancouver Island: Pacific yew. In: Department of National Defence 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.

Publications:

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

Mitchell, A.K. 1996. Rooting cuttings of Pacific yew (Taxus brevifolia) from Vancouver Island locations. Northwest Science (submitted)

Hogg, K.E., A.K. Mitchell and M. Clayton. 1996. Discovery of a monoecious branch of Pacific yew (Taxus brevifolia Nutt.). Canadian Naturalist (in preparation)

Mitchell, A.K. 1996. Shade tolerance in Pacific yew (Taxus brevifolia: foliar acclimation to exposure. Tree physiology (in preparation)

Mitchell, A.K. R.W. Duncan, T.A. Bown and V.G. Marshall. 1996. Distribution of the yew big bud mite on Pacific yew (Taxus brevifolia) in British Columbia. Can. Ent. (in preparation)

Prepared by: A. K. Mitchell, Ph.D.
December 21, 1995.

D - Permit P006-95

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

Author: Mr. N.N. Winchester Phone: 721-7102 (7099)

Organization: University of Victoria
Department of Biology,
P.O. Box 1700
Victoria, BC V8W 2Y2

Location: Rocky Point and Rocky Point Pearson College Canopy Station

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 survivorship will be examined in the field to elucidate variables that contribute to the observed community structure.

Accomplishments to Date:

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

b) **Research Activities:**
Trap installation and the sample program where successfully implemented and components of the sample design were run from December 1994 to December 1995. The total samples generated for each component of the research program are:

1) Malaise traps: 432
2) Pan traps: 384
3) Pitfall traps: 144
4) Beetle traps: 144
5) Branch clipping: 120

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 200 Malaise traps and the remaining traps are currently being processed. In addition, over 25,000 specimens from a variety of arthropod orders have been sorted from 100 Malaise traps. The Coleoptera fauna from the beetle

have been sorted from 100 Malaise traps. The Coleoptera fauna from the beetle interception traps have been sorted, labelled 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

1) Presented two papers on aspects of the project at the Canadian Entomological Society meetings held in Victoria on October 17-19, 1995.
2) Presented one paper on aspects of the project at the Royal Entomological Society meetings held in London, England on September 14-18, 1995.
3) Completed interviews and filming with: Mark Moffet, National Geographic Society; Kevin Krajchuck, Discover Magazine; Doug Colwell, free-lance journalist. The Discover article was published in the Nov./Dec. 1995 issue and was titled "The Secret Life of Backyard Trees".

Neville Winchester
Department of Biology
University of Victoria

E - Permit P009-95

Title: Ecology and Behaviour of Insectivorous Bats in the Canopy of Old Growth Forest: British Columbia

Author: Dr. R. M. Brigham

Organization: Department of Biology
University of Regina
Regina, Saskatchewan S4S 0A2

Location: Rocky Point.

Project Overview:

The project assess the vertical distribution of foraging activity by Vespertilionid bats in Coastal Western Hemlock old-growth forest (Wetter CWH) and Very Wet Hyper-Maritime (CWHvh1). The project documents the species present and their relative activity at ground and canopy levels to determine if there are any changes in the bat community structure between the canopy and forest floor and if there are any changes in bat community structure and habitat use in the different forest types.

The report "Vertical Structure in the Bat community in Old-Growth Temperate Rain Forests" follows.

START DATE: April 15, 1995 COMPLETION DATE: December 31, 1996.

1) **Permit Number:** P009-95

2) **Title:** Vertical structure of the bat community in old growth temperate rain forests.

3) **Project Leader:** Dr. R.M. Brigham. (Ph.: 306 585-4255)

4) **Location:** DND Rocky Point.

5) **Project Overview:**

Here we state the major aims of this study, and include a summary of its theoretical framework.

In forests, particularly old-growth forests, vertical heterogeneity is ordered and may be viewed as stratification or layering. Distinct layers such as the canopy, understorey, and shrub are typically recognised. They can be viewed, simplistically, as habitat edges that run in the horizontal plane. For forest dwelling bats, vertical stratification in forest structure may be an exploitable habitat feature. By short vertical movements into different forest layers, rapid shifts between structurally distinct microhabitats should be possible and may be advantageous. Determining to what extent bats use this dimension of forest structure, and how its use differs between species, was the principal objective of this study in 1995. The aim is to elucidate three dimensional patterns of habitat use by insectivorous bats, be that for the purposes of feeding, roosting and/or commuting to preferred foraging sites. By viewing forest habitats as a complex volume of space, exploitable in three dimensions, a more pervasive understanding of how bats use this habitat may be developed.

In this study vertical forest structure will be quantified as profiles of foliage density. Increasing foliage density can be viewed as decreasing uncluttered space within which a flying animal can manoeuvre. Small interspecific differences in wing morphology have important implications for manoeuvrability and agility, and may be reflected in different vertical microhabitat associations. Predictions about bat activity, based on ecomorphological theory, were made regarding vertical microhabitat association for sympatric species in three forest types on the west coast of Vancouver Island, British Columbia. Predictions will be tested using ultrasonic detectors and mist nets set at three heights, corresponding to the canopy, understorey, and shrub layers.

6) **Objectives:**

a. Assess the vertical distribution of foraging activity by vespertillionid bats in three coastal old-growth forest types on Vancouver Island, British Columbia.
b. Determine habitat structure (in particular vertical structure) differences between the forest types.

c. Determine if vertical habitat structure is linked to bat community composition, through correlational analysis of microhabitat association and vertical forest structure in different forest types.

d. Compare predicted interspecific vertical microhabitat associations with observed distributions.

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

a) Research Activities:

During the 1995 field season three forest types were sampled, representing two biogeoclimatic zones and three subzones (see table 1 of attached manuscript). Bat activity was sampled on a total of 55 nights using ultrasonic detectors and nylon mist nets. The sampling intensity (# of nights) per forest type was as follows:

Upper Carmanah Watershed -	25 nights (69 detector nights)
Rocky Point -	21 nights (63 detector nights)
The Gorge -	9 nights (27 detector nights)

At each site (forest type) 5 sampling trees were climbed by a professional arborist who attached pulleys to canopy level branches (refer to the manuscript for details of tree selection). Using these pulleys, bat detectors were raised to three levels in the forest (i.e. canopy, understorey, and shrub layers; figs 4, and 5). This resulted in a total of 3895 recorded bat call sequences. At present we are in the process of analysing these recordings using Anabat 5.2 software.

b) Highlights of Findings to Date:

During the 1995 field season 52 bats of 5 species were captured in mist nets. In descending order of number captured: *Myotis lucifugus* (Little brown bat); *Myotis californicus* (California bat); *Lasionycteris noctivagans* (Silver-haired bat); *Myotis evotis/keenii* (Western / Keen long-eared bat); *Corynorhinus townsendii* (Townsends' big-eared bat). All bats were netted at ground level. A preliminary forest canopy level netting program was initiated. The canopy was sampled for a total of 12 net nights.

Preliminary analysis of recorded echolocation call data suggests clear differences between forest types in vertical, and total, bat activity. Our analysis, although in its early stages, appears to support the contention that levels of physical 'clutter' in bat flight space are inversely proportional to levels of bat activity measured through echolocation call production. More data are needed to determine the strength of this relationship. Interspecific differences in vertical activity may be exposed when analysis of recorded calls has been completed and call sequences separated to species or species group with Anabat 5.2 software (see manuscript for further details).

c) Extension and Demonstration:

A presentation of current and future forest related bat research was given by R.M. Brigham (RMB) to a joint audience of Ministry of Forestry and Ministry of Environment personnel at the MoF main office in Victoria, May 1995. In July RMB, K.R. Hecker, and

P.A. Bradshaw (PAB) gave a public presentation at Goldstream Provincial Park, B.C. which included a demonstration of bat detectors and mist netting. In October RMB was interviewed on regional CBC radio in Vancouver. A portion of the interview referred to his bat research in BC. PAB presented preliminary results from the 1995 field season at the successful '1st International Bats and Forests Symposium' held in Victoria. This conference was organised and chaired by RMB and R.M.R. Barclay. Proceedings from this symposium will be published early in 1996. Also in October RMB collaborated with the Discovery Channel in the production of a documentary reporting the bat research that RMB is conducting on Vancouver Island. This film was aired at the beginning of November. In November, RMB gave a 30 minute interview on national CBC radio (Vicki Gabereau) where he talked specifically about his research in British Columbia and about bats in general.

In the future we plan to continue this strong commitment to the public exposure of our research, and aim to reach as wide an audience as possible. Further public talks are planned. PAB has been invited, with expenses paid, to present the early findings of this study at the 'Four Corners Bat Symposium' in Durango, Colorado, in January 1996, and will present a talk at the 'Prairie University Biological Symposium' in Lethbridge, Alberta, February 1996.

F - Permit P010-95

Title: Bat Inventory of DND Lands

Author: Dave Nagorsen

Organization: Royal B.C. Museum
675 Belleville Street
Victoria, B.C. V8V 1X4

Location: Albert Head, Mary Hill Battery, Nanoose CFMETR, and Rocky Point.

Project Overview:

The project monitored the command post at Mary Hill Battery to determine its use as a Townsend's big-eared bat nursery colony. In addition, man-made structures at Mary Hill, Rocky Point, Albert Head, and Nanoose were surveyed for summer nursery colonies and their potential for winter hibernacula. The project also evaluated human disturbances in the tunnels and command post at Mary Hill. The project developed specific recommendations for protecting the tunnels and command post, developing a protocol for access to the Mary Hill structures, and further surveys of Albert Head.

This report is given in the report Nagorsen, David, Kerridge, David, and Nagorsen, Nancy. 1995. "Bat Inventory of Man-Made Structures on department of National Defence Properties - Preliminary Report" IN K.H. Morgan (compiler). 1995. Baseline Inventories of Rare Species and Ecosystems of Department of National Defence Properties of Southern Vancouver Island. Environment Canada, Canadian Wildlife Service, Delta, B.C. Pages 2 - 8.

G - Permit P017-95

Title: Demographics of Allium amplectens

Author: Allan R. Hawryzki

Organization: Malaspina College
900 5th Street
Nanaimo, B.C. V9r 5S5

Location: Nanoose Bay CFMETR

Project Overview:

The project is a 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. A series of permanent plots were established in each of three different populations. Measurements were made on the individuals in the plots. Sample bulb were obtained for testing to determine germination rates, ploidy, and plant fertility.

The results of the project are outlined in the following report "Population Demographics of *Allium amplectens* Torr. At the CFMETR (Nanoose) Site".

Progress Report on
Population Demographics of Allium amplectens Torr.
at the CFMETR (Nanoose) Site

Purpose:

To study the life history and population dynamics of a locally rare species,*Allium amplectens* Tor. (Slimleaf onion). *A. amplectens* is on the British Columbia Conservation Data Centre's BLUE LIST or Provincial Rank as S2S3.

It appears that its ploidy level is critical in determining its ability to successfully reproduce: tetraploids being much more successful than triploids.

Methods:

My initial procedure was to conduct a series of gridded walks along the various terraces of the CEMETRE site in order to locate all *A. amplectens* populations.

A series of 1/2 by 1/2 metre quadrats were set up in a series of three different populations on the south slope near the western boundary of the CFMETRE site. The lengths of the leaves, flowering scapes, numbers of flowers per scape, and numbers of capsules and seeds per capsule were to be recorded. The mathematical technique employed is called stage-based projection matrices. In order to obtain preliminary data about changes within a population a minimum of two years data are required.

Sample bulbs were also obtained for the chromosome analyses.

Results:

A total of five different populations were discovered on the CEMETRE site although populations #3 and #4 being contiguous to each other may be considered different components of the same population. Population numbers 2, 3, and 4 had permanent plots placed within them. Ascending numerical values for populations correlated with their positions in a more easterly direction. Therefore population #3 is found further east on the south slope of Nanoose Hill than population #2 and so on.

The two smallest populations are #1 and #5 with population #4 being the largest (Table 1).

Table 1. Number of mature plants within each population measured during summer of 1995.

	Population #1	Population #2	Population #3	Populaton #4	Population #5
Number of mature plants	22	219	206	306	48

Mature plants are plants defined as producing a scape containing an inflorescence of individual flowers. Generally the tallest scapes produced the largest number of flowers within their inflorescence indicating the oldest plants.

Because the stage-based projection matrix model requires a minimum of two years successive data no preliminary prognostication can be made about the long term viability of these populations.

One problem encountered was the very early withering of plant leaves as a consequence of the extremely hot and dry conditions during May of this year. Although this did not impair finding the location and life stage measurement of mature plants (i.e. plants with an inflorescence of flowers) the locations of many juveniles was lost. This will necessitate a third summers data in order to obtain at least two years information about changes in the juvenile developmental stages.

Summary:

1. A total of 5 populations of *A. amplectens* were located on the CEMETRE site.

2. Population sizes, in terms of adult plants only, varied from about two dozen to over 300 plants.

3. Quadrats were established within 3 of the 5 populations.

4. Plants with longer scapes also had more flowers per inflorescence indicating a greater longevity than shorter scaped/lower flowered individuals

5. Data from an additional summer's work ought to yield preliminary results about what is happening demographically to these populations.

H - Permit P018-95

Title: Purple Martin Nestbox Program

Author: Darren R. Copley, B.Sc. (604) 479-6622

Organization: 657 Beaver Lake Road
Victoria, B.C. V8Z 5N9,

Location: Colwood Supply/ Fuel Oil Depot

Project Overview:

This is the third largest site of only 5 Purple Martin colonies in the entire province. 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. Without this nestbox program, Purple Martins would be extirpated from the province.

START DATE: March 1, 1995 COMPLETION DATE: October 1, 1995

Objectives:

To increase the population of breeding birds to a size that will provide "excess" 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, food, habitat requirements, etc...

Accomplishments to Date/of the Project

a) Highlights of findings to Date/Project

Western Purple Martins are adaptable to human disturbance and can co-exist with humans in a high traffic area

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

The Martin numbers at the Colwood Property are now as high or higher than any other site in B.C.

Returning adults this year were estimated at 32 (being the highest single-count made), and at least 16 active nests were observed, with 8 other potentially active sites (eggs present, but possibly abandoned).

b) Research Activities

Research activities were limited to nestbox maintenance and monitoring of the population.

c) Extension and Demonstration

None.