2008/2009 ANNUAL REPORT

DEPARTMENT OF NATIONAL DEFENCE

ESAC

ENVIRONMENTAL SCIENCE ADVISORY COMMITTEE

CANADIAN FORCES BASE ESQUIMALT

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Cover Photos

Top Left:
Photographing Foothill Sedge (*Carex tumulicola*)

Top Right:
Dragonfly at Maintenance Detachment Aldergrove

Bottom Centre:
Western Tiger Swallowtail (*Papilio rutulus*)

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EXECUTIVE SUMMARY

The Department of National Defence (DND) Environmental Science Advisory Committee (ESAC) for CFB Esquimalt was established in 1994 as a multi-agency technical advisory committee that reviews and recommends proposals from researchers and other parties interested in carrying out natural resources research on CFB Esquimalt properties. Every year, ESAC collects, reports, and archives the findings of the research activities in a printed and web-based annual report. ESAC also acts as an advisory body to CFB Esquimalt on various environmental issues occurring on CFB Esquimalt properties, and serves as a gateway to a network of scientists accessible to Maritime Forces Pacific (MARPAC) staff.

In 2008, the Committee reviewed 18 proposals to conduct research and collection activities on CFB Esquimalt properties. Each proposal was reviewed by ESAC for scientific content and forwarded to the DND Formation Safety and Environment Branch, Environment Office and to Base Operations, Range Control personnel to ensure that the proposed activities would not result in any adverse environmental effects or interfere with military operations and activities. Subsequently, each permit was sent to the Base Commander for final review, approval, and permit issue. Eighteen ESAC research and collection permits were issued to individuals and organizations authorizing environmental research on CFB Esquimalt lands. A compilation of the scientific reports obtained from each of these authorized research projects as well as a summary of the Committee's activities conducted throughout the year are presented in this annual report.

Where applicable, wildlife and sensitive ecosystem inventory data obtained from 2008 ESAC research projects were integrated into the CFB Esquimalt Natural Resources Geographic Information System (GIS) database. This information, combined with existing sensitive data, was used to generate significant natural areas maps that are readily available to MARPAC personnel. ESAC research sites located on CFB Esquimalt properties were also added to the GIS database.

To facilitate the sharing of research findings collected on CFB Esquimalt land in 2008, the Committee hosted its ESAC Annual Workshop on 29 January 2009 at the Pacific Forestry Centre, Victoria, B.C. Nine presentations, focusing on wildlife and sensitive ecosystem inventories, monitoring, and restoration were given to personnel from government and non-government organizations. The 2008 ESAC Annual Workshop was well attended with over 60 individuals in attendance.

P074-08 Bald Eaglet (*Haliaeetus leucocephalus*).

TABLE OF CONTENTS

TABLE OF CONTENTS continued

INTRODUCTION

Maritime Forces Pacific (MARPAC) constitutes Canada's Navy on the West Coast. Her Majesty's Canadian Dockyard at Canadian Forces Base (CFB) Esquimalt is home to the Navy's Canadian Pacific Fleet. The role of CFB Esquimalt is to support the ships of the Canadian Pacific Fleet and other key military units.

MARPAC is one of the largest government organizations in the Pacific Region, with approximately 4,000 military and 2,800 civilians working at the base, which covers over 10 hectares. With approximately 4,200 hectares of land amongst 14 different municipalities and regional districts under its administration (Table 1), MARPAC has long acknowledged its responsibility to consider environmental impacts in the management of its training areas and in the planning and conduct of its activities. Efforts to minimize the adverse effects of training and operations, in conjunction with innovative management practices, will ensure continued protection and enhancement of the many significant natural areas and unique features located on CFB Esquimalt lands in British Columbia.

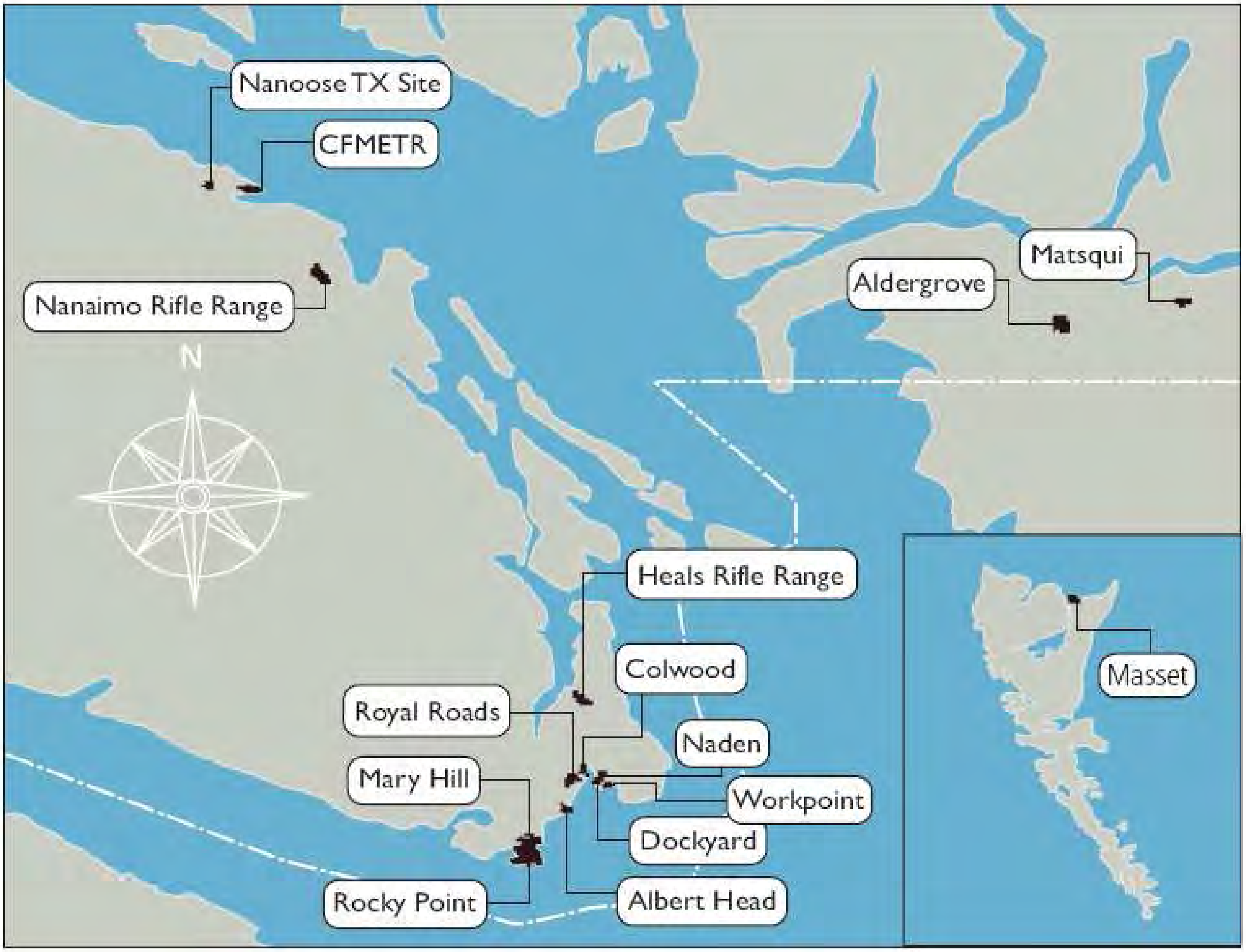
MARPAC properties, while utilized for a variety of military purposes, including industrial activities, training exercises, and communications infrastructure, are often relatively undisturbed by human impact. A number of CFB Esquimalt properties support remnants of sensitive ecosystems such as coastal Douglas-fir forests and Garry oak meadows which provide unique opportunities for scientists to conduct an array of environmental studies.

Table 1. CFB Esquimalt Properties - Area in hectares (ha).

Albert Head	93
Maintenance Detachment Aldergrove	514
Colwood	90
CFMETR	288
Dockyard / Signal Hill / Yarrows	63
Heals Rifle Range	212
Mary Hill	178
CFS Leitrim Detachment Masset (Queen Charlotte Islands)	824
Matsqui TX Site	95
Naden	45
Nanaimo Rifle Range	351
Nanoose TX Site	105
Rocky Point	1078
Royal Roads	229
Work Point	66
Total Area	**4231 ha**

P125-08 Great Camas (*Camassia leichtlinii*).

CFB ESQUIMALT PROPERTIES



BACKGROUND

Prior to 1994, research projects were undertaken by various individuals and organizations on CFB Esquimalt properties. Research was ad hoc and the findings were not readily available to MARPAC personnel for use in environmental management and decision-making. The recognized need for a process to track the research activities and associated findings resulted in the formation of the DND Environmental Science Advisory Committee (ESAC) for CFB Esquimalt. Since the creation of the Committee, in 1994, ESAC has facilitated and coordinated environmental studies on CFB Esquimalt properties in conjunction with other environmental projects funded by DND. In 2006 the ESAC Letter of Understanding between DND CFB Esquimalt and member agencies, was renewed for another five years (2006-2011).

The ESAC provides scientific advice within the context of MARPAC's overall Natural Resources Program. This program encompasses the management of natural resources on CFB Esquimalt lands including species-at-risk, sensitive ecosystems, forests, wetlands, and riparian zones while ensuring sustainable military training and operations.

Members

ESAC is a multi-agency technical advisory committee composed of the following members:

- CFB Esquimalt (Formation Safety and Environment Branch)
- CFB Esquimalt (Base Construction Engineering Office)
- Natural Resources Canada (Canadian Forest Service)
- Environment Canada (Canadian Wildlife Service)
- B.C. Ministry of Forests and Range
- University of Victoria
- Royal Roads University

A complete list of ESAC members in 2008 and contact information is located at the end of this report.

Roles and Responsibilities

Proposal Review and Tracking

The Committee's primary functions are to review, evaluate, and provide scientific expertise and advice to CFB Esquimalt on proposals received to conduct biological and environmental studies on its properties. The Committee maintains a formal permitting system to facilitate the tracking of proposals and permits to conduct research on CFB Esquimalt properties. Research activities requiring a permit include, but may not be limited to, the following: observations; photography; surveys and inventories; tagging and banding; collection of wildlife specimens; and installation of scientific monitoring structures. Individuals interested in conducting environmental studies on CFB Esquimalt properties can obtain more information by visiting the ESAC website at: http://cfs.nrcan.gc.ca/subsite/esac

P125-08 Rocky Point Garry Oak (*Quercus garryana*) Ecosystem.

Each research proposal is sent to and reviewed by ESAC. Subsequently, proposals are sent to the Formation Safety and Environment office and to Base Operations, Range Control personnel to ensure that the proposed activities do not result in any adverse environmental effects or interfere with military operations and activities. Lastly, each permit is sent to the Base Commander for final review, approval and permit issue.

Permit Support

Once an ESAC permit is granted, ESAC provides ongoing support to permit holders. ESAC facilitates a safety briefing for all permit holders who will be conducting activities in active training areas and ranges. The safety briefing is delivered by a DND Range Control Officer and ensures that each researcher is familiar with the potential hazards associated with working on DND properties. Specific safety information is provided about potential hazards, danger areas and emergency procedures. Restrictions and access control procedures are also explained.

In conjunction with the safety briefing, an environmental briefing is also delivered to ESAC permit holders. Each permit holder is provided with information and maps about sensitive environmental and cultural features for each property that they are permitted to access. Information about environmental requirements and restrictions, and information about wildlife encounters are outlined.

Reporting Activities

As part of the reporting process, ESAC permit holders are required to submit a report on their activities and results, for the permit year. ESAC compiles these documents and makes them available to all member agencies and other interested organizations by way of the annual report.

To further promote the sharing of information obtained through ESAC research projects, the Committee hosts an annual workshop. Additional information on ESAC, the annual workshop, and an archive of past annual reports are available on the ESAC website.

Other Committee Activities

ESAC acts as an advisory body to MARPAC by providing direction and insight on various environmental issues occurring on CFB Esquimalt properties. ESAC members also provide MARPAC personnel with the ability to connect with the broader scientific community regarding various ecological issues. In addition, the Committee oversees the activities of the Operating Committee for the Forest Canopy Research Station at Rocky Point.

P044-08 Purple Martin (*Progne subis*) with Dragonfly.

ESAC ACTIVITIES IN 2008

Advisory and Reporting Activities

This year was the 14th full year of activity for ESAC. The Committee met three times during 2008 to review project proposals and status, plan reporting activities, and advise CFB Esquimalt on other environmental issues occurring on CFB Esquimalt properties.

The 2007 ESAC Annual Report was produced and 100 hard copy reports were distributed to ESAC permit holders, military bases across Canada, and other government and non-government agencies throughout British Columbia. The ESAC website was updated to provide information on active projects. Archived ESAC projects can be queried by year or location and all ESAC Annual Reports from 1995 to 2007 are available to download from the website.

The 2008 ESAC Annual Workshop, held 29 January 2009 at the Pacific Forestry Centre, was well attended with over 60 individuals in attendance. Nine presentations, focusing on wildlife and sensitive ecosystem inventories, monitoring, and restoration were given. A wide variety of representatives were present, including the BC Ministry of Environment, BC Ministry of Forests and Range, Royal Roads University, Camosun College, the Victoria Natural History Society, the Rocky Point Bird Observatory, Natural Resources Canada, Wildlife Tree Stewardship Initiative, municipal governments and the Department of National Defence.

P114-08 Garry Oak (*Quercus garryanna*) seedling.

Research and Collection Activities

A total of 18 proposals were received and reviewed by ESAC in 2008. Of the 18 proposals received, 18 permits were issued – with 13 being renewals of previous year's permits. Table 2 shows the number of proposals received and permits issued annually since 1995.

The diversity of projects conducted in 2008 enhanced the knowledge and understanding of the wildlife and sensitive ecosystems occurring on CFB Esquimalt properties. In addition, research findings collected under ESAC permits contributed to sound decision-making and environmental management by CFB Esquimalt personnel. The knowledge gained from these studies could also be applied to neighbouring, similar ecosystems under different jurisdictions, thus adding to the value of the research carried out on CFB Esquimalt properties. Table 3 lists all research and collection activities conducted in 2008 under the auspices of ESAC.

Table 2. Number of research proposals received and permits issued since 1995.

Year	Proposals	Permits
2008	18	18
2007	18	15
2006	22	21
2005	25	21
2004	16	16
2003	26	24
2002	21	20
2001	14	14
2000	19	16
1999	25	25
1998	26	26
1997	24	24
1996	25	24
1995	22	20

Table 3. Summary of research projects conducted under ESAC in 2008.

ESAC Permit Title	Project Leader	Permit #	Property (abbreviations below)
Rocky Point Bird Observatory Avian Monitoring	A. Nightingale	P003-08*	AH, HR, RP, RR
Monitoring Winter Moth and the Parasites Introduced for its Control	I. Otvos	P031-08*	NA
Purple Martin Origins and Relationships	C. Finlay	P044-08*	CO, DY, RR
Wildlife Tree Stewardship Program (WiTS)	G. Greenwood	P074-08*	AH, CO, RP
Garry Oak Acorn Survey	R. Negrave	P079-08*	CFMETR, RP
Studies on the Dynamics of Butterflies and their Host Plants in Garry Oak Ecosystems	J. Hellmann	P090-08*	CFMETR, RP
The Strait of Georgia Mortuary Landscape Project	D. Mathews	P104-08*	AH, CO, RP
Western Bluebird Nestbox Program	T. Chatwin	P108-08*	CFMETR, RP
Monitoring of the Oregon Spotted frog (*Rana pretiosa*)	R. McKibbin	P109-08*	ALD
Garry Oak Ecosystem Dynamics: Controls on Overstory Recruitment	Z. Gedalof	P114-08*	RP
Local Versus Regional Determinants of Community Composition in Garry Oak Ecosystems	J. Bennett	P120-08*	AH, CFMETR, RP
Survey for the Rigid Apple Moss (*Bartramia stricta*) on DND Properties	T. McIntosh	P123-08**	CFMETR, RP
Year-round Microclimates Experienced by Butterfly Larvae in Garry Oak Ecosystems	B. Sinclair	P124-08*	RP
Gene Flow and Dispersal of Plants in Fragmented Landscapes	H. Tomimatsu	P125-08	RP
Efficacy Testing of Pheromones and Kairomones for Woodboring Coleoptera	L. Humble	P126-08	RP
Community Homogenization in Disturbed Landscapes	H. Kharouba	P127-08	AH
Yabea microcarpa Survey	M. Fairbarns	P128-08	CFMETR
Vancouver Island Beggarticks Priority Site Survey	K. Welstead	P129-08	ALD

* Renewed from previous years. ** Project was abandoned or postponed.

Properties: AH: Albert Head; ALD: Aldergrove; CFMETR: Canadian Forces Maritime Experimental and Test Ranges; CO: Colwood; DY: Dockyard; HR: Heals Rifle Range; NA: Naden; RP: Rocky Point; RR: Royal Roads.

Rocky Point Forest Canopy Research Station

Constructed in 1994, the Forest Canopy Research Station at Rocky Point is situated in an old-growth Douglas-fir stand at the southern end of the property. The canopy station towers over 30 m above the northern edge of a one-hectare Ecological Monitoring and Assessment Network (EMAN) plot. An operating committee is responsible for the station's maintenance, use and overseeing its operations as detailed in the station's operating protocol and in an annual update report. Ownership and responsibility for the Rocky Point Forest Canopy Station has been held by Royal Roads University since 2002, as part of the University's efforts to monitor climate change and atmospheric transport of contaminants

The canopy station was originally established by Lester Pearson College and researchers from University of Victoria to measure the canopy arthropod and lichen diversity; and, it has also been the subject of documentaries, news stories and presentations during tours of Rocky Point. In 2008, a canopy microclimate study by Royal Roads University and supported by Environment Canada was the only study using the canopy station infrastructure.

The canopy station has undergone several changes over its life span. The station currently consists of three Douglas-fir trees with tiered platforms that are accessed by a system of ladders, lines, and connecting bridges to facilitate ecological and biodiversity research in the upper canopy of the forest. Aspirated shields are installed at 10, 20 and 30 m beside the study trees to support temperature and relative humidity measurements. Three soil moisture probes are situated at selected locations in the adjoining EMAN site. A small storage shed houses communication equipments that assist with remote data downloading.

Equipment at the site, including a data-logger and sensors, is powered by a 750 W solar panel supported on an 18 m tower on a knoll adjacent to the Canopy Station. The 18 m tower also houses a quantum radiation sensor, a temperature and relative humidity sensor, and a wind speed and direction sensor. A tipping bucket rain gauge is deployed on a 10 m high tower to improve exposure.

The operating committee has found that the repair and safe maintenance of the canopy tree infrastructure has become expensive, relative to its current use. With only one study presently taking place at the canopy station, and no other researchers or groups interested in using or operating the station; in 2008, the operating committee suggested to ESAC that the canopy tree infrastructure be decommissioned. The committee agreed and directed the operating committee to decommission the station in 2009. The canopy microclimate study may continue by transferring canopy tree sensors to the 18 m tower adjacent to the station.

Geographic Information System

All wildlife and sensitive ecosystem inventory data collected in 2008 were integrated into the CFB Esquimalt Natural Resources Geographic Information System (GIS) database. This information, combined with existing data, were used to generate sensitive and natural areas maps that are readily available to MARPAC personnel. Information presented on these maps includes the location of species-at-risk, sensitive ecosystems, wetlands, and riparian zones, and archaeological features. The information available in the natural resources GIS database is utilized by MARPAC personnel when performing a wide variety of activities including the preparation of environmental assessments, environmental awareness and training, planning and designing construction engineering projects, and conducting military exercises.

The locations of ESAC research sites were added to the GIS and subsequently delineated on property maps made available to CFB Esquimalt personnel to reduce any conflicts with military training and activities. Information from ESAC projects and other environmental projects were used to update the natural resources GIS layers.

DEPARTMENT OF NATIONAL DEFENCE

ESAC

ENVIRONMENTAL SCIENCE ADVISORY COMMITTEE

CANADIAN FORCES BASE ESQUIMALT

SCIENTIFIC REPORTS

Research and Collection Activities Conducted in 2008

Rocky Point Bird Observatory Avian Monitoring

Ann Nightingale

Rocky Point Bird Observatory
1721 Cultra Avenue, Saanichton, BC, V8M 1T1
Tel: (250) 652-6450 • Email: Motmot@shaw.ca

Permit #: P003-08
Location: Rocky Point
Project Status: 1994 - ongoing
Start Date: 28 March 2008
Completion Date: 28 December 2008

The Rocky Point Bird Observatory conducted five studies in 2008.

Passerine Migration Monitoring

Project Leader: Ann Nightingale
Location: Rocky Point
Start Date: 28 March 2008
Completion Date: 28 December 2008
Project Status: 1994 - ongoing

Introduction:

2008 marked the 14th season of passerine migration monitoring at Rocky Point. Monitoring typically takes place within the 90-day period from 21 July until 18 October, to maximize coverage during the peak migration season for the majority of Neotropical passerine species migrating through the southern part of Vancouver Island. The protocol calls for daily monitoring during this period except for days with inclement weather or when access to Rocky Point cannot be obtained due to military use on the site. In 2008, 24 days were lost to military activity and an additional two days were lost to inclement weather, resulting in monitoring on only 64 days. Despite the reduced monitoring effort, 3,211 birds of 56 species and forms were banded.

The migration monitoring projects at Rocky Point collect data on population trends, and over time provide benchmark data for determining population changes at the landscape level. Data collected at Rocky Point cover coastal British Columbia and Alaska, but when the data are combined with data collected from the other 24 banding stations across Canada, the status of migrating songbirds can be assessed at a national scale.

Study Area and Methods:

The Rocky Point Bird Observatory (RPBO) is located at the southernmost tip of Vancouver Island, B.C. on the Canadian Forces Ammunition Depot (CFAD) at Rocky Point. The location of the study area is the riparian zone immediately north of Building 100.

The fall migration monitoring effort employed 13 mist nets in established positions around the site, which were opened 30 minutes before sunrise and run for six hours each day between 21 July and 18 October. Bander-in-charge, Gabriel David, was assisted by banding intern, Kelsey Low, hired under the auspices of Environment Canada's Science Horizons Youth Initiative program. Volunteers also contributed 1,236 hours to this project in 2008.

Birds captured in the mist nets were banded, sexed, aged, measured for a number of morphometric features, and released using the criteria in Pyle (1997). Each day, a standardized census route was walked and general observations on all birds present in the area were recorded (Leckie 2008).

In addition to the banding effort and daily census, RPBO personnel also recorded personal observations of birds seen or heard from the study site, including those species that are not banded at Rocky Point.

Additional background information regarding the ecological context at Rocky Point and the methods used to monitor birds is covered in both the final report for 2008 (David 2008) and the RPBO protocol (Leckie 2008).

Results:

During the fall of 2008, monitoring was conducted on 64 days between 21 July and 18 October. Overall 3,211 birds (comprising 56 species and forms) were banded. The five most commonly banded passerines were: Orange-crowned Warbler (*Vermivora celata*) (403) Ruby-crown Kinglet (*Regulus calendula*) (387), Wilson's Warbler (*Wilsonia pusilla*) (301), Pacific-slope Flycatcher (*Empidonax difficilis*) (242), and Yellow Warbler (*Dendroica petechia*) (168). Table 1 lists the complete results of the banding season.

Table 1. Total of all birds banded at RPBO in 2008, by species.

Species	Banded	Species	Banded
Sharp-shinned Hawk	3	Nashville Warbler	1
Barred Owl	3	Yellow Warbler	168
Hairy Woodpecker	1	Audubon's Warbler	3
Red-shafted Flicker	1	Myrtle Warbler	6
Rufous Hummingbird	24	Unidentified Yellow-rumped Warbler	2
Olive-sided Flycatcher	1	**Black-throated Gray Warbler**	9
Willow Flycatcher	24	Townsend's Warbler	8
Hammond's Flycatcher	28	Northern Waterthrush	1
Pacific-slope Flycatcher	242	MacGillivray's Warbler	44
Hutton's Vireo	7	Common Yellowthroat	52
Warbling Vireo	16	Wilson's Warbler	296
Steller's Jay	5	Western Tanager	1
Violet-green Swallow	1	Spotted Towhee	101
Chestnut-backed Chickadee	60	Chipping Sparrow	20
Bushtit	59	Savannah Sparrow	34
Red-breasted Nuthatch	3	Fox Sparrow	124
Brown Creeper	15	Song Sparrow	140
Bewick's Wren	38	Lincoln's Sparrow	119
House Wren	20	White-throated Sparrow	4
Winter Wren	143	Puget Sound White-crowned Sparrow	61
Marsh Wren	6	Golden-crowned Sparrow	82
Golden-crowned Kinglet	110	Oregon Junco	67
Ruby-crowned Kinglet	387	Red-winged Blackbird	8
Swainson's Thrush	72	Brown-headed Cowbird	19
Hermit Thrush	90	Purple Finch	7
American Robin	18	Pine Siskin	5
Varied Thrush	1	American Goldfinch	42
Cedar Waxwing	6	**Total Banded**	**3211**
Orange-crowned Warbler	403	**Species & Forms**	**56**

Bold indicates season-high banding total for species since 1994.

In 2008, a total of 159 species were observed during the monitoring period, through banding, personal observations and the daily census. 2008 was the first year in more than a decade that we were unable to have personnel on site outside of the banding period. As a result, reports of many species, especially raptors and seabirds, were well below those observed in previous years. Table 2 shows the species observed by month through the monitoring period.

Discussion:

Banding totals were the 4th highest since 1994, and when relative mist netting effort is taken in account, 2008 was one of the most productive years for passerine species migrating through Rocky Point, with a capture-rate of 0.70 birds per net-hour, vs a record of 0.73 birds per net-hour in 2005.

A new highest banding record was set by two species in 2008: Orange-crowned Warbler (403), and Black-throated Gray Warbler (*Dendroica nigrescens*) (9). An Olive-sided Flycatcher (*Contopus cooperi*) was captured and banded on 3 August and a Nashville Warbler (*Vermivora ruficapilla*) on 8 October; these were the 7th and 10th banding records, respectively, for these species at Rocky Point. It is probable that 2008 could have been a peak year for Wilson's Warbler (301 banded, second highest season total), had migration monitoring been possible from the period of 16 to 24 August, within generally the peak for this species at RPBO. Another early neotropical migrant is the MacGillivray's Warbler (*Oporornis tolmiei*); and, again August represents the main window of their movement at RPBO. In 2008, 44 MacGillivray's Warblers were banded.

There were 491 recaptures of previously banded birds; many of these were originally banded in 2008 and subsequently recaptured a few days later. In addition, some site-residents were recaptured multiple times throughout the season. Some non-breeding migrants use Rocky Point as an important stop-over habitat during migration, as is apparent by the original capture of an after hatch year Golden-crowned Sparrow (*Zonotrichia atricapilla*) on 16 September and its recapture on 24 September. A Fox Sparrow (*Passerella iliaca*) recaptured on 2 October was likely a returning winter resident, originally banded as a hatch year bird on 15 September 2006.

Conclusions:

RPBO is the westernmost of 25 stations in the Canadian Migration Network and the only station on the Pacific coast of Canada. Data gathered at Rocky Point is of critical importance to the broader understanding of avian population trends in Canada. Monitoring will be continued at Rocky Point as long as it is feasible to do so.

Data collected by RPBO will be shared with Bird Studies Canada, the Canadian Wildlife Service and the Canadian Bird Banding Office. Trend analyses of several species at Rocky Point can be seen on the Bird Studies Canada site at <http://www.bsc-eoc.org/volunteer/cmmn/index.jsp?targetpg=trends&lang=EN>.

Acknowledgements:

The monitoring of passerine migration was due to the efforts of bander-in-charge Gabriel David and banding intern Kelsey Low, aided by a dedicated group of volunteers who contributed more than 1,200 hours to this project in 2008. The Canadian Wildlife Service and Wendy Easton continue to be valuable supporters of avian monitoring at Rocky Point.

References:

David, G. 2008. Migration Monitoring at the Rocky Point Bird Observatory: Fall 2008. Rocky Point Bird Observatory Society, Metchosin, B.C. <http://rpbo.org/finalreport08.pdf> accessed 12 January 2009.

Leckie, S. 2008. Field Protocol for Migration Monitoring at Rocky Point Bird Observatory, Version 2.0. Rocky Point Bird Observatory Society, Metchosin, B.C. http://rpbo.org/protocol/protocol.html accessed 12 January 2009.

Pyle, P. 1997. Identification Guide to North American Birds, Part I. Bolinas, CA, Slate Creek Press.

Table 2. Species recorded at Rocky Point from 21 July – 18 October 2008 by month.

Species	Jul	Aug	Sep	Oct	Species	Jul	Aug	Sep	Oct
Greater White-fronted Goose				*	Hermit Thrush			*	*
Snow Goose				*	American Robin	*	*	*	*
Canada Goose	*	*	*	*	Varied Thrush	*	*	*	*
American Wigeon			*	*	European Starling	*	*	*	*
Mallard		*	*	*	American Pipit			*	*
Northern Shoveler			*	*	Sora		*	*	*
Northern Pintail		*	*	*	Sandhill Crane			*	*
American Green-winged Teal		*	*	*	Black-bellied Plover		*		
Harlequin Duck		*	*	*	Semipalmated Plover				*
Surf Scoter			*	*	Killdeer	*	*	*	*
White-winged Scoter			*	*	Black Oystercatcher	*	*	*	
Bufflehead				*	Spotted Sandpiper		*		*
Hooded Merganser			*	*	Solitary Sandpiper		*		
Common Merganser			*	*	Greater Yellowlegs	*	*	*	*
Red-breasted Merganser		*			Lesser Yellowlegs	*	*		
California Quail	*	*	*	*	Black Turnstone	*	*		
Pacific Loon		*			Semipalmated Sandpiper		*		
Common Loon			*	*	Western Sandpiper		*	*	*
Red-necked Grebe		*	*	*	Least Sandpiper	*	*	*	
Western Grebe			*	*	Pectoral Sandpiper			*	
Sooty Shearwater			*		Short-billed Dowitcher		*		
Brown Pelican		*			Long-billed Dowitcher	*	*	*	
Brandt's Cormorant			*	*	Wilson's Snipe			*	*
Double-crested Cormorant		*	*	*	Red-necked Phalarope		*	*	
Pelagic Cormorant	*	*	*	*	Bonaparte's Gull		*	*	*
Great Blue Heron	*	*	*	*	Heermann's Gull	*	*	*	*
Turkey Vulture	*	*	*	*	Mew Gull		*	*	*
Osprey			*		California Gull	*	*	*	*
Bald Eagle	*	*	*	*	Herring Gull			*	
Northern Harrier	*	*	*	*	Thayer's Gull				*
Sharp-shinned Hawk		*	*	*	Western Gull			*	
Cooper's Hawk	*	*	*	*	Glaucous-winged Gull	*	*	*	*
Northern Goshawk				*	Caspian Tern		*		
Broad-winged Hawk			*		Common Murre	*	*	*	*
Red-tailed Hawk	*	*	*	*	Pigeon Guillemot	*	*	*	*
Rough-legged Hawk				*	Marbled Murrelet			*	*
Golden Eagle			*	*	Cassin's Auklet				*
American Kestrel			*	*	Rhinoceros Auklet	*	*	*	*
Merlin	*	*	*	*	Band-tailed Pigeon	*	*	*	*
Peregrine Falcon		*	*	*	Mourning Dove	*	*	*	*

Table 2. continued.

Species	Jul	Aug	Sep	Oct	Species	Jul	Aug	Sep	Oct
Virginia Rail			*	*	Barn Owl				*
Black Swift	*				Great Horned Owl		*	*	*
Vaux's Swift	*	*	*		Northern Pygmy-Owl			*	
Anna's Hummingbird	*	*	*		Barred Owl	*		*	*
Rufous Hummingbird	*	*	*		Northern Saw-whet Owl			*	*
Belted Kingfisher	*	*	*	*	Common Nighthawk	*	*		
Lewis's Woodpecker			*		Cedar Waxwing	*	*	*	*
Red-breasted Sapsucker			*		Orange-crowned Warbler	*	*	*	*
Downy Woodpecker	*	*	*	*	Nashville Warbler				*
Hairy Woodpecker		*	*	*	Yellow Warbler	*	*	*	*
Northern Flicker	*	*	*	*	Yellow-rumped Warbler	*	*	*	*
Pileated Woodpecker	*	*	*	*	Black-throated Gray Warbler		*	*	*
Olive-sided Flycatcher	*	*			Townsend's Warbler	*	*	*	
Western Wood-Pewee		*	*		Northern Waterthrush		*		
Willow Flycatcher	*	*	*		MacGillivray's Warbler	*	*	*	
Hammond's Flycatcher	*	*	*	*	Common Yellowthroat	*	*	*	*
Pacific-slope Flycatcher	*	*	*	*	Wilson's Warbler	*	*	*	
Cassin's Vireo	*	*	*		Western Tanager	*	*	*	
Hutton's Vireo	*	*	*	*	Spotted Towhee	*	*	*	*
Warbling Vireo	*	*	*	*	Chipping Sparrow	*	*		
Steller's Jay	*	*	*	*	Savannah Sparrow	*	*	*	*
Northwestern Crow	*	*	*	*	Fox Sparrow			*	*
Common Raven	*	*	*	*	Song Sparrow	*	*	*	*
Horned Lark			*		Lincoln's Sparrow		*	*	*
Purple Martin		*	*		White-throated Sparrow			*	*
Violet-green Swallow	*	*	*		White-crowned Sparrow	*	*	*	*
Northern Rough-winged Swallow	*	*	*		Golden-crowned Sparrow			*	*
Cliff Swallow	*	*			Dark-eyed Junco	*	*	*	*
Barn Swallow	*	*	*		Black-headed Grosbeak	*	*	*	
Chestnut-backed Chickadee	*	*	*	*	Red-winged Blackbird	*	*	*	*
Bushtit	*	*	*	*	Western Meadowlark			*	
Red-breasted Nuthatch	*	*	*	*	Brewer's Blackbird				*
Brown Creeper	*	*	*	*	Brown-headed Cowbird	*	*		
Bewick's Wren	*	*	*	*	Purple Finch	*	*	*	*
House Wren	*	*	*	*	House Finch	*	*	*	*
Winter Wren	*	*	*	*	Red Crossbill	*	*	*	*
Marsh Wren	*	*	*	*	Pine Siskin	*	*	*	*
Golden-crowned Kinglet	*	*	*	*	American Goldfinch	*	*	*	*
Ruby-crowned Kinglet	*	*	*	*	Evening Grosbeak	*	*	*	*
Swainson's Thrush	*	*	*						
Total Species	**159**				**Total Species/Month**	**87**	**114**	**130**	**111**

Northern Saw-whet Owl Project

Project Leader: Ann Nightingale
Location: Rocky Point
Start Date: 15 September 2008
Completion Date: 31 October 2008

Introduction:

The Northern Saw-whet Owl (*Aegolius acadicus*) is a small, migratory raptor which has been monitored extensively in eastern North America. The U.S. Geological Survey reports that 113,726 Northern Saw-whet Owls were banded between 1955 and 2004. Their migration has not been similarly studied west of the Rocky Mountains. Since the fall of 2002, Northern Saw-whet Owls have been actively monitored at Rocky Point during their southward migration. Banding resumed in 2008 after a hiatus in 2007. A total of 1,933 Northern Saw-whet Owls have been banded at Rocky Point since this project's inception.

Study Area and Methods:

Northern Saw-whet Owl migration is monitored following protocols established by Project Owlnet (www.projectowlnet.org), a continent-wide consortium of banding stations. Owl monitoring at Rocky Point was conducted nightly from one half hour after sunset for six consecutive hours during the period from 15 September to 31 October, except when constrained by military activities or inclement weather. Banding occurred on a total of 36 nights during this period.

Due to extensive wind damage to the original banding site (coniferous forest east of the banding shack), a new site was selected in the riparian corridor southwest of the banding shack. The new site is sufficiently close to the former site that it is likely to be drawing from the same migration population that was previously attracted to the former site. A square of four joined 12-meter-long x 2.6 meter-high mist nets was erected among the willow and alder, and an audio lure (playing a Northern Saw-whet Owl territorial call) was placed in the centre of the square. Four single passive nets were also employed: one to the southwest, one to the northwest, and two to the east of the owl-square. On a few nights, additional nets were opened to test whether owls were traveling through the riparian area rather than being drawn directly to the lure, but those nets did not capture any additional owls.

Once captured, the owls were removed from the nets and aluminum leg bands were affixed. In addition, various morphometric measurements were taken and the birds were aged before being released.

Results:

In 2008, record numbers of Northern Saw-whet Owls (636) and Barred Owls (*Strix varia*) (15) were banded during 1,700 net hours of operation. The capture rate of Northern Saw-whet Owls was 0.37 birds/net hour (or 0.39 birds per net hour if the three nets which captured no owls are excluded). The capture rate was slightly below the best rate of 0.42 birds per net hour achieved in 2003. Of the 636 Northern Saw-whet Owls banded,

P003-08 Young Northern Saw-whet Owl (*Aegolius acadicus*).

79.53% were hatch year birds, 11.79% were second year, 8.18% were after second year and 0.05% were after third year birds. All of the Barred Owls captured in 2008 were hatch year birds.

During the banding period, two Northern Saw-whet Owls banded at Rocky Point were relocated elsewhere. A bird banded on 8 October was recaptured during the night of 10 October on Bainbridge Island (near Seattle) in Washington. This is the third recapture of a Rocky Point bird at the Bainbridge Island site. The other relocated banded owl was found injured on Jenkins Avenue in Langford, B.C. a week after it was banded at Rocky Point. Unfortunately, the bird later died.

As in previous years, the majority (52%) of the Northern Saw-whet Owls captured were determined to be females using the combination wing chord/mass criteria established by Project Owlnet. Only 19.5% were identified as male. The remaining birds fell within the overlap range of the two sexes and thus their gender could not be assigned.

Six Northern Saw-whet Owls banded at Rocky Point in 2008 were subsequently recaptured on-site, but none were recaptured on the same night as they were banded. In other years, most of the same year recaptures have occurred on the banding night.

One owl that had been banded at Rocky Point in 2006 was recaptured at Rocky Point in 2008, representing the third between-year capture for this project. Between-year captures point to migration route loyalty, emphasizing the importance of habitat preservation along the migration corridor.

The highest abundance of Barred Owls was recorded during the fall 2008 season, with a total of 15 being banded at RPBO, all of which were determined to be hatch year birds. Based on the criteria in Pyle (1997), 7 birds were sexed as males and one as female and 7 as unknown.

Discussion:

The number of Northern Saw-whet Owls banded in 2008 represented a significant record for this project. Although the capture rate per net hour was average, the total number of individuals banded (636) was almost 60% greater than our previous record of 403 set in 2004. In 2008, banding was conducted on 36 nights, compared to 34 nights in 2004. While it might seem reasonable to attribute the increase to the greater effort (1,700 net hours compared to 1,033 in 2004), 76% of the birds captured in 2008 were trapped in only four of the eight nets used—those closest to the audio lure. More than 40 Northern Saw-whet Owls were banded on each of five nights during the monitoring period, with 54 banded on 14 October.

The statistical tool that we used to determine sex of the owls was developed using data from eastern populations. A number of owls captured at Rocky Point were considerably larger than the maximum values listed on the sexing chart, suggesting that there may be differences between eastern and western populations. An attempt should be made to build a comparable tool for western birds.

Young Barred Owls were also banded in unprecedented numbers in 2008, and well beyond the population of resident owls expected in the banding area. Although this species is not considered migratory, the numbers observed and captured suggest that they may be actively pursuing the smaller owls as a food source during Northern Saw-whet Owl migration.

Conclusions:

The number of captures in 2008, with the high ratio of hatch-year birds indicates a productive breeding season for this species. The audio lure is an effective tool for drawing migrating owls into the banding area. The small number of on-site recaptures and the recapture of a banded owl just two days later suggest that banded owls continue their migration shortly after being processed.

Rocky Point is a significant location on the migration route of the Northern Saw-whet Owl. As one of only five Project Owlnet sites west of the Rocky Mountains actively monitoring this species, continued banding operations at Rocky Point will contribute greatly to the knowledge base on the western populations.

All data from this project have been submitted to the Canadian Wildlife Service for inclusion in their database and submission to the Bird Banding Laboratory of the U.S. Geological Survey.

Acknowledgements:

The Northern Saw-whet Owl project was initiated by Paul Levesque in 2002. In 2008, bander-in-charge Gabriel David and banding intern Kelsey Low were assisted by volunteers who contributed more than 375 hours to this project.

References:

Project Owlnet web site: <http://projectowlnet.org>. Accessed 12 January 2009.

Pyle, P. 1997. Identification Guide to North American Birds, Part I. Bolinas, CA: Slate Creek Press.

Monitoring Avian Productivity and Survivorship (MAPS)

Project Leader: Ann Nightingale
Locations: Rocky Point, Royal Roads
Start Date: 30 May 2008
Completion Date: 3 August 2008

Introduction:

The Monitoring Avian Productivity and Survivorship (MAPS) project was created by the Institute for Bird Populations in 1989 to assess and monitor the vital rates and population dynamics of over 120 species of North American landbirds at more than 500 sites across North America. The sites at Rocky Point and Royal Roads are two of four sites in B.C. Monitoring was resumed in 2008 after a hiatus in 2007.

The purpose of the MAPS projects at Royal Roads and Rocky Point is to create an inventory of the breeding songbird populations using a standardized methodology, and to record sightings of other species to allow comparisons of populations and avian diversity between the two sites. The data are submitted to both the Canada Wildlife Service (banding data) and to the Institute of Bird Populations (banding, observation, breeding status, and habitat structure data).

Study Area and Methods:

MAPS monitoring was conducted at Royal Roads and Rocky Point, following the MAPS protocol (DeSante *et al.,* 2005). Songbirds were captured in mist nets and banded during standardized sampling sessions. The mist nets were located in a variety of habitat types, at prescribed distances from each other. The area covered at each study site was approximately 3.25 hectares. The sessions were conducted for a six-hour period starting at sunrise, at each location, once per 10-day period from between 31 May and 10 August. The MAPS protocol requires a minimum of five years of data (to account for annual variation in populations) before trend analysis or site comparisons can be made.

While the protocol recommends that sites be chosen that will remain relatively unchanged over the monitoring period, in some cases habitat change is beyond the control of the researchers. Invasive species removal at both sites necessitated the relocation of some nets at both locations. The habitat change was greater at the Rocky Point site.

Results:

A total of 465 birds (excluding birds that were recaptured) of 41 species were banded during the MAPS project in 2008, making this an average year. As has occurred in each year of the study, the Rocky Point site was much more productive than the Royal Roads site (298 birds at Rocky Point versus 167 at Royal Roads). Species variety was also greater at Rocky Point (38 species) than at Royal Roads (24 species). A detailed list of species for both sites is shown in Table 1. The recapture rate of banded birds was higher at Royal Roads than at Rocky Point.

Discussion:

Rocky Point continues to be more productive, in terms of the number of individuals and in species richness, than the Royal Roads site. As more years of data are collected, the MAPS project should prove to be a useful tool for measuring the effects of site management on songbird populations at the two sites.

The recapture rate of birds banded in previous years is an important component of the MAPS program. Although there is no expectation that the same adult bird will be captured every year, consistency in placement of the nets, dates of monitoring and habitat structure should lead to a high recapture rate of breeding adults over time. This information is a key component of the survivorship aspect of the research.

In 2008, six birds at Royal Roads and nine birds at Rocky Point had been banded in previous years. Only one of these birds was banded in 2005; the others were all banded in 2006. The most significant recapture was a Rufous Hummingbird (*Selasphorus rufus*) originally banded in 2006. This was our first recapture of a hummingbird banded at Rocky Point.

Table 1. MAPS captures.

Species	Newly Banded			Recaptures		
	Rocky Point	Royal Roads	Total	Rocky Point	Royal Roads	Total
Anna's Hummingbird	2	5	7		1	1
Rufous Hummingbird	25	16	41	2		2
Downy Woodpecker	3	2	5			
Willow Flycatcher	1	1	2			
Pacific Slope Flycatcher	18	6	24	1		1
Hutton's Vireo	3		3			
Warbling Vireo	1		1			
Violet-green Swallow	1		1			
Northern Rough-winged Swallow	1		1			
Cliff Swallow	11		11			
Barn Swallow	1	1	2			
Chestnut-backed Chickadee	18	4	22		2	2
Bushtit		14	14		5	5
Brown Creeper	8	4	12	2		2
Red-breasted Nuthatch	1		1			
Bewick's Wren	7	23	30		14	14
House Wren	7		7	6		6
Winter Wren	6	1	7			
Swainson's Thrush	4	7	11	3	1	4
American Robin	20	22	42	3		3
European Starling	6		6			

Table 1. continued.

Species	Newly Banded Rocky Point	Newly Banded Royal Roads	Newly Banded Total	Recaptures Rocky Point	Recaptures Royal Roads	Recaptures Total
Cedar Waxwing	11	9	20		1	1
Orange-crowned Warbler	15	6	21	2		2
Yellow Warbler		1	1			
Townsend's Warbler	3		3			
MacGillivray's Warbler	4	2	6			
Wilson's Warbler	4	4	8			
Common Yellowthroat		1	1			
Spotted Towhee	4	10	14		2	2
Chipping Sparrow	15	7	22			
Song Sparrow	22	16	38	3	10	13
Puget Sound White-crowned Sparrow	13		13	6		6
Dark-eyed Junco	3	1	4			
Rose-breasted Grosbeak	1		1			
Black-headed Grosbeak	1		1			
Red-winged Blackbird	11		11			
Brown-headed Cowbird	1		1	1		1
Purple Finch	8		8			
House Finch	9		9			
Pine Siskin	19	4	23			
American Goldfinch	10		10			
Total Individuals	**298**	**167**	**465**	**29**	**36**	**65**
Total Species	**38**	**24**	**41**	**10**	**8**	**16**

Conclusions:

The MAPS program is providing data on the productivity and survivorship of a wide variety of species in varied habitats across North America. The MAPS database serves as an important resource for population monitoring and conservation efforts. The monitoring should continue.

As with any longitudinal survey, sites should be chosen which have the least probability of major habitat changes during the study period.

References:

DeSante, D.F., K.M. Burton, P. Velez, D. Froehlich and D. Kaschube 2008. MAPS Manual: 2008 Protocol. The Institute for Bird Populations, Point Reyes Station, CA. 75 pp. <http://www.birdpop.org/DownloadDocuments/manual/MAPSManual08.pdf>.

Bander Training Workshop

Project Leader: Ann Nightingale
Location: Royal Roads
Start Date: 28 March 2008
Completion Date: 30 March 2008

Introduction:

The process of capturing wildlife and the marking and collecting of data and samples from individual birds require specialized training to ensure animal safety and successful research results. Since 2003, the Rocky Point Bird Observatory (RPBO) has been offering short training programs to teach the correct techniques in bird capture, banding, ageing, and in morphometric measurements.

Study Area and Methods:

The Avian Monitoring and Bird Banding workshop consisted of lectures, lab sessions, and field work at Royal Roads University. For the field component, six mist nets were used to capture songbirds that were used for live teaching demonstrations. The workshop instructor was Gabriel David, a North American Banding Council-certified trainer and RPBO's bander-in-charge for the last three migration monitoring seasons. Several banders and volunteers assisted with the training, providing about a three-to-one student-to-trainer ratio.

Lectures covered bird anatomy, the value of bird banding for monitoring populations and the basics of ageing and sexing passerines. In addition, Gary Kaiser gave a presentation on bird anatomy to the group.

The lab component of the workshop focused on bird identification strategies, and for those with considerable identification experience, on ageing and sexing the birds according to the criteria in Pyle (1997). Local specimens held by RPBO under the appropriate federal and provincial permits were used in the lab component. A collection of study skins borrowed from the Canadian Wildlife Service's Bird Banding Office was used to provide access to specimens from eastern North America.

As the majority of participants were novices, and to reduce stress on the birds, less emphasis was placed on the physical banding of birds during the field component than has been the case during previous workshops. More time was spent at the nets, instructing participants on proper safe handling of birds and extraction of birds from the mist nets. All participants had opportunities during the field component to handle live birds and to band at least one individual.

Results:

Fifteen participants attended the public workshop. Thirty-seven birds (including two previously banded) comprising 10 species were fully processed. Birds were banded by holders of valid Canadian Wildlife Service banding permits, or by the students under the supervision of permitted banders. The data collected were sent to the Canadian Wildlife Service. Detailed banding data are either available by request from RPBO, or via the CWS Bird Banding Office in Ottawa.

Discussion:

The bird banding workshop has been very successful in providing specialized training to people working on bird research projects throughout western North America. The Royal Roads site is an ideal location for the workshops due to classroom, accommodation and field study amenities. The use of several banders and volunteers to assist the instructor has proven very effective in ensuring that all participants are exposed to a variety of bird handling techniques and strategies for bird identification.

Conclusions:

The Avian Monitoring and Bird Banding workshops continue to be well received by the participants. By providing an introduction to safe handling of birds as well as techniques for ageing, sexing and monitoring populations, the workshop prepares participants for field study or volunteer positions.

RPBO plans to offer another workshop in March 2009.

References:

Pyle, P. 1997. Identification Guide to North American Birds, Part I. Bolinas, CA, Slate Creek Press.

Christmas Bird Counts

Project Leader: David Allinson
Email: passerine@shaw.ca
Locations: Albert Head, Heals Rifle Range, Rocky Point
Start Date: 20 December 2008

Introduction:

Since 1900, the Christmas Bird Count (CBC) has been an annual event attracting thousands of birders across North America to census winter bird populations within a local 24 km circle. Long-term trends are analyzed and compiled now for more than 1,800 counts across Canada by Bird Studies Canada. However, significant habitats found on Department of National Defence (DND) properties were historically off-limits to Victoria and Sooke CBC's compilers, with sporadic coverage beginning in the late 1980's and 1990's. For the sixth year in a row, ESAC Permit P003 provided access for members of the Victoria Natural History Society into three key DND sites on the Victoria CBC: Rocky Point, Heals Rifle Range and Albert Head.

Adverse weather conditions hampered coverage at Heals Rifle Range on 20 December 2008 and prevented coverage for the Rocky Point Ammunition Depot site during the Sooke CBC on 28 December 2008. However offshore results for the latter count area were obtained from Race Rocks Ecological Reserve.

Study Area and Methods:

On the Victoria CBC, participants completed bird surveys at two DND sites. Coverage consisted of four hours at Albert Head, and one hour at Heals Range. Results from the Race Rocks Ecological Reserve, which is within the Rocky Point CBC zone, were obtained. Participants recorded all individual birds observed and/or identified by voice. Albert Head and Heals Range were covered during the Victoria CBC on 20 December 2008. The Sooke CBC occurred on 28 December 2008.

Results:

Albert Head recorded 62 species and 11,946 individuals, and Heals Range tallied 14 species and 90 individuals. Rocky Point (offshore results from Race Rocks only) reported 13 species and 437 individuals. For detailed results, see Table 1.

Discussion:

In the past, the Albert Head site has proven to have a high number of species (species richness) with as many as 90 bird species using the area in winter both for shelter and feeding (*pers. obs.*). Both terrestrial and pelagic species are well represented here. In spite of the cold weather (temperatures -4 to -9°C, not including wind chill), species richness in 2008 was about average. However, total individual numbers were higher than the norm thanks to large numbers of waterbirds, especially Brandt's Cormorant (*Phalacrocorax penicillatus*) and alcids offshore, as well a large influx of American Robins (*Turdus migratorius*). American Robins, Varied Thrushes (*Ixoreus naevius*), and Cedar Waxwings (*Bombycilla cedrorum*) were particularly concentrated in the arbutus (*Arbutus menziesii*) forest at Albert Head. No doubt cold temperatures and recent snowfall pushed birds here to take advantage of the large arbutus berry crop. Nevertheless, many other common species (e.g. chickadees, nuthatches, creepers, kinglets, sparrows) were poorly represented this year and were apparently impacted by the cold temperatures. The settling pond near the obstacle course remained open and served as a haven for a number of dabbling ducks, most notably Northern Shoveler (*Anas clypeata*) and Ring-necked Duck (*Aythya collaris*). Remarkably, the total number of individuals tallied at Albert Head represented almost 10% of the total birds counted on the Victoria CBC, however, that was down from 21% of the total in 2006.

Table 1. Christmas Bird Count Results.

Species	Albert Head	Heals Range	Rocky Point
Canada Goose	36	10	
Mallard	12		
Northern Shoveler	15		
Northern Pintail	3		
Ring-necked Duck	6		
Harlequin Duck	2		10
Surf Scoter	25		
White-winged Scoter	6		
Bufflehead	27		
Common Merganser	6		
Red-breasted Merganser	6		
Red-throated Loon	2		
Pacific Loon	11		
Common Loon	4		
Horned Grebe	4		
Red-necked Grebe	3		
Western Grebe	4		
Brandt's Cormorant	1020		5
Double-crested Cormorant	122		52
Pelagic Cormorant	15		15
Great Blue Heron	1		
Bald Eagle	8	1	3
Red-tailed Hawk		2	
Black Oystercatcher	1		12
Spotted Sandpiper	2		
Black Turnstone	1		36
Dunlin	27		
Mew Gull	120		
Thayer's Gull	60		200
Glaucous-winged Gull	1250	50	
Glaucous Gull	1		
Common Murre	1500		50
Pigeon Guillemot	6		
Marbled Murrelet	4		
Ancient Murrelet	375		
Rhinoceros Auklet	3		4
Red-breasted Sapsucker	1		
Downy Woodpecker	2		

Table 1. continued.

Species	Albert Head	Heals Range	Rocky Point
Northern Flicker	5		
Steller's Jay		2	2
Northwestern Crow	4	5	5
Common Raven		3	
Chestnut-backed Chickadee	6	3	
Bushtit	4		
Brown Creeper	4		
Bewick's Wren	1		
Winter Wren	5	1	
Golden-crowned Kinglet	38	4	
Ruby-crowned Kinglet	2		
Hermit Thrush	1		
American Robin	6500	2	
Varied Thrush	95		
European Starling	310		
Cedar Waxwing	75		
Spotted Towhee	16	1	
Savannah Sparrow			2
Fox Sparrow	10	1	
Song Sparrow	11	5	
Golden-crowned Sparrow	21		
Dark-eyed Junco	102		
Purple Finch	17		
House Finch	12		
Pine Siskin	6		
American Goldfinch	2		
Evening Grosbeak	2		
House Sparrow	6		
Total Number of Species	**62**	**14**	**13**
Total Number of Individual Birds	**11946**	**90**	**437**

Albert Head	**Heals Range**	**Rocky Point**
Date: 20 December 2008	Date: 20 December 2008	Date: 28 December 2008
# of observers: 4	# of observers: 1	# of observers: 2
# hours on foot: 4	# hours on foot: 1	# hours on foot: 0.75
Distance (on foot): 7 km	Distance (on foot): 1km	Distance (on foot): 0.5 km
		# hours by boat: 0.33
		Distance (by boat) 5 km

Uncommon birds of interest included: Glaucous Gull (*Cygnus buccinator*), Western Grebe (*Aechmophorus occidentalis*), Northern Shoveler (*Anas clyptera*), Black Oystercatcher (*Haematopus bachmani*), Spotted Sandpiper (*Actitis macularia*), Ancient Murrelet (*Synthliboramphus antiquus*), Red-breasted Sapsucker (*Sphyrapicus ruber*), Cedar Waxwing (*Bombycilla cedorum*), Hermit Thrush (*Catharus guttatus*), American Goldfinch (*Carduelis tristis*), and Evening Grosbeak (*Coccothraustes vespertinus*).

The Heals Range sub-area has never produced a high number of species or individuals on the CBC, due in part to the low habitat diversity. In 2008, coverage was restricted to the main roads as heavy snowfall had blanketed the remaining area. With the difficult conditions preventing a full scan of the area, only 14 species were detected compared to the average of 20, and the number of individual birds (90) was only slightly higher than the low of 86 reported in 2005, well off the average of 306. Waterfowl were absent, (except for Canada Geese (*Branta canadensis*) that were observed flying overhead), as all ponds and wet areas were frozen. In the five years in which a Christmas Bird Count has been conducted at Heals Range, a total of only 35 species have been reported. It is unknown if better coverage would result in higher species diversity, or if the area simply supports fewer species than other more productive sites.

Race Rocks Ecological Reserve has provided offshore results for the Rocky Point zone when weather permits. 2008 was an exceptional year in that adverse weather prevented counters from covering the primary land area at Rocky Point. However, some results were derived from Race Rocks.

Weather, and the resultant reduction in the number of participants in the counts, were the primary factors in the low numbers observed in 2008. Weather and effort data are tabulated for each CBC sub-area, allowing for analyses of the effects of effort on count results. Bird Studies Canada (2009) reported that a number of Christmas Bird Counts were postponed or cancelled this year due to weather issues across the country.

Conclusions:

The 2008 Victoria CBC results from these sites produced a total of 65 species and 12,473 individuals in total, somewhat below the five-year average of 13,400 birds. If the land area at Rocky Point had been surveyed, it is likely that the results would likely have been above average. That is quite surprising considering the weather conditions. The DND sites are subject to less human disruption than most of the other areas covered during the CBCs and they add to the variety of habitats monitored. It is worth continuing coverage to produce long-term trends for wintering birds on southern Vancouver Island. In 2009, the CBCs will be conducted under a permit sought by the Victoria Natural History Society.

Acknowledgements:

CBC compilers Ann Nightingale (Victoria) and Denise Gubersky (Sooke) are acknowledged for their assistance in preparing this report. In addition, area compilers David Allinson and Warren Drinnan are acknowledged for their efforts in the field.

References:

Bird Studies Canada Latest News, January 2009 <http://www.bsc-eoc.org/organization/newsarchive/1-9-09.html>.

P003-08 Rufous Hummingbird (*Selasphorus rufus*).

Monitoring Winter Moth and the Parasites Introduced for its Control

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Permit #: P031-08
Location: Nadan
Project Status: 1980 - ongoing
Start Date: 1 April 2008
Completion Date: 31 July 2008

Introduction:

The objectives of this study are to monitor winter moth, *Operophtera brumata* L., population densities and determine percent parasitism by the two parasitoid species a parasitic wasp, *Agrypon flaveolatum*, and a parasitic fly, *Cyzenis albicans*, introduced in the Victoria area. This was the 25th year that winter moth and its parasitoid populations were monitored at this location.

The winter moth is an introduced pest that originated in Europe, where it mainly attacks fruit and deciduous trees, although it has also been reported from Sitka spruce plantations in Scotland. In Canada, it was first reported in Nova Scotia in 1949, and was first positively identified in the Victoria area in 1976. Prior to 1976 it was assumed that the damage in the Greater Victoria area was done by the native Bruce spanworm, *O. bruceata*, a close relative of the winter moth. By 1977, the winter moth defoliated over 120 km^2 on southern Vancouver Island where its principle host is the Garry oak, *Quercus garryana* Dougl., a unique tree with restricted distribution that is the dominant species in a threatened habitat. In addition, the introduction of winter moth also posed a threat to the fruit growing regions of B.C.

In the late 1950s and early 1960s, a highly successful biological control program was conducted in Nova Scotia, during which six parasitoid species (three parasitic wasps and three parasitic flies) were introduced from Europe. Of these six species, two species became established and were credited with controlling the winter moth in Nova Scotia. Following the example of this successful classical biological control program, in 1979, the Canadian Forest Service commenced introduction in BC of two natural enemies of the winter moth, a parasitic wasp, *A. flaveolatum*, and a parasitic fly, *C. albicans* that had proven successful in Nova Scotia. Releases were over a four-year period (1979-1982) at a total of 33 different locations in the Victoria area including a Garry oak meadow on Hotham Street on the DND Naden property. After 1982, a monitoring program was initiated at several Garry oak stands in the Greater

Figure 1. Winter Moth monitoring plot, Nadan, DND, Esquimalt. Sample trees contained in outline.

Victoria area to track the success of the introduction of these two parasitoids by monitoring the populations of the host and the parasitoids.

Study Area and Methods:

Two proven sampling methods were employed to monitor winter moth population and to measure the interaction between the host and the introduced parasitoid species in the Greater Victoria area (including the DND Naden property).

Winter moth population density

Winter moth population densities were determined by collecting with a pole-pruner 20 branches from four randomly- selected oak trees (five branches per tree) from early- to mid-May when winter moth larvae had reached the late 3rd or early 4th instar (i.e., when the larvae were still feeding). Different trees were randomly selected for sampling every year so trees sampled one year were, wherever possible, excluded from further sampling the following year. Branches and samples were processed following standard protocols as detailed in previous reports (Otvos 2007). Winter moth larval densities were expressed as the number of larvae per leaf or leaf cluster to monitor changes in the winter moth population over time.

Percent parasitism

Parasitoid populations were monitored by collecting mature winter moth larvae and rearing them because eggs of both species of parasitoid hatch and the larvae feed inside the host pupae, and cannot be identified until they complete development during the fall and winter months, after the host pupates.

To minimize larval rearing, winter moth larval collections were made in mid- to late May just before the caterpillars dropped to the ground to pupate in the duff layer. Trees were selected at random at the permanent sample location and larvae collected by beating lower branches with a 2 m pole and retrieving larvae falling onto a 2 m x 3 m white sheet placed on the ground. This procedure was repeated until about 200 larvae were collected, or 1 hour was spent collecting larvae. The collected winter moth larvae were placed in a bucket with moist peat moss/soil and oak foliage, with a lid with mesh covered aeration hole and transported back to the Pacific Forestry Centre for rearing at room temperature.

Once the winter moth larvae finished pupating and the pupal cuticles had hardened (early June), cocoons were sieved out of the soil mixture, placed in 150 x 20 mm Petri dishes containing a layer of moist sand covered with a filter paper and moistened periodically with an anti-fungal solution to prevent desiccation. Pupae were reared at room temperature until mid-October then transferred to a 5º C growth chamber until the spring, when the parasitoids would emerge. Adult winter moths started emerging around mid-November and finished emerging by about mid-December. Further details on parasitoid rearing methods are in Otvos (2007).

Results:

At the Naden sample plot, winter moth population densities averaged 0.14 and 0.21 larvae per leaf in 2007 and 2008, respectively. This was lower than the overall average for the Greater Victoria area of 0.26 and 0.27 larvae per leaf in 2007 and 2008, respectively. The winter moth population densities in the Greater Victoria area caused defoliation of the leaves that in some locations was visible at a distance. On the other hand, in spite of the increased numbers of insects present at Naden, the damage caused by the winter moth on most trees could only be seen close up, the leaves having "shot-gun" type holes and no discoloration of the damaged leaves. More visible damage was only apparent on a few branches on some of the trees at Naden.

Percent parasitism by parasitoid species, *C. albicans* and *A. flaveolatum*, during the spring of 2008 will be determined in the spring of 2009 when the overwintered parasitoid adults will emerge. Therefore, only parasitism of winter moth during 2007 can be reported at this time.

Parasitism by the more important parasitoid, *C. albicans*, at Naden decreased from 29.9% parasitism in 2006 to 13.6% in 2007. This change was also reflected in the Greater Victoria area, where percent parasitism by *C. albicans* decreased from an average of 38.6% in 2006 to 27.3% in 2007. We are unable to explain this decline in percent parasitism by *C. albicans* at Naden or in the Greater Victoria area at this time.

The pattern of parasitism by the less important parasitoid, *A. flaveolatum*, was more varied. No *A. flaveolatum* were recovered at Naden in either 2006 or 2007. This in itself was not unexpected, because parasitism by this parasitic wasp has been quite low at all six monitoring sites over the years. In the Greater Victoria area in 2007, parasitism of winter moth by *A. flaveolatum* averaged less than 0.1%, compared with the 0.3% parasitism recorded in 2006.

Discussion:

Winter moth populations at Naden were lower in 2007 and 2008 than the regional average, but this is not unusual. Both winter moth and parasitoid population densities have been consistently lower at Naden than the overall host and parasitoid population levels for the Greater Victoria area since 1991. Winter moth populations during the years 2003-2008 were the highest recorded since 1983.

Parasitism by *C. albicans* decreased at Naden (from 29.9% in 2006 to 13.6% in 2007), mirroring a similar decrease throughout the Greater Victoria area as a whole (from 38.6% to 27.3%) for 2006 and 2007, respectively. In 2008, the average winter moth population in the Greater Victoria area remained at approximately the same level as in the previous year, with some minor variations among the plots. This may be due, in part, to the decreased presence of *C. albicans* (which ranged from 2% to 30% parasitism in the Greater Victoria area in 2007). This reduction in parasitism by *C. albicans* undoubtedly enabled the winter moth to maintain its current population levels, rather than continue declining (as occurred between 2006 and 2007). Parasitism by *A. flaveolatum* remained low (less than 1%) in 2007, and is likely to remain at these levels, as this parasitoid has never caused more than 6% parasitism in a single year in B.C. since its introduction 25 years ago.

It appears equilibrium may have been reached between the winter moth and its two introduced parasitoids. These introduced parasitoids will likely not eliminate the winter moth. It is possible that the current small fluctuations will increase in amplitude from time to time to the point where winter moth populations will temporarily “escape” from its parasitoids and cause light to moderate defoliation of Garry oak in localized areas in the Greater Victoria area. It is not known what, if any, factors could disrupt this “natural balance” reached between the winter moth and its parasitoids. The infrequent application of *Bacillus thuringiensis* subsp. *kurstaki (Btk)* against gypsy moth during eradication programs may temporarily disrupt this equilibrium reached between the winter moth and its two introduced parasitoids.

Conclusions:

Monitoring of the winter moth and its parasitoids in the Greater Victoria area shows that the introductions of the two parasitoids, *C. albicans* and *A. flaveolatum*, have resulted in control of winter moth in the Greater Victoria area. However, both the recent drought (which makes the soil dry and hard, making it difficult for the mature larvae to burrow into the soil to pupate) and the eradication programs conducted against both Asian and European strains of gypsy moth in recent years in the Greater Victoria area have made it difficult to predict with any certainty when, and at what host density levels, the winter moth and its parasitoids will reach or remain in equilibrium. In these eradication programs, the bioinsecticide *Btk* was used. Although *Btk* has a much narrower target range than chemical insecticides, it still affects a number of physiologically susceptible Lepidoptera species, including the winter moth. Therefore, it is important to continue monitoring these insects. Continued monitoring will not only reveal the stability of the equilibrium reached by the winter moth-parasitoid complex, it will also show if this equilibrium is affected by the periodic use of *Btk* to prevent the establishment of another invasive species, the gypsy moth.

The successful control of the winter moth in eastern (Nova Scotia) and western Canada (Victoria) has attracted international interest. As a result of these highly successful programs, Dr. J. Elkinton, University of Massachusetts, initiated a parasitoids release program in 2005 to control of winter moth in the eastern United States, where it was recently introduced and is causing significant damage in New England. In a cooperative project, over 32,000 parasitized winter moth pupae were shipped to the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine Service (APHIS-PPQ) for rearing of the parasitoids for release in Massachusetts in 2005, 2006, 2007 and 2008. None of the winter moth that were collected and shipped to the United States were collected at Naden, but rather at other locations (where parasitism is higher) in the Greater Victoria area. We predict that the winter moth in the northeastern United States will also be controlled by the introduction of these two parasitoids. If successful, it will confirm that classical biological control is still an extremely effective way to manage or even eliminate an introduced, exotic pest.

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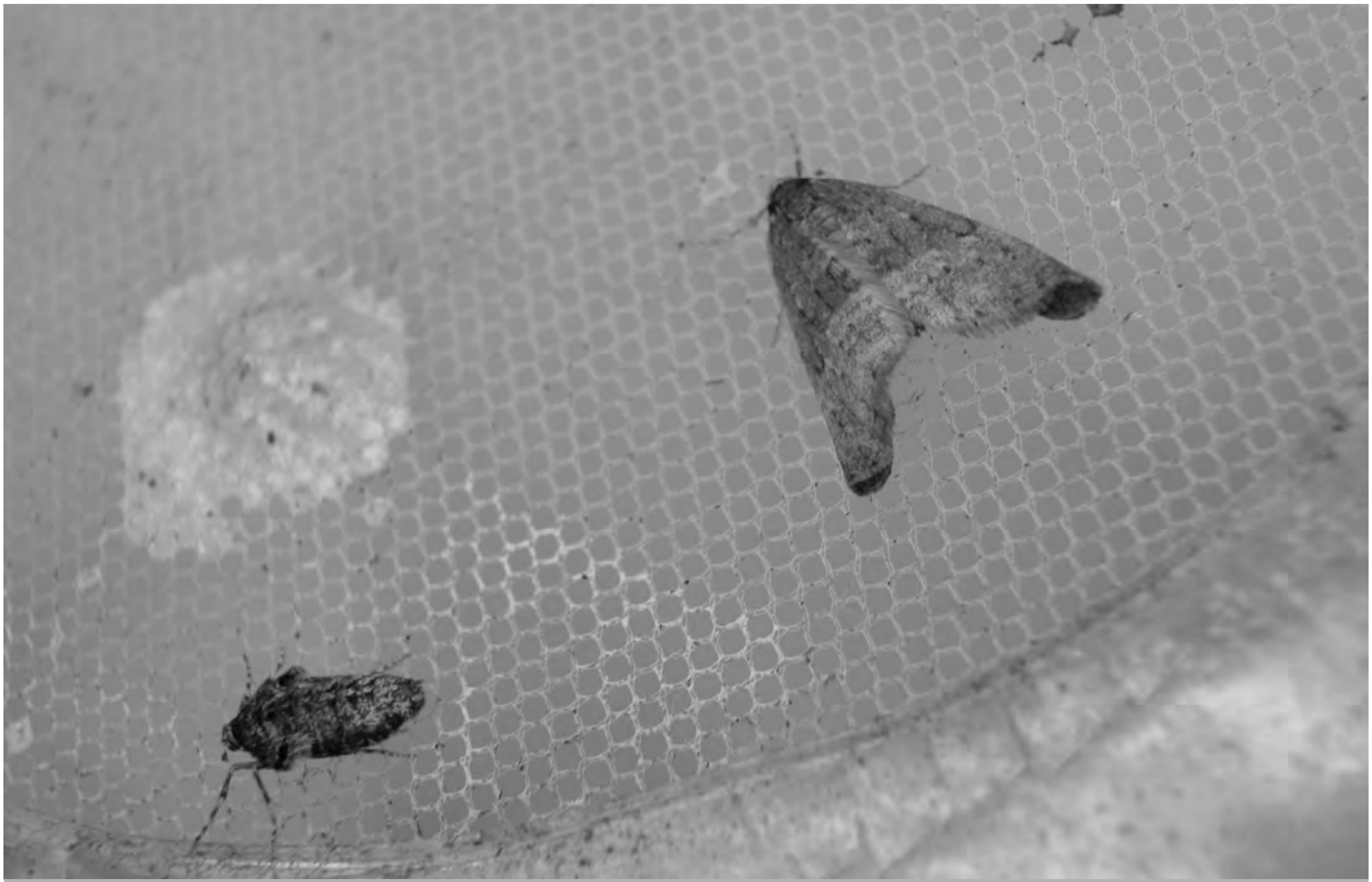

P031-08 Male (right) and Female (left) Winter Moth (*Operophtera brumata*).

Purple Martin (*Progne subis*) Origins and Relationships

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Permit #: P044-08
Locations: Colwood, Royal Roads
Project Status: 1998 - ongoing
Start Date: 1 April 2008
Completion Date: 30 September 2008

Introduction:

Western Purple Martins (*Progne subis arboricola*), the largest member of the swallow family in North America, are at the northwestern limit of their breeding range in southwest British Columbia (B.C.). This partly accounts for the low number of pairs and Blue-listed conservation status ("Vulnerable") in B.C., in combination with widespread habitat loss and competition for cavity nest sites from non-native species within their historic breeding range. This subspecies is considered at risk throughout the breeding range west of the Rocky Mts., from California (CA) to B.C. In 1984 Purple Martin numbers had decreased to less than five known pairs in B.C. By 1995, in response to provision of man-made nest boxes for a decade, the total number of known active Purple Martin nests in B.C. had increased to 55 (B.C. Ministry of Water, Land and Air Protection, 1997).

Since 1997 Purple Martin colonies in B.C. have been monitored systematically to document annual abundance and juvenile production. As well, nestlings were banded to facilitate migration tracking, breeding dispersal and recruitment. From 75% to 98% of all nestlings produced at known breeding locations in B.C. have been banded with both standard Canadian Wildlife Service identification bands and individually numbered, coloured plastic or more recently, aluminum auxiliary bands, visible with binoculars and readable with a spotting scope. The goals of banding are to monitor inter-colony movements and relationships, annual migrations, population age structure, differential production, mortality and recruitment.

Conservation efforts have resulted in the B.C. martin population recovering to ~200 pairs at 16 colonies in 2000, and to a peak of ~650 pairs at 46 colonies in 2007, before declining to ~570 pairs at 44 colonies (a net loss of two colonies) in 2008. The rapid growth prior to 2007 was caused by three nesting seasons with favourable weather that resulted in high nesting success, production and subsequent recruitment. The recent decline was the result of reduced survival, nesting success and production caused by unfavourable spring and summer weather in 2007 and 2008; such declines have been noted by others (Darling *et al.* 2004, Cousens *et al.* 2005a, 2005b, Lee *et al.* 2007).

Study Area and Methods:

The DND Colwood diving dock and Royal Roads colony sites, located on southern Vancouver Island near Victoria, are two of 44 currently active nest box sites in B.C. In 2008, Purple Martin colonies throughout the Strait of Georgia, including these sites, were visited as usual to identify individuals banded in B.C. and Washington (WA) in previous years, document number of pairs and nesting success and band nestlings. The number of visits per colony varied depending on ease of access, with multiple monitoring and band-reading visits and 2-3 nest check and banding visits at accessible sites and a minimum of one nest check and banding visit at more remote sites. The number of eggs and/or nestlings were recorded in all accessible nest boxes inspected. Productivity was determined for each colony on a per pair basis and by nest box type. As in previous years, adults captured incidentally on the nest were examined and band numbers were recorded before the bird was replaced on the nest or released.

Thirteen visits were made to the Colwood and Royal Roads sites between 4 April and 26 July for observations, nest box checks and banding of nestlings, with three additional visits made to Royal Roads in August. Banding and band return records (re-sightings of identified individuals) were compiled and submitted to the CWS Banding Office.

Results:

As in the previous year, three pairs of martins returned to nest at the Colwood colony, but for the third consecutive year all the nests were abandoned during incubation, resulting in complete reproductive failure with no juvenile production.

We started monitoring this site early this year, with the first visit on 4 April and the first sightings of martins on 5 May. Subsequent visits confirmed occupancy of three nest boxes up to 6 July; at which time we did a nest check and found that all three nests contained eggs. We also noted that three pairs of martins were in attendance nearby. Our next visit occurred on 26 July, and based on the presence of cold eggs in all three nests and the absence of the parent birds, we assumed that the colony had been abandoned. This pattern of abandonment during incubation in early-mid July had been observed at Colwood the previous two years. The nests were undisturbed, as occurs when an owl (a well documented martin nest predator) targets the escaping parent birds during incubation rather than nestlings. Although other evidence was lacking, we speculated that the cause of the abandonment was likely due to nocturnal predation by an owl. There were no further observations at this colony after 26 July.

The Royal Roads colony was visited and monitored on the same dates as the Colwood site. The colony had declined by 50%, from 6 pairs in 2007 to 3 pairs in 2008 (as at other colonies on south Vancouver Island). Although others reported observing martins at Royal Roads during the first week of April, we did not encounter any until we did a nest check on 6 July. We found three active nests with eggs in each and three pairs of martins were perched nearby.

Two of these nests fledged a total of nine young. We banded five young from one nest on 26 July and four nestlings from a second nest on 6 August. At that time we found that the chicks in the third nest had died, probably a result of starvation, caused by reduced flying insect abundance for food during the cold, foggy wet weather in late July. We re-checked the colony twice more in August and found Martins flying in the area on both occasions.

Using coloured numbered leg bands applied to nestlings in previous years we are able to read the band numbers on banded birds with a spotting scope to determine where these birds were originally banded and fledged, indicating the extent of dispersal and genetic mixing in the regional population. After reading 206 band numbers found around the Strait of Georgia in 2008, we noted 12 birds widely distributed around the Strait that had fledged at Colwood prior to initial colony abandonment in 2006:

- 1 nestling banded at Colwood in 2005 was found at Ladysmith;
- 8 nestlings banded at Colwood in 2004 were found at Cowichan, Ladysmith, Newcastle Is. and Nanoose Bay;
- 3 nestlings banded at Colwood in 2003 were found at Newcastle Is. and Ladysmith.

After three consecutive years of nest abandonment and failed production at the Colwood site, birds banded here in earlier years are becoming uncommon in the population due to normal mortality with lack of new recruitment. However, the wide distribution of those that remain illustrates the extent of dispersal and mixing within the population.

No birds banded at the small Royal Roads colony were seen elsewhere in 2008.

Discussion:

Three pairs of martins, a mix of returning adult birds and new subadult recruits, attempted to nest at the Colwood DND diving dock in 2008, despite colony abandonment in 2006 and 2007. The colony abandonment and complete breeding failure for the third consecutive year remains unexplained. However, as noted earlier, the most likely cause was nocturnal nest predation attempts by owls. Martins are highly sensitive to such nest disturbance at night and we could find no evidence of disturbance by humans or other wildlife as the likely cause. Although not yet documented in B.C., owl predation is a common cause of colony abandonment in eastern North America and has recently been observed in WA (Hill 1990, Kostka 2000, Buker 2007 *pers. comm.*).

In 2007 we installed wire predator guards on all the boxes, which proved to be effective in preventing attacks by gulls and crows, in the hope of deterring owl attacks. However, even failed predation attempts by already habituated owls could be sufficient disturbance to cause the birds to abandon the site. We had planned to install a motion-sensitive wildlife monitoring camera with invisible infra-red flash illumination to try to document predation attempts in 2008, but with the late nesting start and funding limitations this was impractical and not carried out. If martins return and funding allows us to do so, we will monitor night-time activities at the Colwood colony in 2009.

The 2008 results at Royal Roads closely match those seen at most other colonies on Southern Vancouver Island and throughout much of the Pacific Northwest. The decline in number of nesting pairs was largely the result of losses of adult birds prior to nesting during the prolonged record cold spring weather that extended to almost mid-June (reportedly due to a La Nina Pacific Ocean circulation event), reducing the number of breeding pairs by an estimated 10-15% and delaying early nesting by up to a month.

Raising only a single brood in a season, martins exhibit variably asynchronous nesting timing to reduce the impact risk from periods of adverse weather, with the early season timing determined by weather. In 2008, delays caused by the prolonged cold spring synchronized almost all nesting timing late in the season, leaving an unusually high proportion of broods vulnerable to a single adverse weather event. The high level of nestling mortality and resulting low nesting and fledging success were the result of a 4-5 day period of cool, wet weather at the end of July, temporarily reducing the flying insect food supply during the peak of the unusually compressed nestling rearing period. The adult mortality and reduced nestling production, the latter well below the level needed to offset normal annual post-breeding mortality, are expected to result in a further 10-20% reduction in the breeding population in 2009, mainly due to low yearling recruitment.

We were unable to read bands on birds nesting at the Colwood colony in 2008 to determine origins, largely because of the unfavourable weather conditions prior to colony abandonment. The one band read at Royal Roads was on a subadult bird fledged the previous summer at the nearby West Bay colony in Victoria Harbour.

The number of banded Purple Martins from the Colwood colony seen at other colonies (only 12 in 2008) is declining. That decline is mainly a result of the nesting failure and lack of production of new recruits since 2005, as older birds drop out of the population. No banded birds from the small Royal Roads colony were observed elsewhere in 2008.

Over 1,500 of ~7,800 Purple Martins banded as nestlings at B.C. colonies in 1997-2007 have been re-sighted at different colonies than their natal colonies in B.C., as well as in WA and Oregon (OR), and in CA during migration. In addition, ~30 of 1,400 birds banded in WA in 2001-2007 have been sighted throughout the breeding range in B.C. These data indicate that these regional populations mix and overlap. This conclusion is backed up by the results of mitochondrial DNA work, comparing west coast and eastern populations (Baker *et al.* 2008). The DNA study indicates that the B.C. colonies are part of a broader regionally stratified population ranging north from WA, OR and CA.

The band re-sight data also provide information on the average and maximum life span of Purple Martins, as well as inter-annual variations in population age structure. Those data are critical to understanding population fluctuations and managing the recovery of this at-risk species. Recently, several 9 -10 year-old banded birds have been re-sighted.

After a prolonged decline in the mid-late 1900s, for the past two decades the Purple Martin populations has been increasing in B.C., prior to the recent adverse weather-related declines. This apparent recovery is the result of the provision of and continued availability of clustered single nest boxes. The current B.C. population is derived from the few birds that had adapted to nest box colonies in B.C., augmented by immigrants from the adjacent WA population, which had begun to recover in nest boxes a decade earlier. The DNA work shows little distinction between these contiguous regional populations.

Previous band re-sighting data had shown that the Colwood colony was made up of birds from the USA, the Lower Mainland and more northern Vancouver Island colonies. Assuming that birds will return to the colony in 2009, it will be interesting to see where the recruits come from.

In 2003, blood was collected from Purple Martins in CA for DNA analysis, to compare with samples previously collected from B.C., WA, OR, and selected populations in eastern North America. The results of the analyses (Baker *et al.* 2008) showed that the west coast Purple Martins have been genetically isolated from eastern populations as a separate subspecies gene pool for at least 200,000 years. There was no evidence of a genetic bottleneck or inbreeding (common in small isolated populations). Instead, the results revealed a distinct and extremely diverse genetic makeup of the population (more so than for eastern martins), with regular influx of birds to B.C. from WA (as confirmed by our band recovery data) and direct or indirect genetic input from OR and CA.

In 2006 blood samples were collected from martins in Colorado (CO) and in 2008 additional samples were collected from martins in Utah (UT). These are currently being analyzed and the results will be added to our DNA data base for comparison with earlier samples. This DNA work is part of an overall study of the origin of western martins, which now includes samples collected from birds from B.C., WA, OR, CA, CO and UT, and from Alberta, Manitoba, Ontario and Pennsylvania. The results of the DNA work, to clarify the taxonomic relationship between the western and eastern populations, are important for determining conservation status and appropriate management actions for the western Purple Martin population in Canada and the western United States.

The results of the ongoing B.C. monitoring study are valuable for adaptive management of this threatened species in the Pacific Northwest. Shared with management agency staff and volunteers, this information contributes significantly to science-based recovery efforts for the west coast subspecies throughout its breeding range from B.C. to CA.

Conclusions:

The volunteer-driven nest box-based recovery program for Purple Martins since 1985, coordinated since 2002 by the Nanaimo-based Georgia Basin Ecological

Assessment and Restoration Society, has been highly successful in preserving and recovering the B.C. martin population. The recent minor declines in abundance are caused by adverse weather effects, which tend to regulate martin populations and cannot be avoided.

The ongoing monitoring and banding studies of Purple Martins in B.C. have provided a well-documented record of the progress of recovery and continue to provide valuable biological data on productivity, dispersal, longevity and population dynamics.

The recovery and monitoring program will continue in 2009, including all recent activities at the Colwood site, with the hope of determining and if possible, mitigating the cause of the colony abandonment. In 2009, if there are sufficient numbers of breeding martins at Colwood and if funding permits, we plan to install a motion-sensitive, infra-red flash, wildlife monitoring camera for nocturnal surveillance to attempt to determine if owls are visiting the colony. The equipment will be installed and used as described and approved for the 2008 season.

We hope to obtain access to colonies by 1 April 2009, as martins may return in early April, so that we can check for and read bands on any banded birds. Assuming birds return and successfully produce young, we will continue to monitor production and band nestlings, as part of the on-going population monitoring and nest box maintenance program throughout their breeding range in southwest B.C.

We also intend on continuing the monitoring, nestling banding and band reading sessions at the Royal Roads colony as in 2008.

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(* These references are available on-line at <www.georgiabasin.ca/puma.htm>)

Wildlife Tree Stewardship Program (WiTS)

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Wildlife Tree Stewardship Program (WiTS), FBCN

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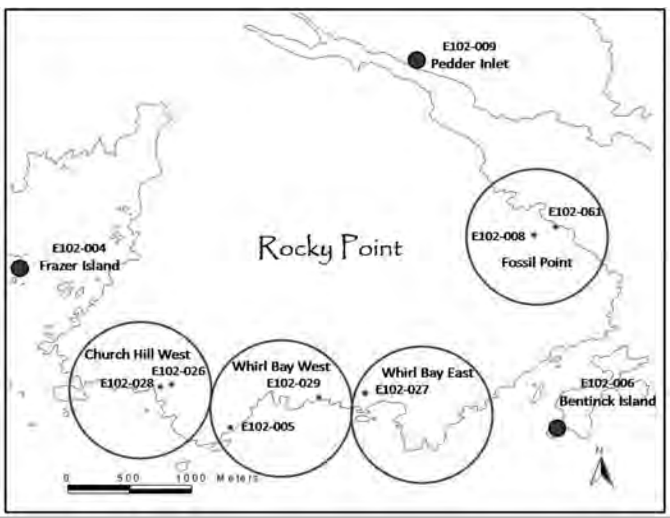
Permit #: P074-08
Locations: Rocky Point, Albert Head, Colwood
Project Status: 2002 - ongoing

Start Date: 1 April 2008
Completion Date: 31 December 2008

Introduction:

The Wildlife Tree Stewardship (WiTS) Program began on Vancouver Island, British Columbia (B.C.) in 2000. The program has two main objectives: 1) to document the use of wildlife trees and the nesting success of raptors, using open nests, and other bird species (owls and woodpeckers) using cavities for nesting; and 2) to provide nest site inventory and monitoring data to regional government staff to help in securing protection of wildlife tree nesting sites.



Map 1. Bald Eagle nest site locations and nesting territories at Rocky Point.

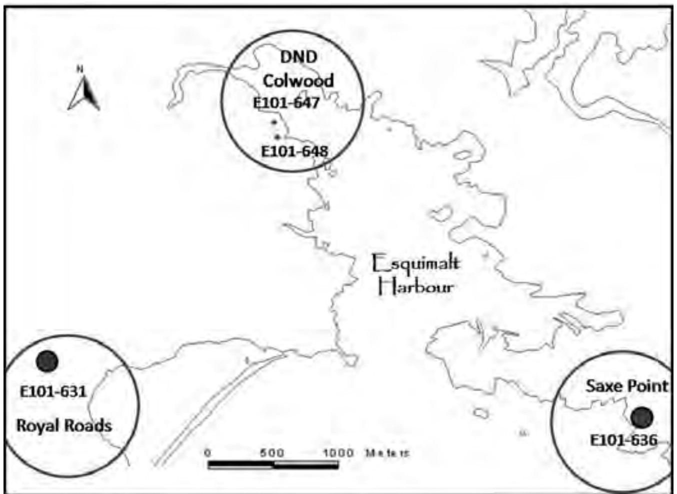
The aspect of the WiTS program carried out on Department of National Defence (DND) lands at Rocky Point, Albert Head and Colwood, to this date, includes the locating and monitoring of Bald Eagle (*Haliaeetus leucocephalus*) and Osprey (*Pandion haliaetus*) nests. As the Rocky Point and Colwood sites are protected from much of the human related disturbance found at sites in more populated areas, these nesting territories are valuable for comparison with other sites.

Study Area and Methods:

The study area includes Bald Eagle and Osprey nests sites in the coastal forests of Rocky Point (Map 1), Albert Head and Colwood (Map 2). Each year, known nest sites are visited a minimum of three times. If conditions are less than ideal and observations are not certain, additional visits may be necessary.

Activity Survey

Between late March and the end of April, an initial site visit is used to determine activity at the nest sites. During that visit, we are extremely cautious to prevent disturbing the birds; observations involve either locating by calls or by viewing from a distance through binoculars or telescopes. During the initial visit we listen and look for evidence of new nest sites, and



Map 2. Bald Eagle nest site locations and nesting territories at and near DND Colwood.

attempt to determine if the birds have shifted between alternate nests within a nesting territory.

Mid Season Survey

In May and through early June a second site visit is conducted to confirm nesting activity and again to look for evidence of new nest sites. During the second site visit, nests are once again viewed from a distance to minimize disturbance.

Productivity Survey

Typically undertaken from mid June to mid July, this site visit is timed to look for and if present, count chicks before they fledge. By this stage in the breeding cycle, the nesting birds are far less prone to disturbance. Nests can be viewed from a distance, or from under the nest tree. When under the tree, we look for evidence of recent nest use and for the remains of fallen chicks. During this site visit, conditions of the nest tree and the surrounding habitat are documented.

Results:

Albert Head

In 2008, we made one road survey; however, because we did not find any evidence of nesting eagles, no further efforts were made.

Rocky Point

Seven eagle nest sites representing four active nest territories were monitored (Map 1, Table 1). Nesting attempts at two of the four occupied territories were successful with one chick believed to have fledged at each of these sites. Although we did not detect any Osprey nests at Rocky Point in 2008, base staff did report observations of Ospreys checking out the nest platform. However, they did not appear to have laid any eggs there.

Colwood

In 2008, Bald Eagles did not nest successfully. Over the past five years, eagles have been observed in and around the nesting territory but there has been no evidence of successful nesting (Table 2). While

Table 1. Bald Eagle nesting history at DND Rocky Point, 2000 through 2008.

Territory Name	**2008**	**2007**	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**2000**
Fossil Point	0C	0C	1C	OT	OT	OT	OT	1C	
Whirl Bay East	0C	1C	A	NA	NA	1C	NA	NA	A
Whirl Bay West	1C	0C	0C	1C	2C	NA			
Church Hill West	1C	1C	NA	1C	2C	A	2C		

Results. A = Active nesting attempt though no evidence of chicks; NA = Not Active; OT = Occupied Territory;
0C = No chicks, nesting attempt failed; 1C = One chick fledged; 2C = Two chicks fledged.

Table 2. Bald Eagle nesting history at DND Colwood, 2004 through 2008.

Territory Name	2008	2007	2006	2005	2004
DND Colwood	OT	A	A	OT	OT

Results. A = active nest though no evidence of chicks; OT = Occupied Territory.

Ospreys were observed in the area, they did not nest at either of the nest platforms.

With only four eagle nesting territories at Rocky Point, the sample size is too small to make statistical comparison between the nests or to predict trends. However, if the data are pooled over the nine seasons, we have 24 observations of occupied territories that may be compared with a pool of previous data collected at other sites, between 1990 and 1996 (Elliott *et al*. 1998, Table 3). There were significant differences between the nest success at Rocky Point compared to Clayoquot Sound (chi-sq = 4.56, 1DF, with P0.05 = 3.84) and the Lower Fraser Valley (chi-sq = 6.27, 1DF, with P0.05 = 3.84).

Discussion:

Bald Eagles often have more than one nest location and will change between nests within their nesting territory over the years. Along the B.C. coast, nesting territories typically cover one kilometre of coastline, though there are many examples of nests that are closer or further apart (I. Moul, *pers. obs*.). Territories are not necessarily centred on the nests and over time, they may change in shape or size, and be divided or engulfed. In areas such as Rocky Point, where nest trees do not appear to be a limiting factor, it is thought that proximity to a food source is the primary variable defended within each territory. At Rocky Point, by tracking the nest activity over several years, we are reasonably certain that there are at least four territories

Table 3. Comparison of nesting history and production of Bald Eagle nest sites at Rocky Point with other studies (from Elliott *et al.* 1998).

Study Site	Years	Nesting attempts in occupied territories	Successful nesting attempts	Chicks per occupied territory
Rocky Point	2000-2008	24	12	0.63
South-east Vancouver Island	1991-1995	32	20	0.95
Fraser River Delta	1993-1996	11	8	1.10
Lower Fraser Valley	1990-1996	21	18	1.20
Barkley Sound	1992-1995	33	15	0.56
Clayoquot Sound	1992-1995	35	8	0.27
Johnstone Strait	1991-1995	27	7	0.30

(circles on Map 1). A previous nest site inventory in 1993 located three additional nest locations (the large dots on Map 1) that likely represent additional territories that have not been detected or occupied during recent years.

The distances between eagle territories at Colwood are much greater than at Rocky Point. The Colwood property is far closer to urban development than Rocky Point is. The more urban nature of the Colwood site may have resulted in fewer suitable nest sites, forcing the eagles to nest much further apart than elsewhere.

Although the production of eagle chicks at Rocky Point is higher than found at more remote wilderness areas, such as Clayoquot Sound and Johnstone Strait; it is lower than has been observed at several more developed locations around the Strait of Georgia. Low eagle nest productivity in those presumably more pristine areas may be related to food supply during the time of rapid chick growth in May and June (Elliott *et al.* 1998). In Clayoquot Sound, an area of low productivity, successful nesting locations appeared to have been associated with proximity to the garbage dumps, fish processing areas or logging camps (I. Moul, unpublished data). The relatively low nesting success at Rocky Point may reflect its location as somewhat of a wilderness area that is yet not too distant from potential supplementary food sources in the Greater Victoria area

Conclusions:

The production of two eagle chicks from four nesting territories at the Rocky Point site falls with within the expected range. In 2009, we hope to continue this study and to again look for undiscovered nest locations at all three study sties, as well as in areas immediately adjacent to the properties. In addition, we plan a more comprehensive analysis of Bald Eagle and Osprey nesting success in the Capital Regional District and along eastern Vancouver Island.

Acknowledgments:

We wish to thank Wendy Tyrrell, Fern Walker, Jenny Hyndman, Sue Myerscough and Gaye Goldie for assisting in data collection for this project. Thank you to Julie Micksch for comments on the manuscript

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P074-08 Bald Eagle (*Haliaeetus leucocephalus*).

Garry Oak Acorn Survey

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Permit #: P079-08
Locations: CFMETR, Rocky Point
Project Status: 2001 - ongoing
Start Date: 5 September 2008
Completion Date: 26 September 2008

Introduction:

Garry oak (*Quercus garryana*) ecosystems from southern California to Vancouver Island are disappearing or changing due to introduction of exotic species, fire suppression and land conversion for agricultural and urban uses (Agee 1993, Bell and Papanikolas 1997, Chappell and Crawford 1997, Reed and Sugihara 1987, Tveten and Fonda 1999). Garry oak-associated communities are among the most threatened ecosystems in Canada (Gedalof 2006) and provide habitat to more than 100 red- and blue-listed species (GOERT 2002). Garry oak primarily reproduces from acorns, although root-crown sprouting may also occur if stems are heavily damaged (Stein 1990).

High annual and tree-to-tree variation in acorn production is characteristic of oak species in general (Koenig 1980), but there is little published information on acorn crop variation or regularity in Garry oak (Stein 1990). The purpose of the Garry Oak Acorn Production Study is to determine the spatial and temporal variation in acorn production and the factors that influence it. Annual acorn production is monitored from Vancouver Island to southern Oregon with the help of volunteers and cooperating agencies. To assist our volunteers and inform the general public, we created a website with background information, methods and forms used in the survey, and results of the survey (www.fs.fed.us/pnw/olympia/silv/oak-studies/acorn_survey).

The Vancouver Island sites are important as they are near the northernmost distribution of Garry oak and may thus reveal important information about climatic limitations on Garry oak distribution. In this report, we describe acorn production among sites on Vancouver Island, including DND properties. Acorn production for adjacent areas in the Puget Sound area of Washington State is presented for comparison.

Study Area and Methods:

The number of trees monitored annually on or near Vancouver Island has increased from 54 trees in 2001 to 230 trees in 2005. In 2008, only 211 trees were monitored due to mortality (10 trees) and lack of access to one DND site (Mary Hill: 16 trees) and one isolated location with boat access only (Pylades Island: 3 trees). The sample trees extend from Courtenay in the north to Rocky Point southwest of Victoria in the south. Mary Hill has been included in past presentations of results but is not included this year, as access to this site is likely to be permanently denied in future.

We surveyed acorns in August or September and ranked acorn production from 1 to 4 with 1 indicating no acorns and 4 indicating a heavy crop (Graves 1980). Acorn class increments are not equal. For example, in total acorn counts from a small sample of trees, class 3 trees averaged about eight times as many acorns as class 2 trees. Results from trees greater than 10 cm dbh are reported here. Trees were assigned to groups based on location and site characteristics. These included: cultivated locations, such as lawns, pastures and parks, riparian locations, near water bodies; woodlands; and CFMETR, which is distinct in that it is very open and savannah-like. The woodland group was further separated into northern and southern groups at the latitude of Duncan. Rocky Point was included in the southern woodland group.

For comparison, 2008 acorn production data are presented for cultivated, riparian and woodland areas in the south Puget Sound (south of Seattle) area and woodlands of the north Puget Sound (north of Seattle) area.

Results:

CFMETR had the lowest acorn production in 2008 (Figure 1), which is consistent with results since 2003. Southern and northern woodlands had equal production in 2008, which differs from the more typical pattern where production is at least slightly greater in southern woodlands. Acorn production was greatest on cultivated and riparian sites. In comparison, the 2008 score was lower at Rocky Point which a median score of 1 had compared to 3 for Mountain View Cemetery (cultivated) in Duncan.

Compared to groups in Washington State, acorn production was greater in cultivated and northern woodland portions of Vancouver Island (Figure 2) and about equal in riparian areas. Among woodland groups, acorn production was highest in south Puget Sound locations. North Puget Sound woodlands had slightly lower acorn production than woodland groups on Vancouver Island.

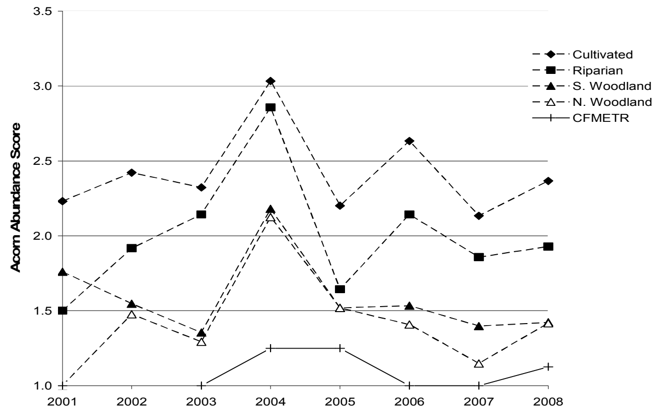

Figure 1. Average, annual, Garry oak acorn production by group for Vancouver Island.

Discussion:

Peter and Courtin (2006) suggested that long, warm, moist growing seasons and dry spring conditions benefit acorn production. The generally moister conditions of cultivated and riparian areas are thus likely responsible for the greater acorn production in these locations. In general, 2008 appears to have been an average year for acorn production on Vancouver Island.

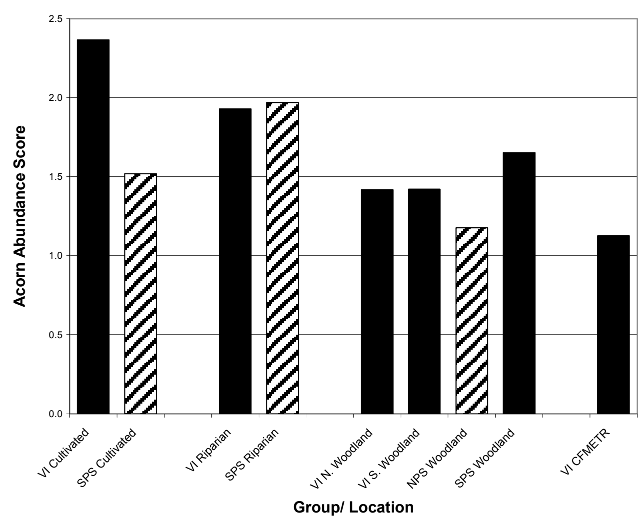

Figure 2. Average 2008 acorn production by group for Vancouver Island (VI), Vancouver Island North (VI N.), Vancouver Island South (VI S.), South Puget Sound (SPS) and North Puget Sound (NPS).

Conclusions:

We plan to continue acorn surveys for at least 3 more years, as each year's data adds clarity to geographic and climatic relationships to acorn production, and hopefully continue the study as long as 2020. We expect this study will result in papers describing geographic and temporal masting patterns, and the effects of weather habitat and competition on acorn production in Garry oak. Data for this study is maintained at the USDA Pacific Northwest Forestry Sciences Laboratory in Olympia, WA.

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P079-08 Garry Oak Acorns (*Quercus garryana*).

Studies on the Dynamics of Butterflies and their Host Plants in Garry Oak Ecosystems

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Permit #: P090-08
Locations: CFMETR, Rocky Point
Project Status: 2003 - 2009
Start Date: 1 April 2008
Completion Date: 1 August 2008

Three separate studies were conducted under this permit in 2008.

Abundance, Performance, and Adaptation of Butterflies in Garry Oak Meadows

Project Leaders: Dr. Jessica Hellmann, Derrick Parker
Locations: CFMETR, Rocky Point
Start Date: 1 April 2008
Completion Date: 1 August 2008

Introduction:

Our research, initiated in 2003, addresses the factors that limit the distribution and abundance of several organisms in Garry oak ecosystems. This report considers studies pursued in 2008 on the role of climate in setting the distributional range limit of the Propertius duskywing (*Erynnis propertius*). Over the past five years, the Hellmann lab has pursued studies about geographic range change with two model butterfly species that have contrasting life history traits. The Propertius duskywing is one of these two species. To date, we have found that both species are affected by climate at their range edge and are strongly differentiated there relative to the core of their distribution (Zakharov and Hellmann 2008; Hellmann *et al.* 2008; Zakharov *et al.* 2009; Pelini *et al.* in review). This suggests that both species are composed of isolated populations with the potential for distinctive peripheral ecotypes and distinct responses to climate change.

Study Area and Methods:

Our activities in 2008 were composed of two parts. First, we continued our long-term site monitoring efforts at both Rocky Point and CFMETR in 2008. Due to other commitments and priorities, the intensity of monitoring was reduced in 2008 relative to previous years. We repeatedly surveyed the butterfly community with on-the-wing abundance estimation along transects established in 2003. On each walk, all butterflies observed within 5 m of the transect line were recorded. Also, temporary digital recording devices were placed in the sites from April 1 through July 31 to measure temperature and precipitation. These data are still being analyzed and thus are not reported here.

Second, between April 1 and May 31, adult females of *E. propertius* (41 from CFMETR and 2 from Rocky Point) were captured, held off-site for egg collection, and then returned to their site of collection within five days. To assess the role of climate on early developmental stages, eggs were allowed to hatch and develop to early instars in a greenhouse setting before being placed immediately into field experiments. Individuals were split into two groups. Half were reared temporarily in field enclosures within the species range (at Rocky Point, CFMTER, and one other site), and the other half were reared outside the species' ranges at three sites in the vicinity of Campbell River, B.C. Larval size was measured every 9-11 days throughout the growing season (May through October) and larvae were allowed to enter diapause in the cages and overwinter.

Survivorship and larval biomass at the end of the growing season were condensed to formulate a single metric of butterfly fitness, larval production (total biomass/individuals per cage). This allowed us to evaluate several components related to butterfly performance. Overwintering survivorship and condition will be assessed in the spring of 2009.

Results:

On-the-wing transect walks reveal lower overall species richness in 2008 than was observed between 2003-2007 (Table 1). This may, in part, be due to the fact that surveys began later and were conducted with less frequency than in previous years.

Larval production did not differ significantly between sites inside *vs.* outside the species range (Figure 1). To meet the assumptions of normality, data were arcsin, square-root transformed.

Table 1: List of species observed at Rocky Point (RP) and CFMETR (CFM) either from quantitative butterfly surveys or from simple observations made while on-site. The codes 03, 04, 05 etc. in the right-most columns indicate the year in which a species was observed.

Code	Common name	Latin name	RP	CFM
EP	Propertius skipper	*Erynnis propertius*	03, 04, 05, 06, 07	03, 04, 05, 06, 07, 08
PZ	Anise swallowtail	*Papilio zelicaon*	03, 04, 07	03, 04, 05, 06, 07
SA	Spring azure	*Celastrina echo*	03, 04, 05, 06, 07	03, 04, 05, 06, 07, 08
CW	Cabbage white	*Pieris rapae*	03, 06	03, 05, 06, 07, 08
GH	Grey hairstreak	*Strymon melinus*	03, 04, 05, 06	03, 04, 05, 06, 07
SO	Sara's orangetip	*Anthocharis sara*	05, 06	03, 04, 05, 06, 07
MC	Mourning cloak	*Nymphalis antiopa*	05, 07	03, 05
PC	Purplish copper	*Lycaena helloides*	03, 05, 06	03
LA	Lorquin's admiral	*Limenitis lorquini*	03	03, 07
RA	Red admiral	*Vanessa atalanta*		03
EI	Elfin (Western or Moss')	*Incisalia iroides* or *Icisalia mossii*	03, 04, 05, 06, 07	03, 04, 05, 07
MC	Mylitta Crescent	*Phyciodes mylitta*		03, 04, 05
Fr	Hydaspe/Zerene fritillary	*Speyeria hydaspe* or *Speyeria zerene*	03, 04	03
Sw	Swallowtail	*Papilio* spp.	03, 05	03, 04, 05
V	Vanessa	*Vanessa spp.*	05, 07	05
Tort	California Tortoise Shell	*Nymphalis californica*		05
SwT	Western tiger swallowtail	*Papilio rutulus*	03, 05, 08	03, 04, 05, 06, 07
SwP	Pale swallowtail	*Papilio eurymedon*	03, 04	03, 04, 05, 07

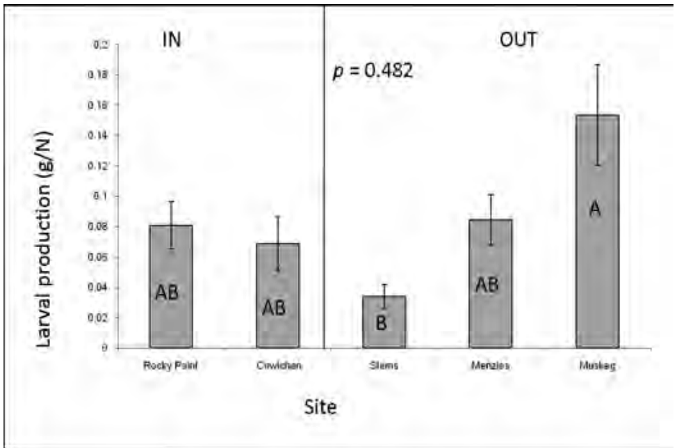

Figure 1: Larval production (total larval biomass/ individuals per cage) by site and region.

Discussion:

Climatic condition north of the historical distribution of *E. propertius* does not appear to be a limiting factor, at least not during the larval stage. We conclude this because individuals grew and survived at northern sites just as well as sites within the species' range. Abiotic differences between the testing regions (inside *vs.* outside the range) seem to be less noticeable during the spring and summer growing season (Marsico 2008). However, overwintering conditions outside the historic range are more pronounced and a climatic effect on *E. propertius* fitness could be limiting the species from poleward colonization. We will know the influence of winter after measurements are taken in spring, 2009. The impact of climate on performance was observed particularly during early larval development. One factor that we know limits poleward range expansion of *E. propertius* is host plant availability. Thus, it may be that resources, not climate, have historically prevented – and could prevent in the future – poleward range expansion.

Conclusions:

Rearing experiments inside *vs.* outside the geographic range limit of *E. propertius* suggest that climate during the growing season is not a range-limiting factor. Winter conditions could be limiting (data forthcoming), but a lack of resources (*Q. garryana*) also prevents poleward expansion of this butterfly species.

Acknowledgements:

We thank L. Breza, J. Dzurisin, Christine Moore, Caroline Williams, Kirsten Prior, and I. Banman for their assistance in the field. We thank the Canadian Department of National Defence and other landowners for access to their property.

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Release from Enemy Control as the Cause of Outbreaks of the Jumping Gall Wasp, *Neuroterus saltatorius*, on Vancouver Island, British Columbia

Project Leaders: Dr. Jessica Hellmann, Kirsten Prior
Locations: CFMETR, Rocky Point
Start Date: 1 April 2008
Completion Date: 1 August 2008

Introduction:

Beginning in 2007, we initiated studies that examine the impact of *Neuroterus saltatorius* (Cynipidae), the jumping gall wasp, and reasons for its outbreaking habit on Vancouver Island (VI), British Columbia. This species recently expanded its range from mainland North America to VI, likely via human dispersal (Smith 1995; Duncan 1997). Like many species that undergo a range expansion, the jumping gall wasp occurs in higher abundance in its new range than in its native range. Where it outbreaks, *N. saltatorius* causes damage to its host, *Quercus garyanna*, and thus may affect the community of oak-feeding herbivores.

In 2008, we investigated one potential mechanism enabling outbreaks of *N. saltatorius* on VI: release from enemy control. *Neuroterus saltatorius* is host to a community of parasitoid wasps in the family Chalcidae. If these parasitoid wasps have been slow to track *N. saltatorius* as it has expanded its range, or are slow to switch hosts from native oak gall wasps, then outbreaks of *N. saltatorius* could occur from a release from parasitoid control in its invaded range, VI. To examine this, we conducted biogeographical surveys of *N. saltatorius* and its parasitoid wasps at various sites on VI, including Rocky Point and CFMETR, and in Washington (WA). We also conducted a parasitoid reduction experiment in the native range (WA) and invaded range (VI, including Rocky Point) to test the relative strength of top-down control on jumping gall wasp density.

Study Area and Methods:

In 2008, 1,300 galls of *N. saltatorius* were collected from leaves at Rocky Point, CFMETR, and 13 other sites on VI and in WA. Collections were made during three sampling dates between 1 July 2008, and 4 September 2008. These collections also were conducted in 2007. Each gall was enclosed in a gelatin capsule. Capsules are currently being housed in greenhouses at the University of Notre Dame to capture and encase parasitoid wasps that may emerge. Emergence was recorded in 2008 and will be checked a few more times until the summer of 2009.

In addition, we made assessments of foliar damage to Garry oak, *Q. garryana*, caused by the jumping gall wasp at Rocky Point and CFMETR. This is the second year of damage assessments at these sites along with 13 other sites in WA and VI. At each site, 90 trees were randomly chosen for assessment. Each tree was assigned to one of the following damage categories: low (if the majority of leaves had <25% of their total green area covered with *N. saltatorius* damage), moderate (25%-75%), or high (>75%). The proportion of leaf damage caused by *N. saltatorius* at each site was estimated by averaging the midpoint of % damage (e.g., low = 12.5%).

Next, a parasitoid exclusion experiment was conducted at Rocky Point, and at 4 other sites in VI (invaded region), and four sites in Southern Puget Sound, WA (native region). Seven paired control and exclusion replicates were deployed at Rocky Point on 19 June 2008 and at all other sites between 17 June – 25 June. Each paired replicate was placed on a single tree. The exclosures were designed to prevent parasitoid wasps from accessing *N. saltatorius* galls by covering a branch with fine mesh. Controls were designed to allow parasitoid wasps access to galls by covering branches with coarse mesh (mesh size 1.0 mm^2). Galls were collected from each replicate at the end of July and end of August 2008 and are currently being housed in greenhouses at the University of Notre Dame. Collected galls from each replicate are held in separate containers with yellow sticky traps to capture emerging parasitoids. In October 2008, the number of galls collected from each replicate, and the number of parasitoids that emerged (from sticky traps) were counted to calculate % parasitism. In 2009, gall survivorship will be recorded.

Results:

As of September 2008, 1,543 parasitoids have emerged from galls collected in 2008. CFMETR had similar parasitism rates to other sites on VI (9.6%) and rates did not change between years (2007 and 2008). Rocky Point had low parasitism rates (2.5%) compared to other sites on VI. Parasitism was 6% lower on VI (invaded region) than in WA (native region) in 2007 (p=0.041; Figure 1) and 4% lower in 2008 (p=0.117; Figure 1). Parasitism rates seem higher in 2007 because many parasitoids emerge in the spring, and thus have not emerged yet from 2008 collections.

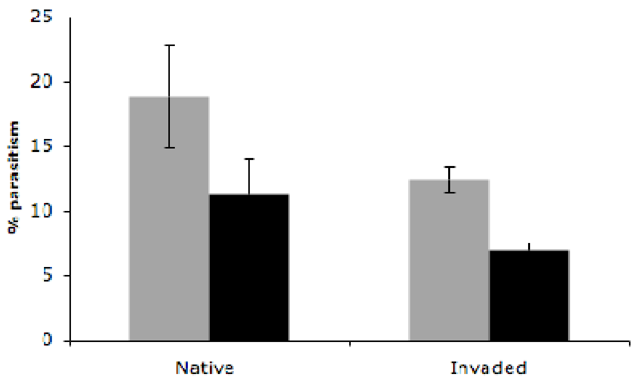

Figure 1: Average % parasitism (+/-SE) of *N. saltatorius* by parasitoid wasps (Chalcidae) in galls collected from sites in Southern Puget Sound, Washington (native) and Vancouver Island, British Columbia (invaded). Light grey bars indicate 2007 and black 2008.

Overall damage levels were lower in 2008 than they were in 2007 on VI (Figure 2). The proportion of damage at Rocky Point decreased by 10% between 2007 and 2008 (2008=0.33). However, Rocky Point remains one of the most damaged sites relative to other sites surveyed. CFMETR has one of the lowest levels of damage caused by *N. saltatorius* among our study sites on VI (0.29). Damage levels were 17% higher on VI (invaded region) than in WA (native region) in 2007 (p=0.019; Figure 2) and 11% higher in 2008 (p=0.009; Figure 2).

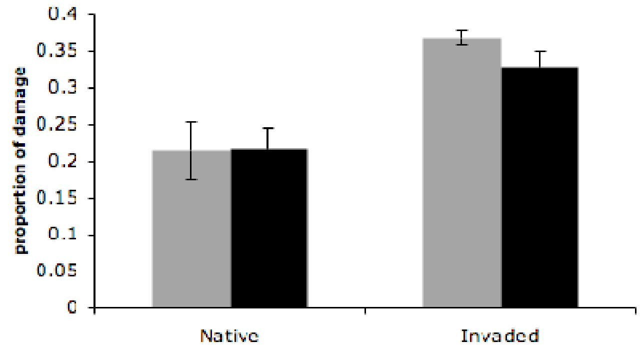

Figure 2: Average (+/- SE) proportion of foliar damage caused by *N. saltatorius* on *Q. garryana* trees in Southern Puget Sound, Washington (native) and Vancouver Island, British Columbia (invaded). Light grey bars indicate 2007 and black 2008.

Percent parasitism of galls was estimated for each replicate in the exclusion experiment. A lower percentage of galls from exclosures were parasitized in both the native and invaded range then from controls (Figure 3) indicating that exclosures were effective at reducing parasitoids. Percent parasitism was higher in

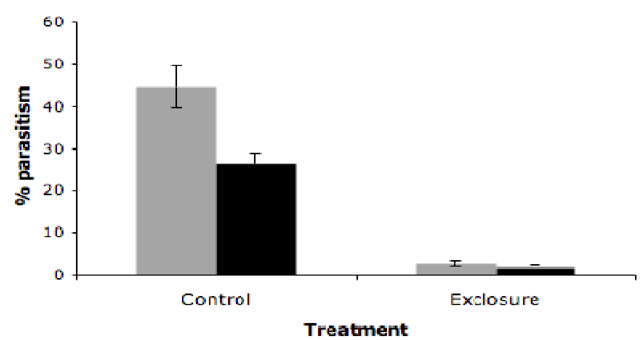

Figure 3: Average percent parasitism (+/-SE) of controls and experimental parasitoid exclosures in the native range in Washington (grey bars) and in the invaded range on Vancouver Island, BC (black bars).

the native range controls then in the invaded range controls (p=0.010; Figure 3) indicating reduced parasitism rates in the invaded range.

Discussion:

Neuroterus saltatorius has previously been described as outbreaking on VI (Smith 1995; Duncan 1997). However, the differences in abundances between the native and invaded range had not been quantified. Damage assessments caused by *N. saltatorius* between Southern Puget Sound, WA and VI in 2007 and 2008 confirm that *N. saltatorius* occurs at higher abundances in its invaded than its native range. Damage levels were lower on VI in 2008 compared to 2007, however. This was likely due to cool temperatures during April and May (personal observation).

Outbreaks of *N. saltatorius* in their invaded range could be caused by many factors, including release from enemy control. In 2007 and 2008, lower parasitism rates were observed from galls collected at sites in its invaded region than in its native region. These results suggest that enemy release is a plausible explanation for increased abundance of *N. saltatorius* on VI.

An enemy reduction experiment was conducted to test if reducing enemies causes a ‘release’ from enemy control. If *N. saltatorius* is controlled by parasitoids in the native range and ‘released’ in the invaded range, it is expected that reducing enemies in the native range would have a larger effect on *N. saltatorius* than reducing enemies in the invaded range. Control treatments reflect background parasitism rates, which were found to be higher in the native range. Galls from this experiment will be dissected in 2009 to calculate survivorship. If no difference in survivorship between regions in the effect of treatments minus controls is observed, then some other factor (e.g., host plant quality) may enable *N. saltatorius* in its invaded range.

Conclusions:

Evidence suggests that outbreaks of *Neuroterus saltatorius* could be caused by a release from enemy control on VI. Results from an exclusion experiment performed in 2008 will reveal if this hypothesis is true. In addition, in 2009 parasitoids collected from 2007 and 2008 will be identified to genus or species when possible to see how enemy community composition changes between the native and invaded range, and survivorship from the exclusion experiment will be measured.

Acknowledgements:

We thank L. Breza, J. Dzurisin, K. Ercit, T. Marsico, J. Mueller, D. Parker, S. Pelini, C. Sartario, and M. Walker for their assistance in the greenhouse and/or field. We thank the Canadian Department of National Defence and other landowners for access to their property. R. Bennett, R. Duncan and J. Smith provided advice on the project.

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Range Limitation and Dispersal of Plants at the Edge of Species’ Ranges

Project Leaders: Dr. Jessica Hellmann, Dr. Travis Marsico
Locations: CFMETR, Rocky Point
Start Date: 1 April 2008
Completion Date: 1 August 2008

Introduction:

We studied three related species of *Lomatium* (*L. utriculatum, L. nudicaule, and L. dissectum*) at and beyond their shared northern range boundary to determine if species with similar life history characteristics are limited by similar or different factors.

These species are useful because they offer a comparison that is phylogenetically conserved, they are food plants of a butterfly species, *Papilio zelicaon*, that is studied by researchers in the Hellmann Lab, all are native species to Garry oak ecosystems, and *L. dissectum* is highly endangered. To test establishment and survival inside and outside their current geographic range, study plots containing these three species were established at Rocky Point and other sites on Vancouver Island, British Columbia (Marsico and Hellmann in review).

Study Area and Methods:

Seeds from each of three *Lomatium* species (*L. dissectum, L. nudicaule, and L. utriculatum*) were collected from Rocky Point and nine other sites across Vancouver Island in 2006. Seeds were attached to color coded toothpicks representing their sources. Six planting sites (three within the species range [one of which is Rocky Point] and three beyond the range boundary) were chosen to receive the collected seeds.

120 study plots (20, $1m^2$ plots in each of six sites) were assessed in June, 2006 for composition of vegetation before plot manipulations. Then, one of four treatment combinations was applied to each plot. One-half of the plots were caged to exclude herbivores and one-half of the plots had vegetation (i.e., competitors) removed. Plots were replicated five times at each site and sites were replicated three times within each study region.

Seeds were planted in July, 2006. Germination of the seeds was assessed in April, 2007, and reemergence was assessed in April, 2008. For each $1m^2$ planting plot, a proportion of germination or reemergence was calculated for each species by dividing the number of living individuals by the number of seeds planted. In addition to measurements taken on the *Lomatium* species, the vegetative community was assessed in the plots in both 2007 and 2008 for species richness, proportion of vascular plant coverage, proportion of each species' coverage, and mean height of the vegetation.

We conducted a three-factor repeated-measures analysis of variance (ANOVA) to determine the influence the applied treatments had on the vegetative communities, irrespective of *Lomatium* performance. To determine a single competition metric for use in ANOVA, we performed a Principle Components Analysis (PCA) using four variables representative of competition levels within the plots: species richness, proportion of vascular plant coverage, mean plant height, and proportion of grasses. This analysis generated a single composite metric that we call, PC_{comp}.

Results:

In both 2007 and 2008, competition as measured by PC_{comp} was greater within the current range of the *Lomatium* species than outside the range. Competition was also greater in plots that had vegetation intact than in plots with vegetation reduced (Table 1). Competition was greatest in within-range plots with intact vegetation, followed by within-range plots with vegetation reduced. Competition was lower outside the range than within the range but lowest in plots with vegetation reduced (Figure 1). The vegetation removal treatment applied to the plots, therefore, had the effect of reducing the strength of competition within each region. Herbivory also had an effect on the competitive community (Table 1). Competition was reduced in plots where herbivores had access to the vegetation.

The region and vegetation treatments, either individually as main effects or in an interaction, significantly affected germination and survivorship for each of the three *Lomatium* species. Herbivory, however, was not an important factor in the first two years of growth, nor was any interaction involving herbivory (Table 2). The species' responses to the significant treatments differed in the following ways: *L. utriculatum* showed no significant interaction between the region and vegetation treatments and no change in the relationship between years. Both region and vegetation main effects were significant (Table 2; Figure 2). The regional treatment effect showed slightly higher germination and reemergence within the current

Table 1. Three factor repeated-measures ANOVA for factor PC_{comp} as the response variable.

		Treatment effects		Comparison across sampling time	
Source	**df**	**F-ratio**	**p-value**	**F-ratio**	**p-value**
Year	1			<0.001	>0.999
Region (R)	1	422.600	**<0.001**	1.262	0.264
Vegetation (V)	1	166.845	**<0.001**	0.084	0.773
Herbivory (H)	1	5.339	**0.023**	10.696	**0.001**
R x V	1	2.642	0.107	0.507	0.478
R x H	1	0.048	0.827	1.015	0.316
V x H	1	0.022	0.882	0.325	0.570
R x V x H	1	3.081	0.082	3.198	0.076
Error	112				

NOTE: **Bold** font p-values are significant at p<0.05. Missing values in 2008 make the error degrees of freedom 106 for *L. utriculatum* and 110 for *L. nudicaule*.

species' range than outside. *Lomatium utriculatum* responded negatively to the vegetation removal treatment in 2007. Upon reemergence, *L. utriculatum* had fewer plants in all region-vegetation treatment combinations, but there was a greater proportional loss in both regions from those plants grown with the vegetation community intact. *Lomatium nudicaule* displayed an interaction between vegetation and region in both growing seasons, only surviving significantly less in the inside-range, vegetation-intact treatment

Table 2. Three-factor repeated-measures ANOVA for germination and reemergence of each *Lomatium* species.

		L. utriculatum		***L. nudicaule***		***L. dissectum***	
Source	**df**	**Treatment effects**	**Comparison across sampling time**	**Treatment effects**	**Comparison across sampling time**	**Treatment effects**	**Comparison across sampling time**
Year	1, 112		**<0.001**		**<0.001**		**<0.001**
Region (R)	1, 112	**0.034**	0.162	0.107	**0.024**	**0.003**	**0.027**
Vegetation (V)	1, 112	**<0.001**	**0.001**	0.098	0.957	**0.005**	**0.001**
Herbivory (H)	1, 112	0.479	0.162	0.353	0.081	0.427	0.513
R x V	1, 112	0.107	0.387	**0.005**	0.695	**0.002**	**<0.001**
R x H	1, 112	0.784	0.997	0.571	0.723	0.820	0.868
V x H	1, 112	0.866	0.138	0.948	0.121	0.500	**0.035**
R x V x H	1, 112	0.874	0.784	0.560	0.984	0.440	0.894

NOTE: **Bold** font p-values are significant at p<0.05. Missing values in 2008 make the error degrees of freedom 106 for L. *utriculatum* and 110 for L. *nudicaule.*

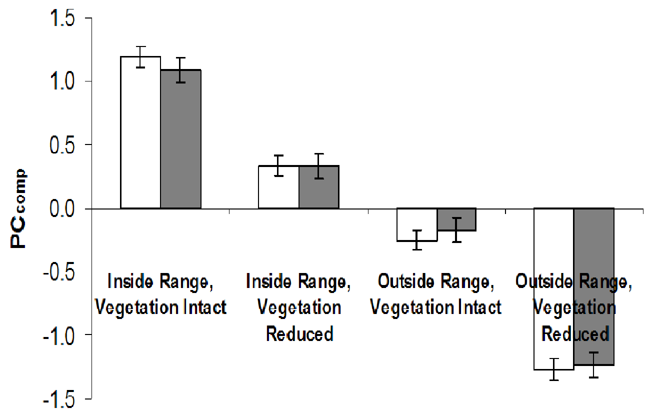

Figure 1. Compiled competition measurement (PC_{comp}) in each region and vegetation treatment combination. White bars are competition values from 2007, and gray bars are from 2008. Error bars are standard error.

combination, the treatment combination with the highest competition level (Table 2; Figure 2). *Lomatium dissectum* showed a significant interaction between region and vegetation treatment in germination, but that relationship changed for reemergence (Table 2; Figure 3). Germination was least successful outside the range when vegetation was reduced but similar in each of the other three treatment combinations. Reemergence was similar in all four treatment combinations.

Table 3. Species comparisons across all four region by vegetation treatment combinations.

	df	F-ratio	p-value
inside range, vegetation intact	2, 82	8.534	<0.001
outside range, vegetation intact	2, 87	8.341	<0.001
inside range, vegetation reduced	2, 84	12.520	<0.001
outside range vegetation reduced	2, 87	12.472	<0.001

NOTE: After significant differences were determined with ANOVA, a Tukey test for pair-wise comparisons was conducted (see Figure 3).

We found species-level differences in survivorship across all region and vegetation treatment combinations (Table 3; Figure 3). The only consistent pattern among all treatment combinations was that *L. dissectum* exhibited the lowest survivorship (Figure 3).

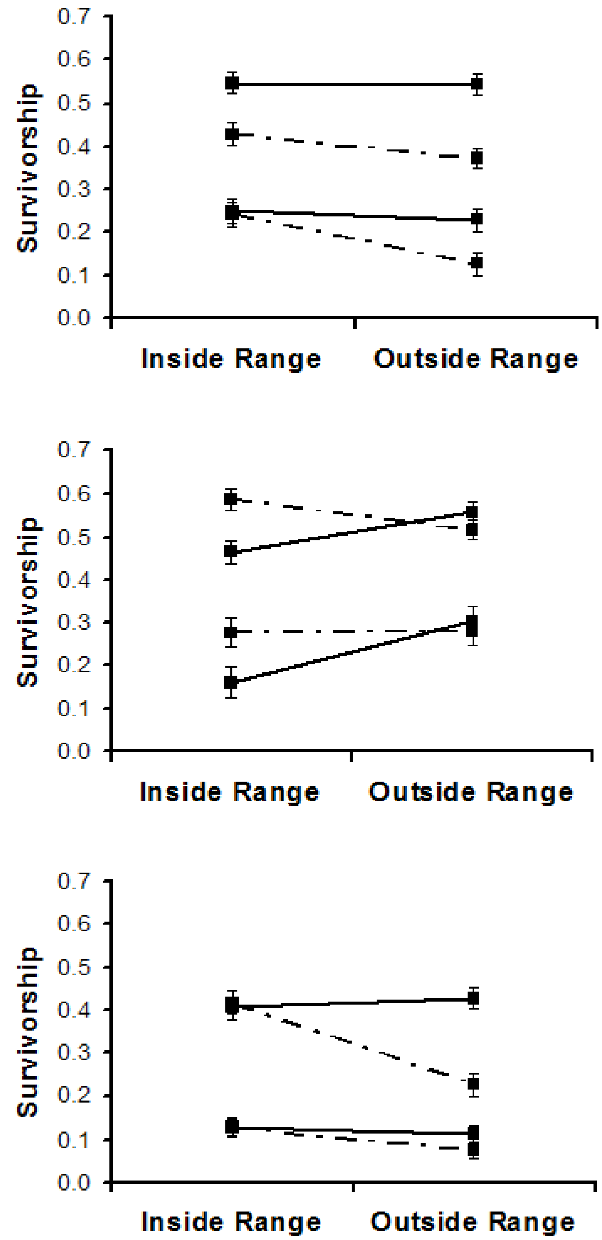

Figure 2. Germination (2007) and reemergence (2008) for each species for the region and vegetation treatments. (See also Table 2.2). Solid lines are vegetation-intact treatments, and dashed lines are vegetation-reduction treatments.

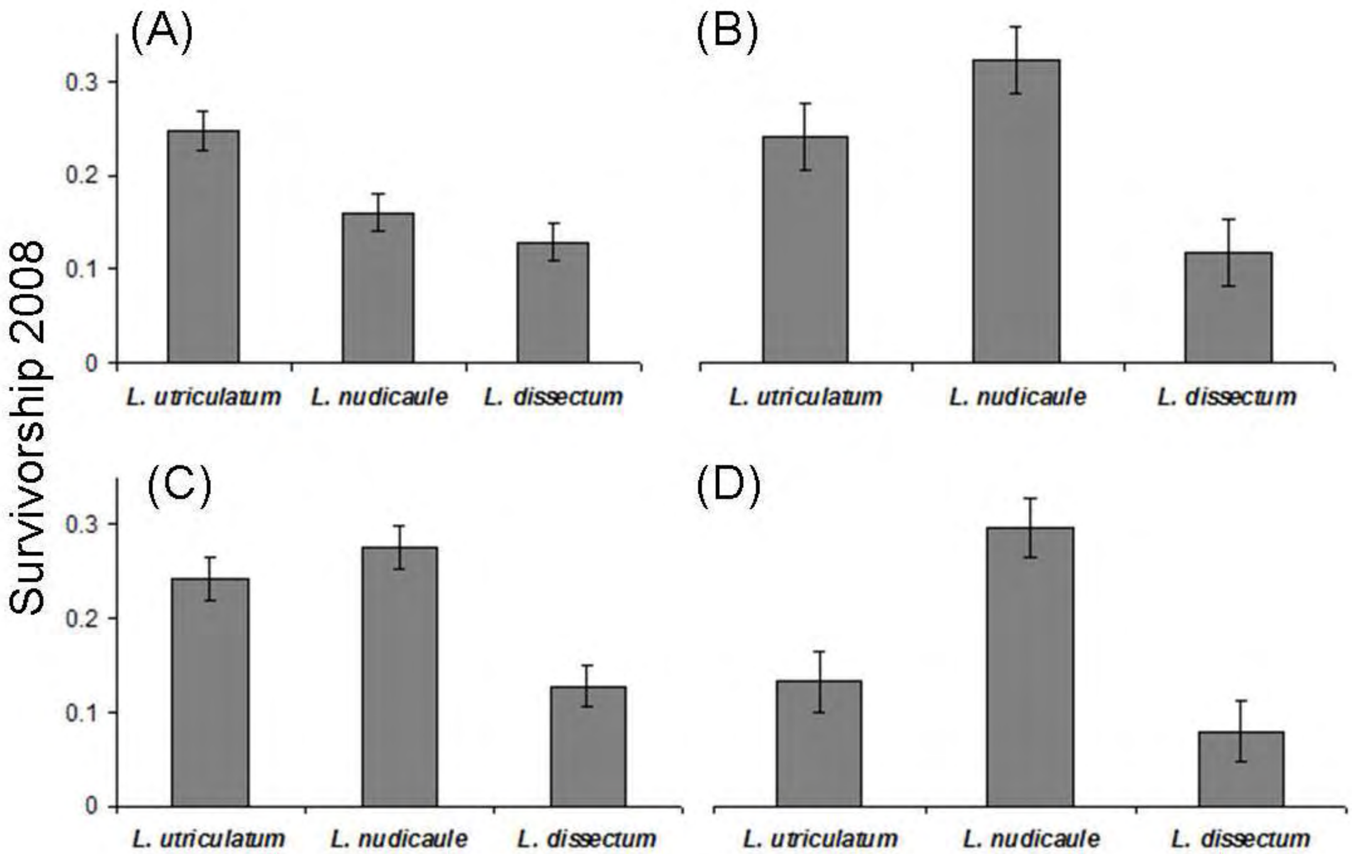

Figure 3. Species-level differences in reemergence (2008) for each of the region and vegetation treatment combinations. (A) inside range, vegetation intact; (B) outside range, vegetation intact; (C) inside range, vegetation reduced; (D) outside range vegetation reduced. Error bars are standard error. Different letters above bars indicate significant differences among species determined by Tukey pair-wise comparisons.

Discussion:

Equal survivorship in plots having the vegetation community intact outside the geographic range to those within the current distribution suggests that dispersal is limited in this system and that populations could establish outside the range if they arrived there. Successful *Lomatium* survivorship also indicates that seed additions in locations outside the current geographic range can overcome dispersal. This study also shows that the intact grassland community of Garry oak ecosystems can be invaded by the three native *Lomatium*.

Conclusions:

It is important to understand the factors involved in range limitation for target species to determine their potential responsiveness to climate and the potential for assisted migration to facilitate northward range movement. This study provides evidence that seed additions of L*omatium* spp. can be used to overcome competition, even for the highly endangered species, *L. dissectum*. The results also suggest that *Lomatium* may not expand northward under climate change because dispersal limitation plays a role in setting the species' current range boundary. Seed additions inside and outside the range may be an inexpensive and effective strategy for conserving these species and facilitating their range expansion under climate change. Experimental populations would have to be monitored after seed additions to determine if growth and survivorship of the planted individuals results in a reproductive, self-sustaining population.

Acknowledgements:

We thank A. Braun, J. Dzurisin, K. Kleaveland, J. Mueller, D. Parker, J. Pratt, K. Prior, and C. Williams for their assistance in the greenhouse and/or field. E. Gonzales and E. and W. Boorsboom provided some equipment used in the experiment. We also thank the Canadian Department of National Defence and other landowners for access to their property. E. Elle, A. MacDougall, and M. Vellend provided advice on the project.

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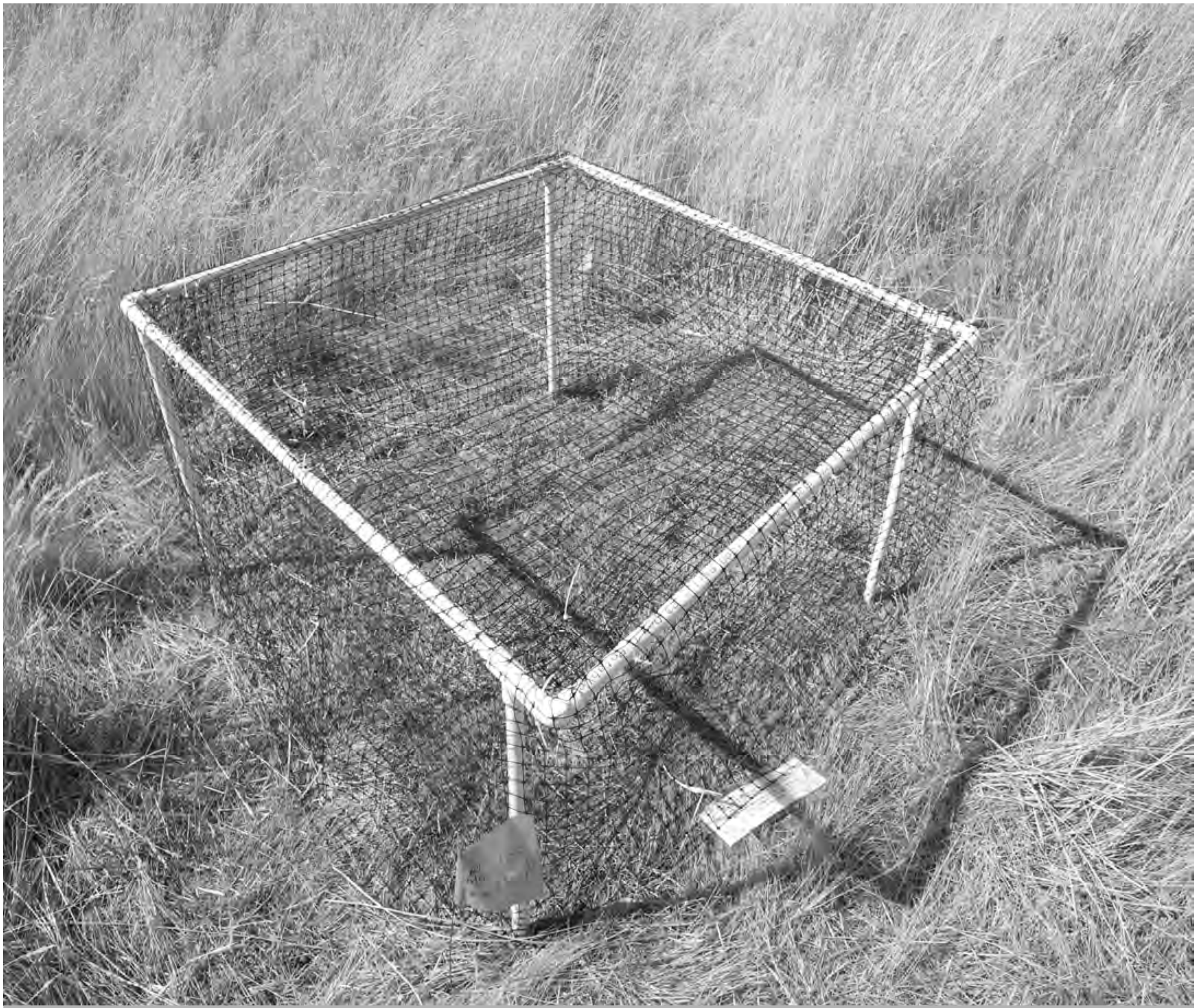

P090-08 Herbivore Exclosure.

The Strait of Georgia Mortuary Landscape Project

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Permit #: P104-08
Locations: Rocky Point, Albert Head, Colwood
Project Status: 2004 - ongoing
Start Date: 1 January 2008
Completion Date: 31 December 2008

Introduction:

Prior to European contact, the Straits Salish people, an ethnolinguistic group centred on present day Victoria in southwestern British Columbia, built a distinctive form of grave. The burial cairn and mound, a phenomenon occurring 1500–1000 years before present (Thom 1995) consists of an arrangement of rocks and soil placed over the deceased (Figure 1). Cairns and mounds vary in form and distribution, often occurring in an array of shapes and sizes. Cairns are constructed primarily from stone, with only a minor or moderate amount of soil. Burial mounds are essentially burial cairns covered with a thick layer of soil. Burial cairn and mound sites comprise as few as one and as many as 300 or more cairns. During the late nineteenth century, burial cairns in the Victoria area attracted international attention from early researchers (Smith and Fowke 1901) but have received virtually no archaeological attention during most of the twentieth century. Recent research on burial cairns and mounds in the Fraser Valley on the mainland of British Columbia (Lepofsky *et al.* 2000) has begun to address the interpretive potential of these important features. Although there has been very productive work on similar mortuary features in

Figure 1. Example of burial cairns at Rocky Point.

Europe (Bradley 1998, Tuovinen 2002) burial cairn research in British Columbia is a remarkable but largely untapped avenue for exploration into the social aspects of Straits Salish life. Building on the proven method and theory of this earlier work, this project is an ongoing detailed examination of some of the largest remaining burial cairn cemeteries in British Columbia. Particular emphasis has been paid to a large burial cairn site, designated DbRv-3, at the Rocky Point Department of National Defence property (Figure 2). Working with members of the Scia'new First Nation, almost 400 cairns at the Rocky Point site have been mapped in great detail using a geographical information system. Other cairn sites on the subject properties are being similarly mapped.

I hypothesize that the external attributes of burial cairns and mounds – their location and shape – are important signifiers of the social identity of the person buried within. Much like historic and contemporary EuroCanadian grave markers say important things about the social affiliations of the dead (their relative socioeconomic standing, membership to special organizations such as the military, etc) and how cemeteries are divided into sections, again based on

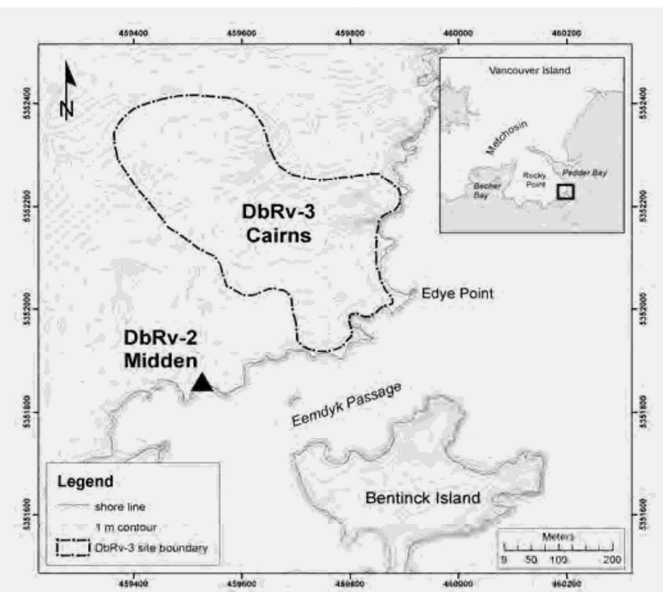

Figure 2. Location of DbRv-3, The Rocky Point cairn cemetery.

attributes of the dead person's place in society, burial cairns at precontact Straits Salish cemeteries, like that at Rocky Point, can be reasonably viewed as memorials, built to endure and presumably to express the identity of the deceased. Although burial cairns do not have written biographical text like Western headstones, the manner in which mortuary space is used – the style, material choice, size, and placement of cairns – has great interpretive potential to identify socially meaningful patterns.

The objective of this project is twofold. Firstly, collection of data on the physical form and spatial location of individual burial cairns on DND properties is being undertaken. Patterns in cairn size, construction, and orientation, in addition to spatial analytical variables, may be reflective of underlying local social structures, such as group identity and status. Secondly, intrasite landscape spatial data is being collected. The geographic layout of cairn sites in relation to each other and to the natural and cultural elements of the local landscape are informative regarding larger scale regional concepts of space and group identity.

Study Area and Methods:

Ongoing data collection has been undertaken at Rocky Point and adjacent Bentinck Island, Albert Head and Colwood. Partial data was collected at Mary Hill before access to that property was restricted. Interpretation of the data was facilitated by a spatial analysis using a Geographical Information System (GIS).

In order to conduct the project analysis, the properties were inventoried with systematic pedestrian survey. A crew of three to five experienced archaeologists walked systematic transects with a 2-metre interval between surveyors, recording the location of each petroform feature with a global positioning system. The spatial data was imported into a geographic information system.

For the analysis of individual cairns, a total of 18 analytical variables were collected, in addition to the production of photographs, and detailed diagrams of significant cairns. The metric attributes of each feature, information on the specific type, amount, shape, and size of the constituent rock, and the structure of each cairn were recorded on a standardized form. Some cairns required at least partial clearing of accumulated vegetal matter, particularly from invasive species such as Scotch broom and gorse. Cairns were otherwise not affected by the research. This clearing substantially enhanced the amount of visible data and, therefore, the interpretative potential of the site.

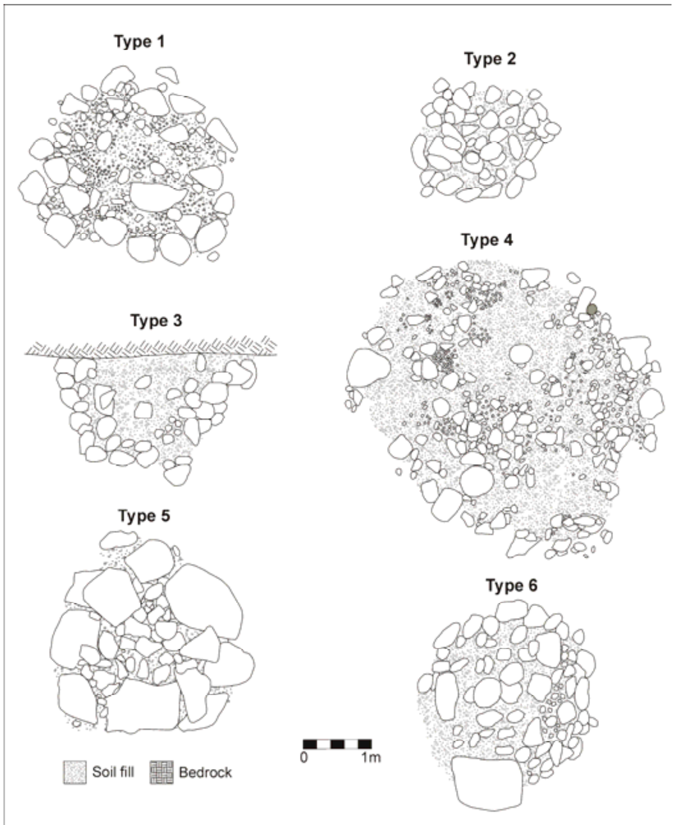

Figure 3. Cairn types at DbRv-3, Rocky Point.

GIS was instrumental as a means of data quantification and management, ensuring a high level of accuracy in mapping and analysis, and a method by which to group data. By using GIS as a management tool, mortuary features were quantified and reorganized and reassigned into analytical units based on quantifiable spatial and morphological attributes.

Results:

Prior to this research, there had not been a comprehensive and encompassing examination of the spatial distribution of burial cairns in the Strait of Georgia, despite the fact that the cairns were one of the earliest types of archaeological sites studied in the region (Mathews 2006a). Additionally, there had not been a comprehensive inventory of burial cairns in the Victoria region. From a culture history perspective, this research generated a systematic and detailed survey of over 1400 hectares of land in Metchosin (and 20 km of shoreline), the largest systematic archaeological survey conducted in the Victoria area. In addition, over 700 cairns were inventoried, mapped, and entered into a GIS spatial database. This type of non-invasive detailed analysis of the individual burial cairns, such as at DbRv-3 at Rocky Point, is the first of its kind in the province, and possibly in North America.

Analysis to date has identified six distinct types of features (Figure 3). Concurrently, a spatial analysis defined seven distinct areas within the site. Analysis of the distribution of the six types of cairns throughout the seven different areas identified distinct patterns. This patterning indicates that certain types of cairns were restricted in terms of where they could be built. The distribution of burial cairns at Rocky Point likely may reflect the burial locality of separate households.

Discussion:

The 2008 field season was abbreviated due to time necessary for the completion of doctoral coursework and comprehensive examinations. The 2009 field season will be the primary year in which field data will be collected and analyzed. The aim of the research will continue to focus on gathering detailed information on individual cairn morphology from Rocky Point, Albert Head, and Colwood and using this information to spatially and statistically test associations between individual cairns and the spatial associations between cairn sites and the natural landscapes of DND properties, as well as at other non-DND properties throughout the Strait of Georgia and Puget Sound.

Conclusions:

I hypothesize that the use of mortuary space at multiple scales of interaction, from the village level to the region, is a snap-shot in time of Straits Salish social relationships—presenting an unparalleled opportunity for archaeologists to investigate in unusually good detail a pivotal time in this precontact society. Burial cairns and the funerals in which they were built were an institution of ceremonial exchanges, a network that linked people from separate villages within the wider regional community. Together with marriage and the cultivation of other strategic social, economic, and political ties, I argue that burial cairns may have simultaneously provided a forum in which identity and social relationships at the local kin or village-based level could be created, contested, and renegotiated. This ongoing research on DND properties will form the theoretical and methodological stepping off point from which a regional analysis can be approached. The regional analysis will focus on sites throughout the Strait of Georgia and Puget Sound.

The results of the doctoral dissertation resulting from this research, which I anticipate defending in 2010, will be the basis for a book and multiple articles on the burial cairns and mounds of the Strait of Georgia. This resulting data will be curated with the Environmental Sciences Advisory Committee, The University of Victoria Archives, and the Royal British Columbia Museum for access to future researchers and resource managers.

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Western Bluebird Nest Box Program

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Permit #: P108-08
Locations: Rocky Point, CFMETR
Project Status: 2005 - ongoing
Start Date: 1 March 2008
Completion Date: 31 December 2008

Introduction:

The Georgia Basin population of Western Bluebirds (*Sialia mexicana*) has declined since the 1950's; however, until the 1990's the birds were regularly sighted in Garry oak (*Quercus garyanna*) meadows on south-eastern Vancouver Island, British Columbia. Western Bluebirds are currently Red-listed in British Columbia, and are included within the Garry Oak and Associated Ecosystems Recovery Strategy (GOERT, 2002). The Western Bluebird requires open habitat with some perches. Garry oak meadows are ideal, but the birds can successfully nest on farms and grassland areas as well. Although suitable habitat is thought to still exist on southern Vancouver Island and the Gulf Islands, the small population has been drastically reduced in recent years. The cause for the decline is thought to have been a series of wet springs and the resulting decline in available insect prey.

Nest box programs have been very successful in nearby Fort Lewis, Washington, where the Western Bluebird population is now increasing. The Fort Lewis population has grown from only a couple of pairs when boxes were first erected to over 200 pairs at present. This population is now providing a source for more local reintroductions in the Georgia Basin. In the spring of 2007, 16 adults were reintroduced to San Juan Island. In 2008, five adult pairs were moved from Fort Lewis to San Juan Island and nested successfully, with 4 of the 5 pairs raising second broods. In addition, one unbanded (ie. non-introduced) pair of bluebirds successfully nested and produced young; it is assumed that these birds were offspring of the 2007 reintroductions. In 2008, an estimated 30 juvenile bluebirds survived through the fledging phase. This will greatly increase the possibilities of a higher number of returning birds in the spring of 2009. Plans for 2010 include reintroduction of Western Bluebirds to a Canadian site, likely on Salt Spring Island. Nest box programs are relatively easy to implement and support more intensive reintroduction efforts that are underway in the Georgia Basin.

The Department of National Defence property at Nanoose (CFMETR) and Rocky Point are of special importance because birds have been historically recorded in these areas and there is little habitat competition from other avian species such as European Starlings (*Sturnus vulgaris*) and House Sparrows (*Passer domesticus*).

Throughout this project the Vertebrates Recovery Implementation Group of the Garry Oak Ecosystems Recovery Team will monitor, repair and add boxes at CFMETR and Rocky Point. Nest box monitors (Tom Gillespie, Kersti Vaino and Shyanne Smith at Rocky Point and Trudy Chatwin, Karen Barry, Guy Monty and Dr. Harry Webster at CFMETR) check the boxes for nesting activity.

Study Area and Methods:

The study area for the entire project includes suitable habitat throughout south-eastern Vancouver Island and the southern Gulf Islands. Study areas on DND lands occur at Nanoose (CFMETR) and Rocky Point.

Existing nest boxes were located in the field, numbered, and coordinates were determined using a handheld GPS. The plastic zip-ties previously used to secure the boxes to the trees were removed from most boxes and replaced with UV-resistant poly rope. The boxes were cleaned (twigs, spiders and other debris were removed) and photographed.

Eight additional nest boxes were erected at Rocky Point, and five at CFMETR, using the UV-resistant rope. One of new boxes installed at CFMETR replaced an existing box that had fallen and broken. As with the existing ones, each nest box was labeled, photographed, and the coordinates recorded.

Results:

Only one of the existing boxes (at Rocky Point) showed evidence of bird nesting. Except for the degradation of zip-ties on boxes exposed to direct sunlight, the majority of the boxes were in good condition. Suitable locations for additional boxes were noted at both Rocky Point and CFMETR.

Discussion:

The addition of more boxes to the two sites may increase the possibility of nesting in the future. Existing boxes, including original boxes approximately 20 years old, are in good condition and can continue to be monitored for bluebird nesting activity. Zip-ties should not be used to attach boxes to the trees, and should be completely replaced by UV-resistant rope in 2009. Rope can be easily adjusted to allow for tree growth and/or to move boxes if required.

Conclusions:

Ongoing maintenance, monitoring and some additional box placement is proposed for 2009. The successful end result of this project would be the establishment of a nesting population of Western Bluebirds on southern Vancouver Island (or elsewhere within the Georgia Basin). Ongoing reintroductions on San Juan Island will continue in 2009, and a reintroduction within Canada (not on DND land) is planned for 2010. Long-term results of the larger project will be published, preferably in a peer-reviewed journal. Data collected for this project are housed with the Garry Oak Ecosystems Recovery Team and are available on request.

Note: In December 2008, 12 Western Bluebirds were found in Greater Victoria and as of February 2009, several remained in the area. If these birds survive the winter and nest in nearby boxes, they could form the nucleus of a local breeding population on southern Vancouver Island.

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P108-08 Western Bluebird (*Sialia mexicana*) Nestbox.

Monitoring of the Oregon Spotted Frog (*Rana pretiosa)*

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Permit #: P109-08
Location: MD Aldergrove
Project Status: 1999 - ongoing
Start Date: 1 March 2008
Completion Date: 30 September 2008

Introduction:

Rana pretiosa (Oregon Spotted Frog) is a Pacific north-west species (Corkran & Thoms, 1996). In B.C. today, it occurs in three sites in the extreme south-west corner of the province: namely Maintenance Detachment (MD) Aldergrove, Mountain Slough in Agassiz, and Maria Slough adjacent to Seabird Island (Haycock, 2000a).

R. pretiosa was designated as "endangered" in an emergency listing in November 1999 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Haycock, 2000b). The reason for the designation is the fact that the distribution of it's population has been reduced to only three isolated sites in BC, each containing very low numbers of individuals and because the species has been adversely affected by habitat loss due to urban expansion, agriculture, exotic competitors, and exotic vegetation (COSEWIC, 2000).

The MD Aldergrove population, particularly, has shown a steady annual decline from 90 egg masses in 1997 to 33 egg masses in 2001 (Haycock, 2001). The goals of the study are to determine the number of egg masses oviposited at MD Aldergrove and their embryonic survivorship; to increase the breeding population by captive rearing programs; and to determine the survivorship of adults previously reared at the breeding facilities and released at MD Aldergrove.

Study Area and Methods:

Study Site

The research was conducted at the Department of National Defense's MD Aldergrove facility (latitude 49° 4' and longitude 122° 29'). The MD Aldergrove study site consisted of three sub-sites; these were Pipeline, Frog Restoration Site (FRS), and 264th. The sub-sites are connected and are open wetlands with a mix of open water and vegetation. FRS was altered in 2002 and now consists of a large body of open water with little vegetation in the littoral zone.

Methodology

Embryonic survivorship and captive rearing

No embryonic survivorship study was done and no egg masses were collected and therefore no captive rearing was done during 2008.

Oregon Spotted Fog trapping

Sixty collapsible minnow traps were put out during the weeks of 11 and 27 March and 21 September at the FRS and Pipeline sub-sites at known *R. pretiosa* oviposition sites. Thirty traps were put out at each sub-site. Traps were put out on Tuesday mornings and checked on Wednesday, Thursday, and Friday mornings. Traps were removed from the wetland after being checked on Friday mornings. Traps were moved to a new location within the sub-site every week. A GPS reading was taken at each trap and traps were put out in numerical order to ensure all traps were checked at each visit. If an amphibian was caught, the species and sex (if possible) were recorded and mass, snout-vent-length (SVL), and total lengths (for salamanders only) were recorded. To avoid salamanders from drying out, they were placed in a Ziploc bag with water while measurements were taken. Disposable gloves were worn at all times.

Stowaway® "tidbit" thermometers were placed in the water where amphibian trapping was done. Water temperature was recorded every 60 minutes during the weeks of trapping.

Results:

Embryonic survivorship and captive rearing

Surveys for egg masses were conducted at the three sub sites during March and April 2008. No egg masses were found and therefore no embryonic survivorship was done and no eggs were collected for captive rearing.

Oregon Spotted Frog trapping

Six amphibian species were caught during trapping, including *Hyla regilla* (Pacific Tree Frog), *Ambystoma gracile* (North-western Salamander), *A. macrodactylum* (Long-toed Salamander), *Taricha granulosa* (Rough-skinned Newt), *Lithobates catesbeianus* (Bullfrog) and *Rana aurora* (Red-legged Frog). The North-western Salamander was the most common species caught (Table 1).

During amphibian trapping in September, two Bullfrogs and two North-western Salamander were caught that appeared either lethargic or had what appeared to be a fungal growth. The specimens were sent to the Animal Health Centre in Abbotsford to test for Chytrid fungus (*Batrachochytrium dendroba*) and iridovirus. Both Bullfrogs tested positive for Chytrid fungus but negative for iridovirus while the salamanders were negative for both.

Mean water temperature during the week of 11 March at FRS was 7.8 ºC (SD ± 1.26). At Pipeline mean water temperature was 7.1 ºC (SD ± 0.67). The week of 25 March was slightly cooler with mean water temperature at FRS at 6.33 ºC (SD ± 0.87) and at Pipeline it was 5.91 ºC (SD ± 0.57). During September, mean water temperature at FRS was 13.23 ºC (SD ± 0.98) and at Pipeline it was 13.29 ºC (SD ± 3.28) (Table 2 & 3).

Table 1. Number of amphibians trapped at MD Aldergrove during 2008.

Date	*Hyla regilla*	*Ambystoma gracile*	*Taricha granulosa*	*Lithobates catesbeianus*	*Rana aurora*	*Rana pretiosa*	*Ambystoma macrodactylum*	Total/ trap night	# of amph./ trap
11-Mar-08	1	58	2	0	0	0	3	**64**	**1.07**
12-Mar-08	1	17	3	0	1	0	0	**22**	**0.37**
13-Mar-08	6	19	5	0	1	0	0	**31**	**0.52**
26-Mar-08	5	12	4	1	0	0	1	**23**	**0.38**
27-Mar-08	6	12	6	0	0	0	0	**24**	**0.40**
28-Mar-08	1	4	1	0	0	0	0	**6**	**0.10**
23-Sep-08	0	16	0	5	0	0	0	**21**	**0.35**
24-Sep-08	0	18	0	3	0	0	0	**21**	**0.36**
25-Sep-08	0	5	1	2	0	0	0	**8**	**0.14**
Total	**20**	**161**	**22**	**11**	**2**	**0**	**4**	**220**	

Table 2. Water temperature at MD Aldergrove at the FRS sub site during amphibian trapping during 2008.

Date	Min temp (ºC)	Max temp (ºC)	Mean temp (ºC)	Std dev (ºC)
11-Mar-08	6.83	9.44	8.36	0.83
12-Mar-08	5.09	10.59	7.31	2.21
13-Mar-08	6.54	8.57	7.74	0.74
25-Mar-08	5.09	7.99	6.66	1.08
26-Mar-08	5.38	8.86	7.08	1.29
27-Mar-08	5.38	7.7	6.36	0.77
28-Mar-08	4.81	5.67	5.22	0.32
22-Sep-08	13.09	16.31	15.01	0.95
23-Sep-08	9.34	15.42	12.58	2.20
24-Sep-08	12.22	14.26	12.98	0.56
25-Sep-08	11.93	12.51	12.33	0.20

Discussion:

R. pretiosa usually breeds in February and March, soon after snow melt (Licht, 1971). The lethal thermal limits for young *R. pretiosa* embryos are about 6 – 28 °C (Licht, 1971). During 2008, temperatures in known oviposition sites were in the low range of temperature tolerance limits for *R. pretiosa*. On a few occasions, minimum temperatures dropped below 6 °C for a few hours but *R. pretiosa* embryos can withstand temperatures of 1 °C for up to eight hours (Licht, 1971). Temperatures are therefore within acceptable limits for *R. pretiosa* breeding.

R. pretiosa breeds in very shallow water (Cockran and Thoms, 1996 and Jones et al, 2005), sometimes in only 3-5cm deep water (*pers obs*). During 2008, the water

Table 3. Water temperature at MD Aldergrove at the Pipeline sub site during amphibian trapping during 2008.

Date	Min temp (ºC)	Max temp (ºC)	Mean temp (ºC)	Std dev (ºC)
11-Mar-08	7.03	8.48	8.04	0.45
12-Mar-08	4.99	7.89	6.51	1.04
13-Mar-08	5.87	7.32	6.74	0.51
25-Mar-08	4.99	7.03	6.18	0.77
26-Mar-08	5.58	7.61	6.51	0.68
27-Mar-08	4.99	6.73	5.96	0.53
28-Mar-08	4.71	5.58	4.97	0.29
22-Sep-08	9.36	22.35	16.32	4.63
23-Sep-08	3.57	29.21	11.84	6.69
24-Sep-08	11.66	13.39	12.52	0.58
25-Sep-08	11.94	16.3	12.50	1.20

level at Pipeline and FRS ranged from 3 to 10cm and water depth is therefore also within acceptable limits for *R. pretiosa* breeding.

Chytrid fungus has been linked to amphibian mortalities and declines around the world (Bosch *et al*., 2001, Green *et al*., 2002, Lips *et al*., 2006) and has the potential to contribute to local amphibian extirpations (Bosch *et al*., 2001 and Pounds *et al*., 2006). Chytrid fungus is present at MD Aldergrove and it is therefore essential to maintain the strict protocol for cleaning and storing of equipment that is currently in place when doing amphibian (or other wetland) research to prevent the spread of Chrytrid fungus to other wetlands.

Conclusions:

No *R. pretiosa* egg masses were located during 2008 and no *R. pretiosa* was observed during visits to the study area. However, *R. pretiosa* takes two to three years to breed (Jones *et al* 2005) and individuals that were released from the captive rearing facilities during 2005 and 2006 can still breed in future years. Surveys should therefore continue to determine whether *R. pretiosa* is still present at MD Aldergrove.

Acknowledgements:

Thank you to Keena McNeil, Dennis Knopp, Christine Bishop and Dave Toews for their assistance during surveys and amphibian trapping and for the personnel of MD Aldergrove and CFB Esquimalt for granting us access to the property.

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Garry Oak Ecosystem Dynamics: Controls on Overstory

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Permit #: P114-08
Location: Rocky Point
Project Status: 2005 - 2008, Completed
Start Date: August 2008
Completion Date: August 2008

Introduction:

Field investigations undertaken from 2004 to 2006 (Smith 2006; Gedalof *et al.* 2004; Gedalof *et al.* 2006) throughout southern Vancouver Island and the Gulf Islands revealed an alarming trend among a range of Garry oak (*Quercus garryanna*) associated ecosystems. At six sites where detailed stand structure and stand composition reconstructions were undertaken using dendrochronological techniques, no oak recruitment to the overstory was found to have occurred in at least the last 50 years. At three of the sites (located in Beaumont Marine Park, on Tumbo Island, and in Helliwell Provincial Park), no seedling establishment was observed. At the remaining sites (Rocky Point, Burgoyne Bay, and the Cowichan Oak Preserve), abundant seedlings were observed, but there was no evidence of successful recruitment to the overstory. For example, at Rocky Point 678 seedlings were counted within the sample area (0.9 ha), but only 3 saplings were found. In contrast, Douglas-fir (*Pseudotsuga menziesii*) appears to be regenerating very successfully: although only 53 Douglas-fir seedlings were found, 41 saplings were also found – suggesting that survival rates are generally high. Additionally, overstory recruitment of Douglas-fir has been fairly continuous over the last century. Lastly, conifer encroachment is occurring in portions of all observed Garry oak ecosystems, suggesting a dramatic change in stand structure and composition relative to recent centuries.

In light of these findings, it is important to identify the controls on seedling survival, and subsequent recruitment to the canopy. Fire exclusion has been implicated as a factor in some studies (e.g., Agee 1996), and burning by first nations in Garry oak associated ecosystems is well documented (Turner 1999; White 1999; Williams 2000). However, recent experimental studies have failed to identify a robust link between fire and seedling establishment (Regan and Agee 2004). Similarly, the potentially confounding effects of competition and herbivory have not been adequately addressed. The purpose of this study is to assess the importance of herbivory and above-ground competition on the survival of Garry oak seedlings.

Study Area and Methods:

The study area is located in an area of transition from prairie to closed forest at DND Ammunition Depot Rocky Point. The southeast corner of the sampling area is located at N 48° 19' 28.5" W 123° 32' 45.3" (horizontal accuracy ± 5m). The site is generally flat, with only a few relatively small undulations (<1 m) in topography. The understory vegetation is composed primarily of introduced grasses, with coverage of approximately 30 percent orchard grass (*Dactylis glomerata*), 30 percent colonial bentgrass (*Agrostis capillaries*), 20 percent sweet vernal grass

(*Anthoxanthum odoratum*), and 20 percent bracken fern (*Pteridium aquilinum*). The overstory is composed primarily of Garry oak, with some Douglas-fir, grand fir (*Abies grandis*), arbutus (*Arbutus menziesii*), and lodgepole pine (*Pinus contorta* var. *contorta*) in the vicinity. Canopy closure is variable, but is less than 30 percent in the area where experimental treatments were applied.

One hundred seedlings were identified, and randomly assigned to a treatment type. To minimize biases due to seedling age, only seedlings with few leaves, and no obvious signs of resprouting were considered. Two treatment types, as well as their interaction, were targeted in this analysis. In order to assess the effect of browsing on seedling success, small circular exclosures were established around 20 seedlings. The exclosures are composed of wire fencing supported by re-bar, and are approximately 50 cm in diameter and 1 m in height. To assess the effect of competition with grasses, a small square of landscape cloth was placed around 20 seedlings to reduce competition for resources. To assess interactive effects, 20 seedlings had both treatments applied (Figure 1). Forty control seedlings were identified and marked for future identification. Seedlings were remeasured in August, 2006, 2007 and 2008.

Results:

Seedling survivorship was moderately low over the three years of the experiment, with only 51 percent of seedlings monitored surviving (Table 1). Difference of proportions tests (Zar 1999) indicate that there were no significant differences between any of the treatment types in terms of their cumulative survivorship rates. However substantial year-to-year variability was seen in mortality rates. In 2006, the first growing season of the experiment, mortality was significantly higher for the landscaping cloth treatment, and significantly lower for the exclosure treatment. From 2006 to 2007, the only significant result was an elevated mortality within the exclosure treatment. From 2007 to 2008, mortality was highest among the control group, with no significant differences among the remaining treatment types.

Discussion:

Three years of monitoring seedling survival at Rocky Point has provided four main insights into the processes inhibiting overstory recruitment of Garry oak on southern Vancouver Island: (1) It is unlikely that

Figure 1. (left) Landscaping cloth used to reduce competition with grasses; (right) landscaping cloth and large ungulate exclosure used to test for an interaction effect.

Table 1. Summary of seedling mortality.

Treatment	N	Cumulative Survivorship			Mortality Rate		
		2006	2007	2008	2006	2007	2008
Control	40	0.80	0.73	0.40	0.20	0.09	0.45
Cloth (only)	20	0.65	0.55	0.55	0.35	0.15	0.00
Exclosure (only)	20	0.90	0.70	0.60	0.10	0.22	0.14
Both	20	0.65	0.70	0.60	0.35	-0.08	0.14
All Cloth	40	0.65	0.63	0.58	0.35	0.04	0.07
All Excl.	40	0.78	0.70	0.60	0.23	0.07	0.14
All	100	0.76	0.68	0.51	0.24	0.11	0.25

acorn predation or poor viability are responsible for the lack of overstory recruitment. Abundant seedlings (including many newly established seedlings) were noted during every year of the study. (2) Large ungulates seem to play a relatively minor role in reducing seedling survival rates for Garry oak. Although survival rates were initially higher in the exclosure treatment, high mortality during year two of the experiment compensated for this difference, and by the end of the experiment there were no significant differences among any of the treatments. (3) Competition with exotic vegetation for water or light also does not appear to be limiting of itself. In fact, young seedlings appear to require the presence of vegetation. This result may be explained by the fact that seedlings have shallow root systems, and may experience moisture deficits without vegetation to shade them and reduce transpirative moisture losses (Cui and Smith 1991). For this reason, seedlings may have different environmental limitations than mature trees do. (4) The causes of mortality seem to be highly variable from year to year. Significant differences between treatments in mortality rates were seen in every year of the study. However, the overall mortality rates were not significantly different when cumulated over the period of study.

In the context of the original research question, *Why is Garry oak failing to reproduce at Rocky Point*, three possible explanations remain: (1) natural mortality, including the effects of herbivory from all sources, may be sufficient to make regeneration events extremely rare. This problem may have been exacerbated in recent decades by the introduction of livestock to many Garry oak meadows (e.g., cattle, horses, goats, and sheep), as well as the elimination of large predators from most remaining Garry oak ecosystems. (2) Fire may interact with other limiting factors in ways not addressed by previous studies. (3) Competitive effects may affect older seedlings disproportionately. As seedlings grow, shade and moisture deficits may be more problematic to Garry oak seedlings. Similarly, they may become more visible to large ungulates – exposing them to elevated risk of predation. (4) Exotic vegetation may have distinct effects on Garry oak seedlings that are not directly related to above-ground competition. For example, the invasive plant garlic mustard (*Alliaria petiolata*) has been shown to disrupt the mycorrhizal fungi required by many trees for vigorous growth and reproduction (Stinson *et al*. 2006). If these sorts of effects occur in Garry oak ecosystems, the removal of immediately adjacent vegetation (as undertaken in this experiment) would not be a useful proxy for an uninvaded ecosystem, since the below-ground community remains fundamentally different and the seedlings may consequently be more susceptible to drought or nutrient deficiencies.

Conclusions:

The logical next steps in these analyses involves the comparison of invaded and non-invaded Garry oak associated ecosystems with respect to their seedling survival, and the comparison of seedling survival rates in soils with intact and disrupted mycorrhizal communities. Because the ideal method of modifying these systems involves the application of herbicides and fungicides, since these treatments do not affect native vegetation or disturb the soil, these experiments can not be undertaken at Rocky Point due to DND policies. Consequently, future experiments are being undertaken at the Nature Conservancy of Canada Cowichan Oak Preserve, where exotic species eradication has been undertaken over the past several years, and reasonably intact native communities have been restored.

Two experiments have been undertaken to date, though only preliminary results are available. In the first experiment, soil moisture was monitored through one growing season in invaded and uninvaded oak associated ecosystems. It appears that exotic plant communities exploit soil moisture more efficiently and later in the summer than native plant communities do, bringing them into more direct competition with oak seedlings (Davy 2007). In the second experiment, native and exotic oak associates were seeded in individual pots in a growth chamber, and their weekly soil moisture use was determined using a lysimeter. This experiment showed that most exotic plant species emerge earlier, and remain metabolically active longer than most native oak associates. They are also able to produce more than one seed crop per year when water is not a limiting factor. Future work will examine the growth of oak seedlings in the presence and absence of mycorrhizal fungi, and the effect of exotic plant species on mycorrhizal abundance.

No future research is planned for Rocky Point at this time.

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Local Versus Regional Determinants of Community Composition in Garry Oak Ecosystems

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Permit #: P120-08
Locations: Albert Head, CFMETR
Project Status: 2006 - 2010
Start Date: 13 May 2008
Completion Date: 31 May 2008

Introduction:

This study is a biogeographic comparison of ‘mainland’ (i.e., Vancouver Island) versus island patches of the Garry Oak Ecosystem (GOE). Island Biogeography Theory (e.g. MacArthur and Wilson 1967; Whittaker and Fernandez-Pelacios 2007) contains specific predictions regarding the number and characteristics of organisms inhabiting islands versus contiguous swaths of mainland habitat. Island Biogeography Theory has also been used to develop predictions regarding communities inhabiting fragmented habitats on mainlands, treating patches as pseudo-islands. However, due to a paucity of appropriate study areas, very few analyses have directly compared true islands with habitat patches of the same ecosystem type. A combination of geography and recent habitat fragmentation makes the GOE of southern Vancouver Island an ideal area for such a comparison.

As is well known among those working in GOE patches, there are many general and patch-specific threats to the ecosystem. A clear and quantitative understanding of the drivers of species composition in GOE patches, in terms of cover and identity of native versus introduced species, is necessary to guide stewardship efforts. Such an understanding would help preserve patches that are relatively intact, and could guide remedial action on degraded patches. A comparison of islands and mainland patches (of which the latter have significantly higher dominance and diversity of introduced species), will help to understand drivers of community composition.

This study therefore looks to compare the floristic composition of GOE patches on islands versus Vancouver Island, in order to address the theoretical and practical issues outlined above. The work on DND sites forms a small but necessary part of this study, which involves surveys of GOE patches from the southern San Juan Islands (and the southern tip of Vancouver Island) north to the Parksville area.

Study Area and Methods:

In year one (2006), 1 m^2 plots were established at a consistent aerial coverage on GOE patches at CFMETR. Plots were located using 100 m, 50 m, or 25 m nodal points using a GPS. Initial surveys of flora using plots took place, as did the following environmental measurements: slope, aspect, canopy cover, and soil depth.

In year two (2007) some plots at CFMETR were re-visited, and new plots in different locations (including additional plots at CFMETR and plots at Rocky Point) were established. Plots were surveyed as above. Small (approximately 10 gram) soil samples for nutrient analyses were collected, to be analyzed at a future date. In addition, full surveys of vascular plants were conducted for Garry oak meadows at Wallace Point, Wallace Point Island, and Nanoose Peninsula. These surveys were conducted by walking transects 5-10 m apart along the lengths of the meadows. For both full and plot-based surveys, plants that could not be identified *in situ* were collected, unless there was a possibility that they could be federally or provincially listed species.

In year three (2008), surveys were conducted as above at Albert Head. Only plot-based surveys were conducted, since Patrick Lilley (M.Sc. student, UBC) had conducted full surveys in 2007. In addition, some plot locations from Nanoose Peninsula and Wallace Point were revisited to check for interannual variability. Attached maps (Figures 1 and 2) provide location details. Finally, a population of *Allium geyerii* (BC Red List) at Wallace Point Island was revisited to confirm precise location and population size.

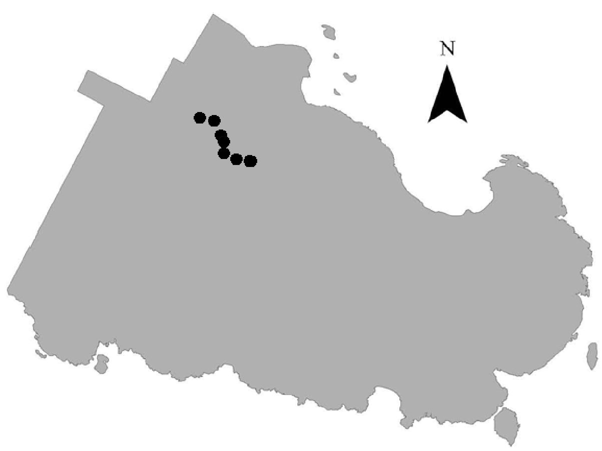

Figure 1. Map of Albert Head showing 2008 sample locations.

Results:

Plot-level surveys at Albert Head revealed a site that is more impacted by introduced species than most sites in the broader study. Percent cover of introduced species averaged 35% in the seven plots surveyed, while percent cover of native species averaged 6%. This is considerably worse than the averages for 2008 plots across all study sites (24% introduced and 37% native species). Generally low total percent cover of vascular plants at Albert Head reflects high percent cover of moss due to shallow soil depth. However, higher than average percent cover of introduced species likely reflects past disturbance, resulting from pre-military agricultural use of the site and/or installation/ maintenance of military infrastructure.

Figure 2. Map of CFMETR showing 2008 sample locations.

In the six repeat plots from 2006 at CFMETR, there was no evidence for increasing dominance of introduced species: percent cover was 26 in 2006 and 23 in 2008. However, the sample size is too small for this site to allow any quantitative inferences about a trend.

The population of *Allium geyerii* was confirmed at about 20 individuals, along the south shore of Wallace Point Island (UTM coordinates: 419594E 5458131N). Two bulbs had been disturbed by winter storms, and were carefully replanted.

Discussion:

The findings for 2008 are similar to previous years: DND sites do not show greater protection from introduced species than other, more publicly-accessible sites. Two possible reasons for this situation are: 1) a legacy of past disturbance, either pre- or post-military occupation; or 2) current issues, such as deer browsing (which is heavy at both CFMETR and Albert Head) and trespassing (which appears to be a major problem at Wallace Point). Albert Head probably suffers from synergistic effects of both deer browsing and past disturbance.

Lack of protection from invasive propagules does not mean that DND sites are not useful for the maintenance of the endangered GOE. A number of rare species apparently occur on the CFMETR property, and many rare species have been found by other researchers at Rocky Point. As areas that are currently isolated from heavy human use, these sites represent important baselines for the study of processes affecting GOE plant communities. And as time goes on, the legacies of past disturbance may either diminish or become smaller in comparison to current disturbance problems at more publicly-accessible sites.

Conclusions:

While there are too few DND sites and too many factors (such as disturbance and previous land use) to point to any systematic difference from all other sites, it seems obvious that DND sites are not necessarily better protected than other sites, at least for now. However, the DND system of trying to keep people away from sites of ecological and cultural interest through signage is an excellent management practice for non-public areas. Further work to keep trespassers out of DND facilities would also help to diminish the impact of disturbance on sensitive ecosystems.

More detailed results of the broader study will be published in 2009 and 2010, and copies of publications will be provided to ESAC. Publications will examine the following issues: climatic influences on ecosystem components; island/mainland biogeographic comparisons; a comparison of spatial and environmental influences at different scales in this ecosystem; and models predicting species occurrences to assist remedial efforts. These publications will form the bulk of my PhD thesis, which will also be provided to ESAC. Raw data and detailed statistics will be contained in thesis appendices.

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P124-08 Garry Oak (*Quercus garryana).*

Year-Round Microclimates Experienced by Butterfly Larvae in Garry Oak Ecosystems

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Permit #: P124-08
Location: Rocky Point
Project Status: 2007 - Ongoing
Start Date: 1 January 2008
Completion Date: 31 December 2008

Introduction:

This project addresses the impacts of overwintering conditions and climate change on the biology of species at the edge of their geographic range. It is complementary to, and conducted in consultation with, Dr Jessica Hellmann at University of Notre Dame. The overall goals of the project are to determine the effects of microclimatic conditions on the energy utilization, survival, and subsequent reproductive potential of overwintering individuals of the butterflies *Erynnis propertius* and *Papilio zelicaon*. Physiological work is being conducted in the laboratory in London, ON, using larvae collected for other purposes by Hellmann's group, and these physiological data will be interpreted using the long-term microclimate temperature recordings. The primary questions to be addressed using microclimate temperature data collected from Rocky Point and other locations on Vancouver Island are as follows:

1. To what extent is reproductive output determined by energy consumption during the overwintering period;
2. What is the relative importance of temperature conditions in fall and winter in determining energy reserves remaining for spring reproduction in these species; and
3. Is there a risk of mortality for these species due to low temperature exposures of short or long duration?

Thus, to address the central question of this study: "Do overwintering conditions, whether through mortality or energy expenditure, determine the northern geographic limit for these species?", the microclimate data from Rocky Point site will be need to combined with data from other microclimate stations (to be established in Oregon and elsewhere on Vancouver Island) along with the results of the physiological measurements.

Overall, this study will provide important information for ongoing studies on the flora and fauna of the Garry oak ecosystem, will provide information for future conservation and management of the butterfly species, and will address a number of knowledge gaps concerning the effects of changing winter conditions on insect population biology.

This research is supported by the National Science and Engineering Research Council of Canada (NSERC), the Canadian Foundation for Innovation (CFI), the Ontario Research Foundation, and the University of Western Ontario.

Study Area and Methods:

Microclimate temperature recording stations were established in October 2007 in Garry oak meadows at Rocky Point in close proximity to transects used for on-the-wing butterfly surveys carried out by Dr Hellmann.

Each microclimate station consists of four iButton DS1921 or DS1922 dataloggers, which make time-stamped temperature recordings at one- hour intervals. The data loggers at each of four stations were deployed in two pairs – two were affixed to a branch in the canopy at 1.8 to 2 m height (representative of 'leaf temperature', experienced by growing caterpillars and by caterpillars overwintering in leaf rolls that do not drop to the ground), while two were anchored to tent pegs and placed in the leaf litter directly below the canopy data loggers to provide temperature measurements representative of overwintering habitat in the leaf litter. Each pair of iButtons was encased in a plastic vial filled with silica gel to prevent moisture damage. This configuration was also used at two other sites in Garry oak meadows on Vancouver Island and at two sites in Oregon. The level of replication within and between locations was necessary to allow a determination of the variability of temperature conditions both among and within sites.

Data download and maintenance of the dataloggers was done on site using a laptop computer.

Results:

Dataloggers were checked and data downloaded on 30 April 2008 and again on 24 May 2008 at which time the loggers were set to run unmonitored for 360 days to avoid difficulties in having to return prematurely to reset the loggers (anticipated to be in April 2009). Hourly temperature data from each of the four stations from October 2007 until April 2008 was collated and mean monthly minima, maxima and means were calculated. Six loggers were found to be faulty as a result of moisture entering into the inner mechanism, thus all subsequent deployments use a new system of encasing them in plastic to waterproof them.

Discussion:

This project is still in its early stages – we do not anticipate utilizing the data in models until we have at least three winters' worth of data, so we will likely begin analysis combined with the physiological data in early-mid 2010.

Conclusions:

We successfully established microclimate temperature monitoring sites at Rocky Point, as well as at two other Vancouver Island locations and two locations in Oregon. Related work on the physiology of the butterfly species is proceeding slowly owing to a poor season in 2008, but we have strong pilot data for work in the 2009 field season.

Future plans include the download and maintenance of the data loggers (with the hope that this will become a long-term monitoring project), and the expansion of physiological studies of animals reared under climatic conditions which simulate climate change scenarios. These physiological parameters (metabolic rate-temperature relationships and rates and nature of metabolic fuel use under different temperature regimes) will eventually be integrated with the microclimate data (including that collected at Rocky Point) to create a wider model of overwintering energetics in diapausing Lepidoptera.

P124-08 Sealing the iButton into its waterproof container.

Gene Flow and Dispersal of Plants in Fragmented Landscapes

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Permit #: P125-08
Location: Rocky Point
Project Status: 2008 - 2009
Start Date: 1 April 2008
Completion Date: 30 April 2008

Introduction:

Numerous episodes of plant invasions during the past few centuries emphasize that recent human activities have assisted species' dispersal over long distances and hence greatly affected the regional dynamics of plant species. In contrast, excluding cultivated varieties, the extent to which prehistoric human activities affected plant dispersal still remains unclear. In North America, many plant species were utilized by indigenous peoples for cultivation or trade, so the effect of such activities on plant distribution and dispersal has been widely discussed (e.g. Murphy 2001; MacDougall 2003). However, previous debates based on historical documents or locations of native villages are often inconclusive because of the fragmentary nature of ethnographic data. Genetic approaches can be beneficial and used to test hypotheses resulting from ethnographic evidence.

Camassia quamash (Pursh) Greene (*Agavaceae*) was historically one of the most important plant resources utilized by indigenous peoples on the Northwest Coast of North America. Large quantities of bulbs were collected, consumed, and traded among remote villages in exchange for other food plants (Turner and Bell 1971; Gritzner 1994). Despite the ethnographic evidence, no genetic studies have been conducted to examine the effect of camas trading on the pattern of genetic structuring. Species conservation will depend fundamentally on a thorough understanding of the dynamics of populations, including historical human involvement.

We are examining the factors affecting the genetic structuring of *C. quamash* in western British Columbia and the northwestern United States. Specific questions are (1) whether historical activities by indigenous peoples influenced spatial genetic structure of the species, and (2) what natural processes explain the pattern of genetic structure. The former effect is tested by comparing the results of *C. quamash* with those of death camas, *Zigadenus venenosus* S. Watson (Melanthiaceae), a similar species that was not consumed because of a highly poisonous alkaloid.

Study Area and Methods:

Sampling was conducted between April and July of 2007 and 2008. We sampled 35 and 21 populations of *C. quamash* and *Z. venenosus*, respectively, from across the southwestern British Columbia and western Washington state. The sampled populations of *C. quamash* include Rocky Point (in Area B), where we collected samples on 13 May 2008. In each population, leaf material was collected from six plants except for a single site where only four plants of *C. quamash* were available (*C. quamash*: n=208; *Z. venenosus*: n=126).

Total DNA was extracted from ~1 cm^2 of leaf tissue using DNeasy Plant Mini Kit (Qiagen, Valencia, California, USA). On the basis of a preliminary screening, we examined two noncoding regions of chloroplast DNA in each species: rpl32-trnL and psbJ-petA for *C. quamash*, and rpl32-trnL and rpl16 intron for *Z. venenosus* (Small *et al.* 1998; Shaw *et al*. 2007). Polymerase Chain Reaction (PCR) was used to generate templates, which were sequenced directly with BigDye Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems, Foster City, California, USA). The resulting products were electrophoresed and detected with an automated sequencer at the DNA Sequencing Laboratory, University of British Columbia.

P125-08 Common Camas (*Camassia quamash*).

Conclusions:

We are currently analyzing the sequencing data and expect to finish this project by April, 2009. Our research will demonstrate if and how habitat patches have been historically connected via dispersal. The research may also give new insights into the pattern of historical gene exchange by indigenous peoples, and thus provide an important present-day conservation legacy. The project outcomes will be a single article in a peer-reviewed scientific journal.

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Efficacy Testing of Pheromones and Kairomones for Woodboring Coleoptera

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Permit #: P126-08
Location: Rocky Point
Project Status: 2008 - 2010
Start Date: 1 May 2008
Completion Date: 27 August 2008

Introduction:

Over the past decade, invasive Cerambycidae including the brown spruce longhorn beetle (*Tetropium fuscum*) and the Asian longhorn beetle (*Anoplophora glabripennis*) have established at various localities across Canada. Detection of populations of introduced Cerambycidae in urban and natural forests remains problematic as there are currently no efficient pheromone based detection tools for the majority of the species of Cerambycidae. Silk *et al.* (2007) recently developed pheromone based lures for *T. fuscum* that have served to greatly enhance our ability to detect this and a related European species during surveillance trapping for invasive alien species. Little is known of the range of native or invasive species responding to these generic lures and pheromones.

Lacey *et al*. (2004) reported the first verified occurrence of a male produced aggregation pheromone in the Cerambycidae. They noted that at least two other species were attracted to the pheromone blends tested against *N. acuminatus* and stated "that the pheromones bear structural similarities to those produced by males of six other species in the Cerambycinae (straight chains of 6, 8, or 10 carbons with hydroxyl or carbonyl groups at C2 and C3). It is likely that males of other species in this large subfamily produce pheromones that are variations on this structural motif." Ray *et al*. (2006) subsequently surveyed 65 species in 24 tribes of the subfamily Cerambycinae and demonstrated that gland pores thought to be the site of pheromone release were present in the males of at least 49 species while Ginzel and Hanks (2005) demonstrated that volatiles released by host trees also play a role in attraction to susceptible hosts. Long range attractants have also been found in a second subfamily of Cerambycidae. Silk *et al.* (2007) showed that at least two species of coniferous feeding cerambycids from Europe, *Tetropium fuscum* and *Tetropium castaneum* (Cerambycidae: Spondylinae), also respond to specific pheromones. These represent the first demonstrations of functional long range attractants for this economically important group of species that include a significant number of invasive species in Canada and around the world.

The primary objective of this study is to determine if any native Cerambycidae exhibit species specific responses to generic C-6 and C-8 diol and ketol lures with and in the absence of ethanol. Secondarily, species of bark and woodborers captured in the traps are being used to generate mitochondrial DNA barcodes and support the development of cytochrome oxidase I barcode libraries in conjunction with the Barcode of Life (see <http://www.boldsystems.org/views/login.php>).

Study Area and Methods:

Lures and traps

Racemic C-6 and C-8 ketols were synthesized by Dr. Peter Silk (Natural Resources Canada - Canadian

Forest Service, Atlantic Forestry Centre, Fredericton NB) and supplied to Pherotech International, Inc. (Delta, BC) for incorporation into release devices. Ultra-high release rate ethanol (UHR-EtOH) lures were obtained from Pherotech International, Inc. All experiments were conducted using 12-funnel Lindgren traps with the wet-trap option (PheroTech International, Inc.). The collecting cup of each trap contained 125 ml of food grade propylene glycol to retain any specimens captured and traps were hung from metal hangers placed in the ground. The minimum separation between traps was 30 meters. Traps were serviced on monthly basis at which time trap contents were collected into Whirl-Pac bags and the propylene glycol in the cups replenished.

All trap trials were conducted at DND-Rocky Point. Trap locations were selected on 1 May 2008 and placement of each replicate is noted in Figure 1. Traps were established on 8 May 2008 and lures were placed on the traps on 13 May 2008. Trap collections were made on 16 June 2008, 15 July 2008 and 13 August 2008 and all equipment was removed on 27 August 2008. Lure trials were set up in a randomized complete block design with 11 replicates of each of 6 treatments (unbaited trap; UHR-EtOH; C-6 ketols; C-6 ketols & UHR-EtOH; C-8 ketols; and C-8 ketols & UHR-EtOH).

Trap and Specimen Processing

Upon return to the laboratory, contents of each Whirl-Pac bag were washed in running water and then preserved in 95% ethanol. All Coleoptera recovered were subsequently sorted from plant debris in the traps and either direct pinned or preserved in 95% ethanol

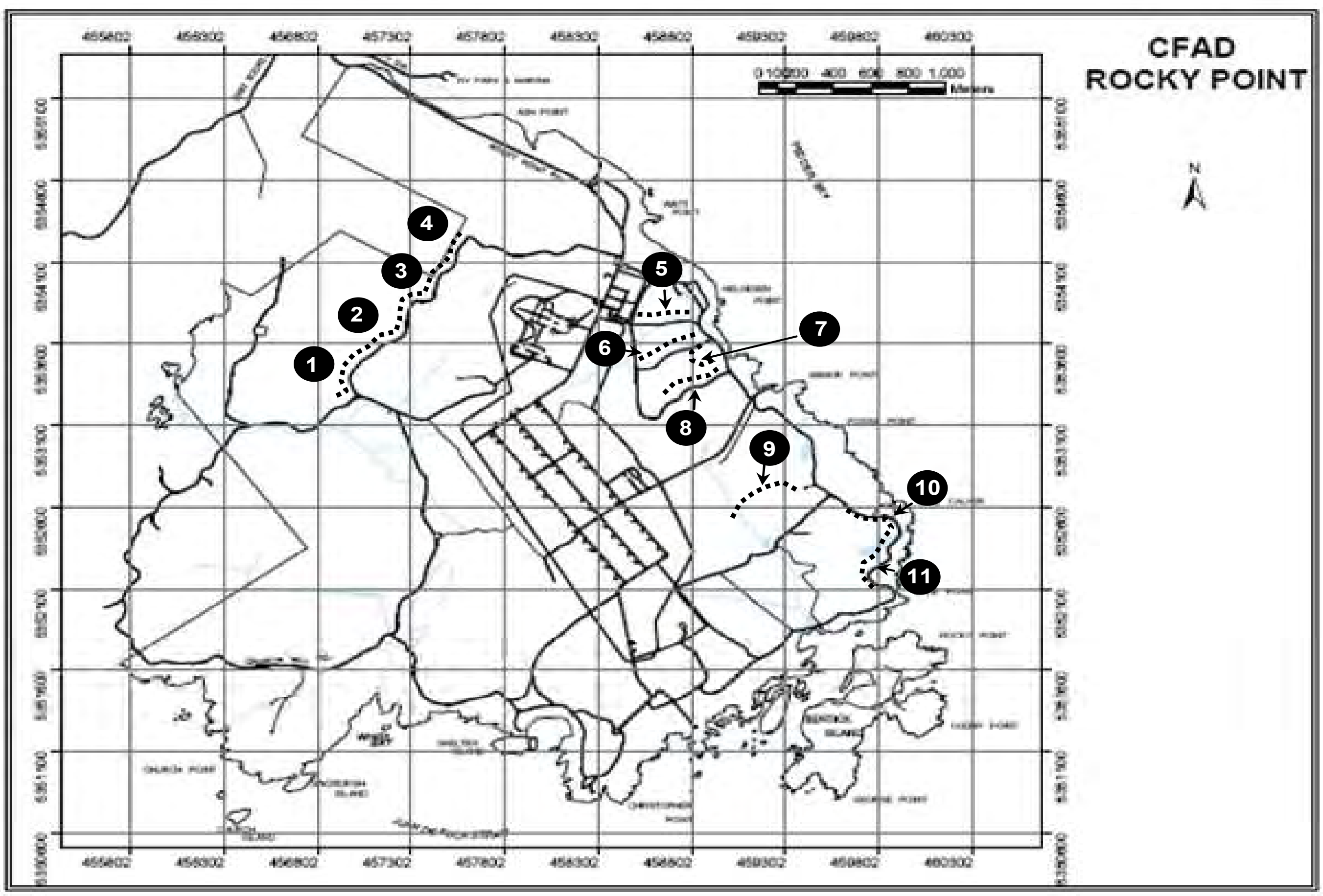

Figure 1. Location of replicate blocks (dark circles) along lines of traps (dotted lines) at Rocky Point, Metchosin, B.C. in 2008.

prior to identification. All target species (bark and woodborers) were then identified to species, counted and representative specimens of each species mounted and labeled for accession into the reference collection at Pacific Forestry Centre (PFC).

Species Identification

All Cerambycidae were initially identified at PFC by Ms. Chelsea Burdge. Pinned voucher specimens of all species were subsequently submitted to Mr. Serge Laplante (Canadian National Collection, Agriculture and Agri-food Canada, Ottawa) for confirmation of the identifications.

Barcode of Life Sampling

Single legs were removed from reliably identified voucher specimens of each species collected (to a maximum of five individuals per species). Individual legs (282 in total) were placed in microtubes and data associated with each specimen prepared for submission to the Canadian Barcode of Life project. All voucher specimens are being imaged (one dorsal and one lateral image per specimen).

Results:

In total 3,489 adult Curculionidae and 1,082 adult Cerambycidae were recovered from the 66 funnel traps at DND-Rocky Point. Total number of individuals for each family and subfamily by collection date and species recovered by Family and Subfamily are given in Tables 1 and 2 respectively.

Preliminary data analyses suggest that at least two of the species recovered responded to racemic ketol lures alone or in combination with UHR-EtOH lures, however the significant variability in capture rates across blocks is problematic for statistical testing.

At the present time no results are available for DNA sequencing.

Discussion:

The results of the 2008 trapping experiments at Rocky Point suggest that multiple species of Cerambycidae were attracted to racemic C-6 ketols. Variability in captures across treatment blocks makes it difficult to obtain statistically significant results for all of the species captured. More targeted sampling will be required in 2009-2010. One of the species is associated with Douglas fir (*Pseudotsuga menziesii*) and was recovered from all treatment blocks, with more than 77% of the total captures being recovered from Blocks 1-4 (see Figure 1). The second species is associated with Garry oak (*Quercus garryana*) and Arbutus (*Arbutus menziesii*). Slightly more than 87% of the total

Table 1. Total numbers of Curculionidae and Cerambycidae recovered from multiple funnel traps at DND-Rocky Point between 8 May 2008 and 27 August 2008.

	Collection Date				
Taxon	**16 Jun.**	**15 Jul.**	**13 Aug.**	**27 Aug.**	**Total**
Curculionidae					
Cossoninae	0	25	0	0	25
Scolytinae	1769	1275	338	82	3464
Total Curculionidae	**1769**	**1300**	**338**	**82**	**3489**
Cerambycidae					
Aseminae	0	1	6	5	12
Cerambycinae	94	635	283	19	1031
Lepturinae	0	6	28	5	39
Total Cerambycidae	**94**	**642**	**317**	**29**	**1082**

Table 2. Genera and species of Curculionidae and Cerambycidae recovered from trap experiments at DND-Rocky Point.

Family	Subfamily	Genus or Species
Curculionidae	**Cossoninae**	**Rhyncolus sp.*
	Scolytinae	**Alniphagus aspericollis*
		**Carphoborus sp.*
		**Cryphalus pubescens*
		Dendroctonus pseudotsugae
		**Gnathotrichus sulcatus*
		**Hylastes longicollis*
		**Hylastes nigrinus*
		**Hylurgops porosus*
		**Hylurgops rugipennis rugipennis*
		**Monarthrum scutellare*
		**Pityophthorus sp.*
		**Pseudohylesinus sp.*
		**Scolytus sp.*
		**Trypodendron lineatum*
		**Trypodendron retusum*
		**Xyleborinus saxeseni*
		**Xyleborus dispar*
		**Xylosandrus germanus*
Cerambycidae	**Aseminae**	**Megasemum asperum*
	Cerambycinae	**Clytus planifrons*
		**Eumichthus oedipus*
		**Neoclytus conjunctus*
		**Opsimus quadrilineatus*
		**Phymatodes aeneus*
		Xylotrechus longitarsis
	Lepturinae	**Brachyleptura dehiscens*
		**Cosmosalia chrysocoma*
		**Grammoptera subargenata*
		**Leptura obliterata obliterata*
		**Lepturopsis dolorosa*
		**Necydalis cavipennis*
		**Necydalis laevicollis*
		**Pidonia scripta*
		**Pyrotrichus vitticollis*
		**Strophiona laeta*
		**Ulochaetes leoninus*
		**Xestoleptura behrensi*
		**Xestoleptura crassipes*

Taxa denoted by an asterisk ***** have had legs removed for DNA analyses.

captures of the second species were recovered from three treatment blocks (9-11), with smaller numbers (1% to 4.3% of total captures) in five additional treatment blocks (1- 4 and 7).

Conclusions:

While trap results suggest that multiple species are utilizing C-6 ketols as semiochemicals further research is needed to determine the identity of the specific compounds and demonstrate their function as attractants. Ultrastructural examinations with a scanning electron microscope are currently underway to determine the presence or absence of gland pores in each sex of the species responding to ketol lures.

Additional trap studies are being planned using both racemic and optically active C-6 ketols (3-Hydroxyhexan-2-one, R-3-Hydroxyhexan-2-one and S-3-Hydroxyhexan-2-one) to determine which, if any, of the optical isomers of the C-6 ketols is functioning as a semiochemical. In addition, live trapping and/or rearing programs will be undertaken to obtain individuals for aeration experiments to determine which compounds are released by each of the species. Live traps and/or infested host material in rearing will be monitored on a daily basis (when permitted) and beetles recovered identified to species and separated by sex. Pooled individuals of each species separated by sex will be placed in aeration chambers. Charcoal filtered air will be drawn through the chambers and volatiles emitted by the test subjects (minimum of 20 individuals) captured on chemical absorbents (e.g. Super-Q or Porapak Q, Alltech Associates, Deerfield, Illinois) placed in the outflow stream from the aeration chamber. Analyses of the adsorbed volatiles will be conducted by Drs. J. Sweeney and P. Silk (Natural Resources Canada, Canadian Forest Service-Atlantic, Fredericton New Brunswick). Once the chemical composition of the volatiles has been determined an attempt will be made to confirm their biological activity by conducting electroantennagrams (EAG) using antenna excised from beetles of both sexes. Once these studies have been completed in 2009, manuscripts will be submitted for publication.

This research trial is part of a larger national study attempting to identify lure systems useful for surveillance monitoring for invasive species of Cerambycidae. Parallel studies were conducted in forest habitats near Ottawa, Ontario by Dr. B. Gill (Canadian Food Inspection Agency) and in the Maritimes by Dr. J. Sweeney in 2008-09. Plans are currently being made to initiate testing of these lures in both China and Europe during 2009-10. Voucher specimens of all species recovered have been deposited in the Natural Resources Canada, Canadian Forest Service-Pacific reference collection (PFCA).

Acknowledgements:

The assistance of Jane Seed (NRCan, CFS, Victoria) for trap set-up and monitoring; Chelsea Burgde (NRCan, CFS, Victoria) for preliminary identifications as well as sorting, mounting, labeling and sexing the target taxa; and Serge Laplante (Canadian National Collection, Agriculture and Agri-food Canada, Ottawa) for confirming cerambycid identifications is gratefully acknowledged.

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Community Homogenization in Distributed Landscapes

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Permit #: P127-08
Location: Albert Head
Project Status: 2008 - 2010
Start Date: 12 May 2008
Completion Date: 31 December 2008

Introduction:

Biodiversity has been differently influenced by human activities at different spatial scales. Although human activities have led to decreased global species diversity as a result of species extinctions, at regional and local scales the introduction of non-indigenous species has often outweighed the loss of natives such that species richness has increased over time (Sax and Gaines 2003). A less recognized aspect of these trends, however is that although local or α-diversity has increased, this is typically at the expense of decreased β-diversity among regions (Olden 2006a). The homogenization of communities, or the increase in species compositional similarity through time, has recently become a focus of study. This process has been observed for many taxa across several regions of the world (e.g. Blair 2001; McKinney 2004; Rooney *et al.* 2004). Homogenization has the potential to reduce overall community and ecosystem functioning, stability and resistance to environmental disturbance (Olden *et al.* 2004).

Most often, homogenization occurs as specialists with restricted distributions are replaced by generalists with broader distributions. Emerging evidence suggests that specialist species across many taxa are declining throughout the world (plants, Fischer and Stöcklin 1997, Rooney *et al.* 2004; butterflies, Warren *et al.* 2001; carabid beetles, Kotze and O'Hara 2003; coral reef fish, Munday 2004; birds, Julliard *et al.* 2004; marsupials, Fisher *et al.* 2003). Specialist species have also been found to be located in less disturbed landscapes than generalists (Devictor *et al.* 2008).

The Garry oak (*Quercus garryana*) ecosystem on Vancouver Island is one of the most threatened ecosystems in Canada. Less than 5% of the original habitat remains in a near-natural condition and many native plant and butterfly species are considered to be ‘at risk’ of extinction in Canada (Fuchs 2001). Here, we want to determine whether anthropogenic disturbance has caused the homogenization of butterfly communities at a regional scale in the Garry oak ecosystem on Vancouver Island and whether there are more generalists and fewer specialists in more disturbed areas.

Study Area and Methods:

Butterfly communities were surveyed in remnant patches of the fragmented Garry oak ecosystem across a development gradient along the Saanich Peninsula near Victoria, British Columbia, Canada (48°26' N 123° 22' W), on southeastern Vancouver Island (Figure 1). Butterflies were surveyed from May to July 2008 during the peak butterfly season in 17 habitat patches. Patches were selected so that they varied in their area (0.2-30 ha), isolation, surrounding land use, but that they varied minimally in environmental conditions. Parallel transects covering the entire patch, spaced 25m apart were surveyed with a moving observation

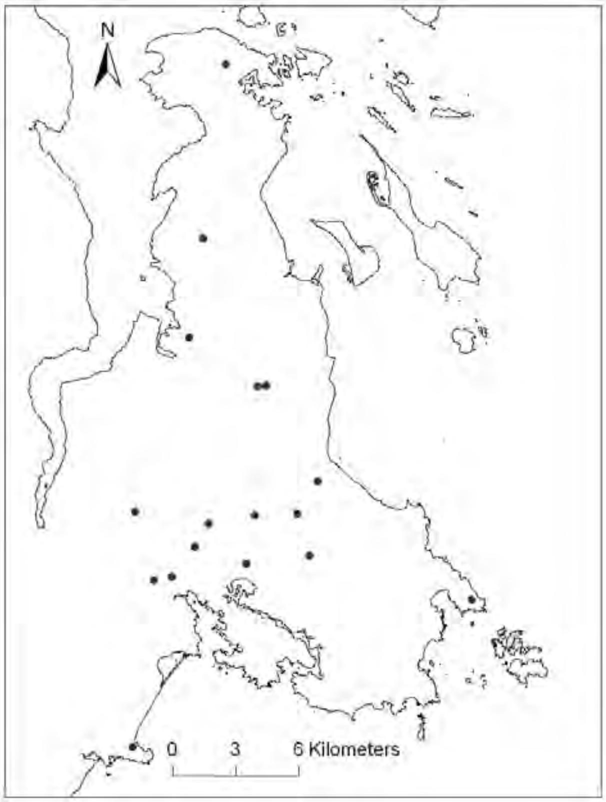

Figure 1. Map showing remnant Garry oak ecosystem patches along the Saanich Peninsula that were surveyed for butterflies (n=17).

radius of 5m. Butterfly species presence was recorded. All field work was conducted between 9:00 and 16:00 when temperatures were over 15^{o}C and when it was mostly sunny. We visited each site a total of 6 times.

As a measure of human disturbance, surrounding road density was used as the length of roads per unit area in a 500 m buffer around each patch.

To calculate diversity of each site, we used the Simpson diversity index, which gives the probability that any two individuals drawn at random from an infinitely large community will belong to the same species. To measure β diversity, we used the Bray-Curtis index, which is a measure of compositional similarity between two locales using species abundance information. The index was calculated for all pair-wise comparisons across sites and then the average per site was taken.

We tested whether there was a significant relationship between species richness, total abundance, diversity and similarity, and road density after accounting for the combined effect of site area and climate. We compared two models, with and without road density, to see whether road density explained significant additional variance.

Results:

There were 1041 individuals counted from 14 species. The most abundant species was the Lorquin's Admiral (*Limenitis lorquini*) and the least abundant was the Satyr Anglewing (*Polygonia satyrus*) (Figure 2). Taking into account area, Konuk had the highest species diversity. The average Simpson diversity index across sites was 0.733 and the average Bray-Curtis index across sites was 0.623 for butterflies.

Increasing road density significantly increases butterfly species richness ($p=0.003$) and abundance ($p<0.0001$), after accounting for area of sites and climate (Figure 3 and 4). However, there is no significant relationship between diversity (Simpson index) and road density ($p=0.0936$) or between similarity (Bray-Curtis index) and road density ($p= 0.109$), after accounting for area and climate.

Discussion:

These results suggest that as road density increases, the number of butterfly species and the total number of individuals increases. However, increasing road density does not increase the compositional similarity of sites to other sites, which differs from previous research (Blair 2001; McKinney 2004). These preliminary analyses suggest that biotic homogenization may not be occurring in these remnant Garry oak patches.

Future work includes figuring out whether there are fewer specialists and more generalists in more disturbed sites, identifying whether all species are positively correlated with road density, and determining whether there are patterns between these community

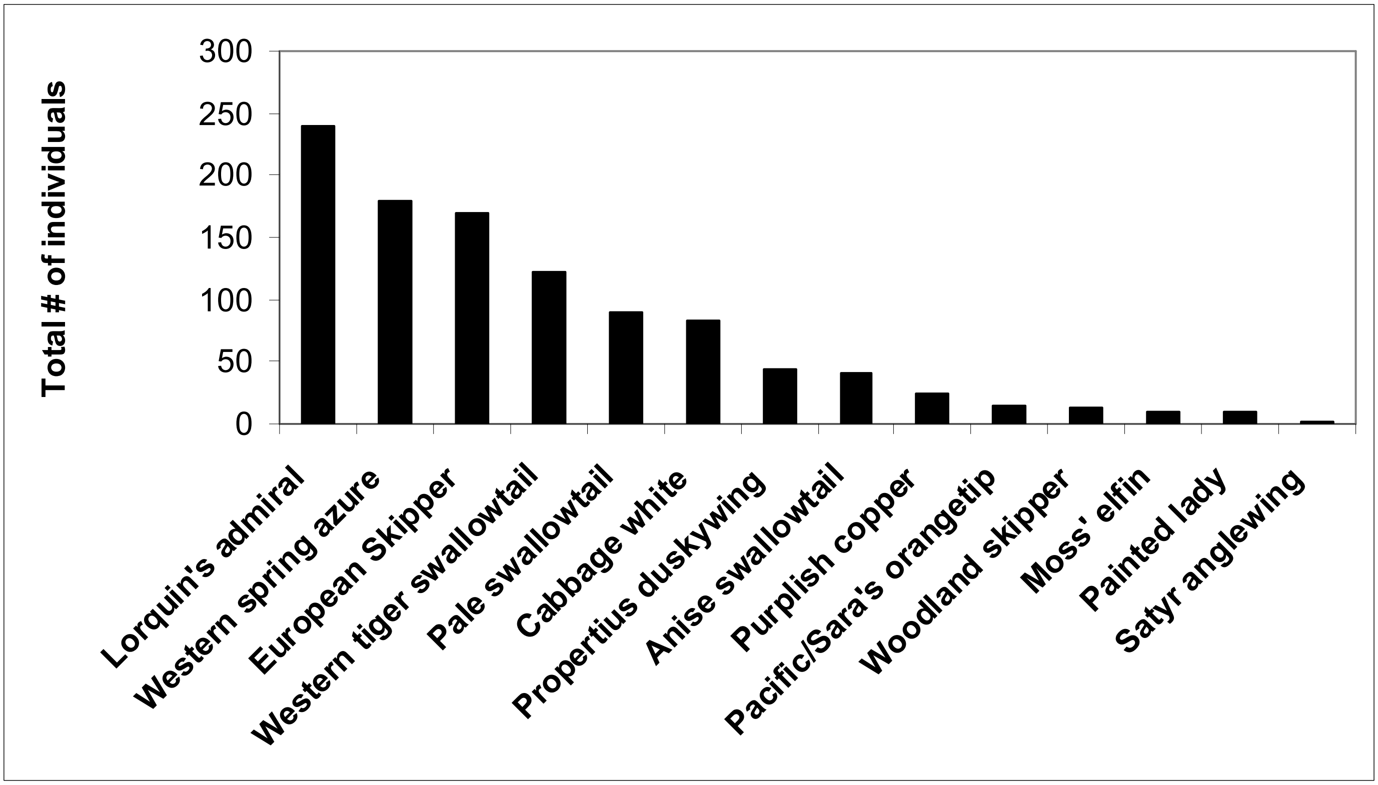

Figure 2. Distribution of total abundance for butterflies surveyed in 17 remnant Garry oak ecosystem patches (n=14).

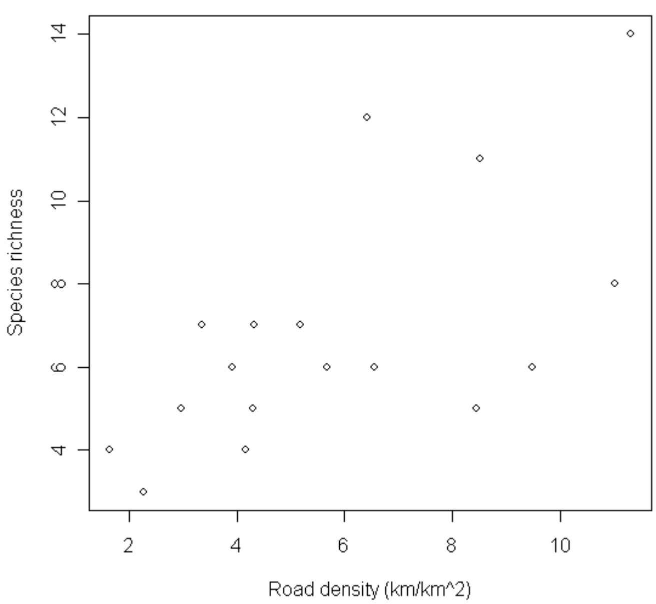

Figure 3. Relationship between butterfly species richness (n=14) and surrounding road density (km/km^2) of surveyed Garry oak ecosystem patches (n=17).

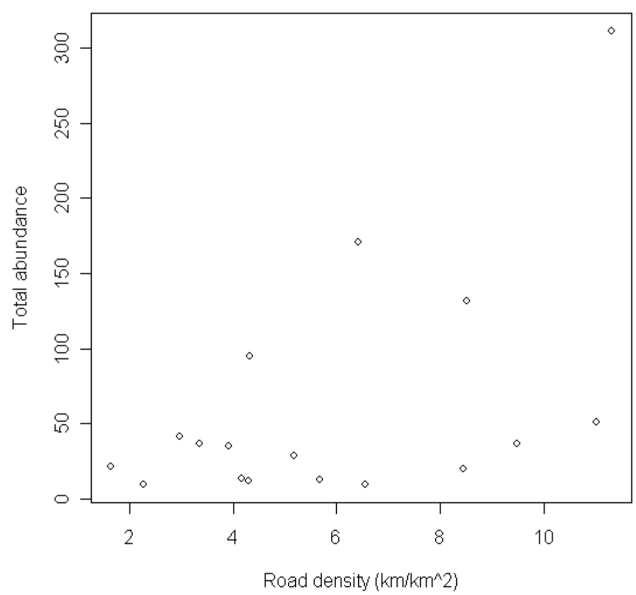

Figure 4. Relationship between butterfly total abundance (n=14) and surrounding road density (km/km^2) of surveyed Garry oak ecosystem patches (n=17).

indices and other measures of human disturbance (e.g. connectivity, landcover).

Conclusions:

Future plans include (potentially) another field season in 2009, inclusion of work in PhD dissertation and ultimate publication in an ecological or conservation themed journal (e.g. Journal of Ecology, Biological Conservation).

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P127-08 Albert Head.

Yabea microcarpa Survey

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Permit #: P128-08
Location: CFMETR
Project Status: Completed
Start Date: 17 May 2008
Completion Date: 24 June 2008

Introduction:

Yabea microcarpa is a very rare plant in Canada, only known from a small number of sites - all in south-western B.C. It was first observed at Notch Hill (CFMETR) in 2007 during the course of other survey work but there was insufficient time to determine the full population size that year. The objective of the 2008 project was to determine the distribution of *Yabea microcarpa* on Notch Hill and obtain information on location, habitat, plant numbers and area, and condition.

The information was collected in order to provide accurate information on *Yabea microcarpa* for incorporation into a COSEWIC status report for the species. The record at Notch Hill represents significant new information on this species for status determination purposes.

Study Area and Methods:

The study area consists of open slopes on Notch Hill at CFMETR. The methods were simple:

- Locate *Yabea microcarpa* on Notch Hill.
- Record relevant data on a BC Conservation Data Centre field form (submitted to and on file with ESAC).

The searches were conducted during the heart of the fruiting season, when the species is most easily detected. The study area was divided into 100 m x 100 m cells and transects were walked at 50 m intervals. Wherever *Yabea* was encountered, all suitable habitat within the cell was examined. In low density patches, individual plants were counted. In patches of > 100 individuals, plants were counted in groups estimated to contain approximately 5 plants. Check plots were periodically sampled in dense patches to determine if the estimates remained accurate to within 5% of the true value. The location of each patch was recorded using a hand-held GPS (Garmin E-Trex) with a nominal spatial uncertainty averaging 10 m or less. After the transect survey had been completed, areas of high quality habitat were re-examined to determine if patches of *Yabea microcarpa* had been overlooked.

Results:

A total of 4,567 individuals were counted. Survey errors were probably slight since the entire slope was surveyed and the population size was determined by counting individual plants (or groups of 5 plants in dense patches) rather than making rough visual estimates of the number of plants in each patch as is often the case with rare plant surveys. The check plots demonstrated that individual counts remained accurate to within 5% of the true value and the errors among check plots were generally offsetting (i.e. there was no evidence of systematic under- or over-estimation). The follow-up surveys of high quality habitat did not reveal the presence of patches of *Yabea microcarpa* that had been overlooked during the transect surveys. There is some uncertainty associated with the counts because a few of the plants in dense patches may have been counted twice, while others may have been overlooked. Nevertheless, the true population size is estimated to lie between 4,300 and 4,800. The plants occurred over an area of approximately 15.6 ha.

The occurrence itself is in excellent condition.

Reproduction and Health

The plants are of moderate to high vigour and reproducing. There was no evidence of disease or herbivory sufficient to have a significant impact on reproduction and survival.

Ecological Processes

Natural processes do not pose a significant threat to the long-term viability of the population. The plants occur on an actively eroding scree slope but are probably well-adapted to such circumstances.

Species Composition

Neither the species richness nor evenness of species distribution place significant limitations on the site suitability for *Yabea microcarpa*. There are numerous exotics within the occurrence and they pose a significant threat because they may shade out *Yabea microcarpa* or compete effectively for spring moisture and create a poor seedbed. The most serious threats come from bur chervil (*Anthriscus caucalis*) and invasive grasses (*Cynosurus echinatus, Dactylis glomerata*) on the scree slope. Another invasive species of concern is *Daphne laureola*, which is not yet abundant within the population but does occasionally occur in the immediate vicinity of *Yabea*. The niche of *Yabea microcarpa* appears to be wholly included within the niche of *Anthriscus caucalis*, a closely related, similar exotic herbaceous species which has a very similar form and life history but tends to be more robust than *Yabea* where the two species grow close together. *Anthriscus caucalis* seems to have a slightly broader niche than *Yabea microcarpa*.

Discussion:

The Notch Hill population is the third largest in Canada and the only sizeable population to occur on public lands. DND operations are unlikely to have negative impacts on the species in the short-term but any activities which interrupt seepage may destroy the *Yabea* population. Even in the absence of threatening activities, the population and its habitat should be monitored regularly to determine the magnitude of year-to-year fluctuations in population size and detect any overall trend in the population size. If there is a decline in population size, it may well be the result of competition from invasive species. The impacts of invasive species may be measured by establishing numerous permanent plots, removing invasive plants from a randomly-selected subset of the plots, and measuring the response by *Yabea*.

Conclusions:

Management of the Notch Hill population is likely to be key to the successful implementation of the recovery plan for this species, once the plan is prepared.

Acknowledgements:

I would like to thank Brenda Costanzo, of the BC Ministry of Environment, for arranging financial support to conduct the survey. Tracy Cornforth (DND), Mike Waters (DND) and Andrea Schiller (Canadian Forest Service) provided valuable assistance in expediting the ESAC process.

P128-08 *Yabea microcarpa.*

Vancouver Island Beggarticks Priority Site Survey

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Permit #: P129-08
Location: Aldergrove
Project Status: Completed
Start Date: 16 October 2008
Completion Date: 16 October 2008

Introduction:

In August 2008, the B.C. Ministry of Environment (MOE) and the Fraser Valley Conservancy initiated a joint study with the primary objective of updating Lower Mainland and Fraser Valley survey results for Vancouver Island Beggarticks (VIBT) (*Bidens amplissima*) priority areas (i.e. areas historically known to have been inhabited by Vancouver Island Beggarticks). The secondary objective was to identify new and prospective VIBT locations. Seventeen priority sites were surveyed by Gebauer & Associates Ltd. personnel, which included two DND Aldergrove sites listed on the BC Conservation Data Centre (Occurrences 7594 and 7595). In order to complete the surveys at the DND Aldergrove sites, an ESAC application permit was required.

Vancouver Island Beggarticks is a provincially blue-listed (threatened) and federally-listed (COSEWIC) species of Special Concern. Study findings are currently being used by the MOE and conservation groups to update existing databases and direct recovery and protection efforts.

Study Area and Methods:

Surveys consisted of between one and three field personnel. The field work component consisted of a systematic site reconnaissance survey. Specifically, areas were thoroughly traversed utilizing a modified rare plant survey methodology as outlined by the Alberta Native Plant Council (ANPC) and E-flora website. In addition to the use of customized map sheets and element occurrence record location descriptors, field personnel uploaded location information onto handheld GPS units for orientation and to assist in the location. Historical accuracy was used to denote the extent of the survey. Typically, a minimum 50 m radius (+/- 25 m accuracy) around the historical location was traversed utilizing 10-15 m spaced transects to ensure adequate coverage. Adjacent areas containing suitable habitat were also surveyed.

Results:

Sites at Canadian Forces Station Aldergrove were inventoried under escort by Mike Waters from Formation Environment at CFB Esquimalt on 16 October 2008. Site access was granted following review and approval of an Environmental Science Advisory Committee (ESAC) Research and Collection permit application (ESAC Permit P129-08) on 08 October 2008. DND personnel provided a map (no available reference), which contained two additional locations (referenced as Site 3 and Site 4), which are discussed in additional detail below.

Occurrence 7594 (UTM 10 538209 E; 5435290 N) – no VIBT were observed. The location of the UTM coordinates appears to have once contained a wetted depression; however, the area had become heavily overgrown with *Phalaris arundinacea*, which was confirmed in the 2008 Golder report (Golder Associates Ltd., 2008).

Occurrence 7595 (UTM 10 538520 E; 5436730 N) – no VIBT were observed. Numerous native riparian stock shrubs and trees had been planted along the banks of the creek in 1998, approximately two years before the last observation date. The riparian plants were well established, effectively shading the creek and surrounding areas. Moreover, the creek appeared to have been recently armoured with rip-rap and contained a uniform rocky substrate throughout. The creek was traversed east to 272nd Street. Suitable habitat is currently limited to an area where the creek widens between the DND perimeter fencing and the bridge beneath 272nd street, in which trees and shrubs are largely absent. However, the area is heavily overgrown with *Phalaris arundinacea*.

Site 3 is located at the edge of a recently excavated area historically containing contaminated soil in the vicinity of the sewage lagoons. The area appears to have been recently excavated and no vegetation was observed in the excavated area. No VIBT were observed at the UTM location provided or around the edge of the excavation; however, suitable habitat exists. Surrounding areas were heavily overgrown with *Phalaris arundinacea*.

Site 4 is located in an open area bound by a dense stand of *Spiraea douglasii* and *Phalaris arundinacea* to the north and west and an active beaver dam and wetland feeder channel to the east and north, respectively. As a result, the surrounding soils were saturated. Although no plants were observed, habitat is conducive to that of VIBT.

Discussion:

No VIBT were observed at the historical locations on the DND Aldergrove property. However, during the priority site surveys at the DND Aldergrove site, readily accessible prospective areas were also assessed, which included an area on the eastern edge of the natural wetland located adjacent and west of the access road (UTM 10 537929 E; 5435449 N). Six plants were observed in a small outcropping, which had been heavily utilized by waterfowl (sign). However, due to the late timing of the survey, the plants were in an advanced state of decay and were not readily identifiable. Collection of the achenes confirmed that that they were of the *Bidens* genus; however, species could not be confirmed. The 2008 Golder report prepared for DND states that *Bidens cernua* (Nodding Beggarticks) were observed during the September 2008 survey; however, location details were not provided.

Conclusions:

Given that VIBT is an annual species, yearly variation is anticipated to occur. Given the suitable habitat and utilization by waterfowl, there is a high potential that VIBT may occur in other areas on the property. Therefore, it is recommended that comprehensive, follow-up surveys be conducted at the DND Aldergrove site to verify the presence and extent of VIBT between mid-August and the end of September.

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P129-09 Occurrence Site 7595.

OUTLOOK

ESAC will continue to track and review research projects on CFB Esquimalt properties, sponsor the annual workshop, prepare an annual report, and update the ESAC website.

In addition, the Committee will confer on issues related to the Rocky Point Forest Canopy Research Station and other monitoring stations as well as provide advice to MARPAC on environmental issues occurring on CFB Esquimalt properties.

In 2009, the ESAC website will undergo updates with the intent of ensuring that all current information on ESAC projects is readily accessible for use by MARPAC personnel and other interested parties.

ACKNOWLEDGEMENTS

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- All 2008 ESAC permit holders for their cooperation and contribution to the knowledge of flora, fauna, and ecology on CFB Esquimalt properties.
- The Canadian Forest Service – Pacific Forestry Centre for coordinating and hosting the annual workshop.
- All of the individuals who presented at and/or attended the ESAC annual workshop in January 2009. Your attendance and participation are valued.

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