GARRY OAK ECOSYSTEMS RECOVERY TEAM

RESEARCH COLLOQUIUM 2003

Pacific Forestry Centre
Canadian Forestry Service
506 W Burnside Road
Victoria, BC, Canada
February 28, 2003

ABSTRACTS OF PRESENTATIONS

Garry Oak Ecosystems History, Distribution and Classification

New insights into the history of Garry oak (*Quercus garryana*) on Vancouver Island

Recent completed and ongoing studies of lake and wetland cores on south Vancouver Island refine our knowledge of the past extent of Garry oak and limits in its distribution. Garry oak arrived by an unknown vector on Vancouver Island between 7000-8000 radiocarbon years ago (yBP). It was most abundant between 6000 and 4000 yBP when oak pollen occurs abundantly in sediments of Saanich Inlet. At the same time oak pollen reaches its highest values in other sites throughout the region. The abundance of oak pollen at Saanich Inlet and its depositional context suggests that oaks may have grown widely in the Cowichan Valley at this time. Pollen records from southwest Vancouver Island, in the Alberni valley and in the Nanoose-Parksville area reveal that the range of oak probably extended somewhat beyond where it grows today. But it would seem that extensive tracts of oak ecosystems never existed more than a few kilometres beyond the present day limits, except possibly in the Cowichan Valley and adjacent valleys. A notable second, less-prominent, peak occurs later in the Holocene in some sites and may be related to aboriginal land-management practices.

Richard Hebda, Royal British Columbia Museum and Dept. of Biology, and Schools of Earth and Ocean Sciences and Environmental Studies, University of Victoria.
Email: RHebda@royalbcmuseum.bc.ca

Historical Garry oak ecosystems of Greater Victoria and Saanich Peninsula

A map compares the 1800 and 1997 distribution of Garry oak ecosystems in the Victoria area. A table is provided that shows the extent of the area originally covered by Garry oak ecosystems, as well as the present extent. Overall, less than 5 percent of the original ecosystems still remain, and this is only in isolated, fragmented communities that mostly have no connection to other Garry oak communities, thereby preventing migration of populations or mixing of genetic material of species from one area to another.

The map area includes Victoria city, plus municipalities, cities, and Indian Reserves surrounding Victoria. The Highlands Municipality was not included in this study. The map of historical distribution of Garry oak ecosystems depicts those areas where Garry oak (*Quercus garryana*) was believed to be the dominant cover or co-dominant cover with Douglas-fir (*Pseudotsuga menziesii*) or Arbutus (*Arbutus menziesii*) in the 1800s. Other areas may have had, and still have, Garry oak as a minor component of the ecosystem; however, these areas were not considered for this mapping.

Originally, two major types of ecosystems occurred in the Garry oak areas. These include ecosystems on deep soils, known as Parkland Garry oak communities. Common understorey plants included snowberry, Indian plum, camas and fawn lily. A mosaic of shrub-dominated communities and forb-dominated communities probably occurred in the landscape dependent on a variety of disturbances such as fire, both natural and by First Nations, and grazing by wildlife.

Almost all of this ecosystem type is now gone, as these were the first areas in the Victoria region that were cleared for agriculture and urban development. Many large Garry oak trees still remain, however most of these trees have lawns, roads, agricultural fields, golf courses or blacktop beneath them, rather than natural plant communities. The few examples of this ecosystem still remaining include a stand in Beacon Hill Park and areas at the Department of National Defence lands at Rocky Point, at the south end of Metchosin Municipality.

The second major Garry oak ecosystem type occurs on shallow soils and is often referred to as scrub oak ecosystems, as the oak trees are often of low stature, compared to those growing on deep soils. More of this ecosystem still remains, as many of these rocky areas were difficult to develop and have been left in Parks such as Mount Tolmie and Mount Douglas Parks, or in areas surrounded by houses, that were difficult to build on in early days. The understorey of these rock outcrop communities was originally dominated by many spring flowering perennial forbs, grasses and mosses. Much of this has been replaced by weedy species such as Scotch Broom, agronomic grasses and other weeds.

Many species at risk are associated with Garry oak ecosystems including 60 plant taxa, 2 reptile, 9 bird, 3 mammal, 1 earthworm, 9 butterfly and 7 other insect species (Garry Oak Ecosystems Recovery Team, 2000). These species include the golden paintbrush (*Castilleja levisecta*), apple moss (*Bartramia stricta*), earthworm (Arctiostrotus perrieri), leaf bug (*Ceratocapsus downesi*), Island marble (*Euchloe ausonides* – undescribed subspecies), which is extirpated, sharp-tailed snake (*Contia tenuis*), and Lewis' woodpecker (*Melanerpes lewis*), also considered extirpated.

Methods

Historical Garry oak ecosystems in Victoria and surrounding municipalities and Indian Reserves were mapped at a 1:20,000 scale. The Highlands Municipality was not mapped, due to a lack of data. These maps include areas where Garry oak was a dominant or co-dominant component of the ecosystem. Other areas had, and presently have, Garry oak as a minor component; these areas are not mapped or included in this analysis. The Garry oak historical mapping is based on original land surveys done in the 1850s and 1860s, available at the BC Crown Lands Registry Service, as well

as ecosystem mapping done by the Canadian Forest Service in 1976. Additional information was collected in field studies in 2001 and 2002. Expert opinion was used to determine areas that had the potential to support Garry oak ecosystems before urban, suburban and agricultural development took place in the greater Victoria area.

Mapping for 1997 was extracted from the Sensitive Ecosystem Inventory mapping done by the B.C. Ministry of Environment, Lands and Parks (Conservation Data Centre and MELP Nanaimo) and Environment Canada (Canadian Wildlife Service) (1997). For more information on this mapping see http://srmwww.gov.bc.ca/cdc/sei/.

More detail is available at www.goert.ca

Ted Lea, Biodiversity Branch, B.C. Ministry of Water Land and Air Protection. Victoria, B.C. Ted.Lea@gems2.gov.bc.ca

Genetic survey of Garry oak

The survey was conducted to assess genetic variability and assist with recommending gene conservation because of Garry oak's threatened status, and in guiding plant-transfer studies. Forty-two populations, 28 in BC and 14 in the US, covering 9º of the total 15º of latitude occupied by Garry oak, were chosen to cover topographic variations where known. Winter buds, 12-15 per tree, were collected from 17-33 well-spaced trees per population in 1996/97 from BC sources, and in 1998 from US sources. Isozyme analyses on bud primordia produced 65 allozyme forms ("alleles") in twenty-two variable enzymes. Nine and eight alleles were unique to US and BC sources, respectively. Genetic variation among sources accounted for approximately 8.5% of the total variation. When "rare" alleles were pooled and the same gene-diversity analysis was repeated, the results indicated that pooling of alleles had little effect on among-source variation. Thus, rare alleles had little effect on the groupings found.

Cluster analysis of all sources produced three outlying BC sources grouped separately from all others. US sources generally grouped together, leaving 24 BC populations in the largest group. Collections on either side of Georgia/Juan de Fuca Straits grouped separately. Among BC sources there was a general correlation between grouping and geographic distance; for example, North and South Pender Islands were paired, as were Cedar Hill and Government House, Victoria. However, the Yale source grouped with Comox and Denman Island. Helliwell Park (Hornby Island, BC) grouped with Redding, CA. Although the among-population genetic variation is similar to that of other oaks, the "patriotic/unique" distribution of alleles found in Garry oak is highly unusual. Garry oak's latitudinal and elevational range place it among the widest-distributed broadleaved species in North America.

Considerable genetic variation has been found, warranting consideration of local gene-conservation programmes.

As an adjunct to the data reported here, studies of DNA variation and Garry oak's mating system are underway at the University of British Columbia under the direction of Drs. Y. A. El-Kassaby and K. Ritland.

George Edwards; dgwe@shawcable.com
Mike Meagher; mmeagher@pfc.forestry.ca

Oak research at the Olympia Forestry Sciences Laboratory (volunteered paper)

Research on the biology and management of Oregon white oak or Garry oak (*Quercus garryana*) by the Silviculture and Forest Models Research Team in Olympia, WA was started in the late 1990s with funding from Fort Lewis. Current projects include maintaining an on-line bibliography for the species, and research on: factors influencing acorn productivity, effects of fire on acorn production and soil characteristics, techniques for establishing oak regeneration, effects of releasing oak from overtopping conifers, and developing landscape alternatives for oak management. Much of the research on oak management utilizes sites on Fort Lewis; however, many other cooperators are involved in various aspects of the project. The on-line bibliography has more than 800 citations for *Quercus garryana*, geographically associated and botanically related species, and for *Quercus* in general. It contains keywords, abstracts, and electronic links to information available on the internet. The study on factors influencing acorn production began in 1999. The survey is range-wide and uses volunteers to survey acorns produced each year; more than 1000 trees were surveyed in fall 2002. The study of releasing oaks from overtopping conifers is 2 years old; early results are favorable, including increased acorn production with the release treatments. The on-line bibliography, instructions for, and results from, the acorn survey, and updates on several of the other oak projects can be found on-line at: www.fs.fed.us/pnw/olympia/silv

Constance A. Harrington, David H. Peter, Warren D. Devine, Pacific Northwest Research Station, Olympia, WA
Contact charrington@fs.fed.us for information on the bibliography, dpeter@fs.fed.us for information on the rangewide acorn survey, and wdevine@fs.fed.us for information on the management studies.

Distribution and persistence of species on islands

Approaches to reserve design for Garry oak and associated species are likely to draw on theory to prioritize decisions on the size, distribution, and connectivity of managed reserves. However, relatively little is known about plant species richness and community structure in Garry oak meadows of B.C. prior to settlement by Europeans. This lack of knowledge impedes our ability to predict the response of oak meadow plant communities to habitat fragmentation, isolation or to current-day grazing by native and exotic species.

My colleagues and I have begun to survey many small islands in southern B.C. to create a database with which to describe statistically the effects of island size and isolation on the probability of occurrence for individual plant species, including many Garry Oak associates. We show here how logistic regression models can be used to predict the occurrence of plant species subject to colonization/extinction dynamics. We also show that some lilies used widely or not at all by First Nations Peoples in the region appear to be distributed in ways not predicted by standard ecological theory. Overall, we suggest that smaller islands un-impacted by exotic grazing and modern human development offer outstanding baselines against which to judge restoration efforts, and with which to predict the effects of reserve size, isolation and grazing on plant species richness and diversity.

Peter Arcese, Associate Professor, Centre for Applied Conservation Research
Forest Sciences, 3004-2424 Main Mall, University of British Columbia
Vancouver, BC. V6T 1Z4. Email: arcese@interchange.ubc.ca

Conservation planning for grassland butterflies in the Garry oak ecosystem

Two of the most endangered butterflies of BC's Garry oak ecosystems are Taylor's checkerspot and the island large marble. Both are associated with grasslands. Conservation planning for these species has included investigations of the ecology of the butterflies and their host plants, as well as experiments in habitat restoration.

James Miskelly and Don Eastman, Biology Department, University of Victoria, PO Box 3020, STN CSC
Victoria BC. V8W 3N5; 250-721-7118 Email: j_miskelly@hotmail.com

Impact of climatic change on northern butterfly populations

I am initiating studies that examine ecological and evolutionary influences on butterfly populations in Garry oak ecosystems. British Columbia's Garry oak grasslands represent the northern edge of an ecoregion that spans the coast of North America. They also house a suite of butterflies that vary in their specialization and dispersal capacity. I am harnessing this northern boundary and its butterflies as a model for examining geographic range shifts under climate change. In study sites that span from Rocky Point to Hornby Island, I am determining: 1) if latitudinal position or habitat quality predict butterfly abundance, 2) the degree of local adaptation of two focal species, *Erynnis propertius* and *Papilio zelicaon*, and 3) the amount of genetic differentiation among populations. I predict that easily-dispersing generalists, such as *P. zelicaon*, have the capacity to shift their ranges northward under climate change, but that specialists with limited movement, such as *E. propertius*, will be negatively affected by change even at their northern range limits. Data testing these predictions will be collected over the next several years.

Jessica J. Hellmann, Ph.D., Postdoctoral Fellow, 2001-2003, Centre for Biodiversity Research, University of British Columbia. 6270 University Blvd.,Vancouver, BC V6T 1Z4. Tel: 604-822-5937; Email: hellmann@zoology.ubc.ca

Insect biodiversity on Garry oak – the good, bad and beautiful

This presentation gave a brief overview of some of the more than 100 species of insects known to feed on Garry oak in British Columbia. Ultimately, this work will result in the publication of web-based and hard-copy identification guides to the Garry oak feeding insects of British Columbia. A colourful collage of images depicting over 50 species, including harmful (winter moth, jumping gall wasp, oak phylloxera, oak looper), beneficial (parasitoids and predators of harmful insects) and beautiful (innocuous species), were presented. Groups covered included defoliators (mostly Lepidoptera), gall formers, leaf miners, tent formers, acorn feeders, wood borers and sucking insects.

Bob Duncan, Entomologist, Pacific Forestry Centre, Canadian Forest Service, 506 W Burnside Road, Victoria, BC. V8Z 1M5. Email: rduncan@pfc.forestry.ca

Effects of native soil mycorrhizae on growth and survival of *Quercus garryanna*

I will plant *Quercus garryana* seedlings in three disturbed meadows in Victoria. Half of the acorns are being grown with native soil added (~15%/vol.) to the growing medium. I propose to investigate any correlation between presence and extent of mycorrhizal colonization of oak seedling roots with seedling growth and survival. This is a project in progress. My

purpose for presenting is to solicit feedback and advice to better construct my experiment and answer my research question.

Geri Poisson, University of Victoria, Victoria, BC; Email: geripoisson@yahoo.ca

Factors affecting Garry oak distribution in southwestern BC – a work in progress

Climate is widely accepted as the major limiting factor of Garry oak distribution. Through this study we hope to discover factors in addition to climate that may be limiting Garry oak range. We are using herbarium specimens and site visits to determine specific locations of current and historical Garry oak sites. Data are being collected on soil type and texture, bedrock, age of the surface, elevation, aspect, climate and distance from the coastline. We will be examining these data to determine how these factors may be combining and interacting to influence Garry oak distribution. Ultimately we hope to answer the question of why Garry oaks grow where they do, but, more importantly, why they are absent in other areas. This research will help us better understand the ecology of Garry oaks, in turn resulting in more successful restoration efforts.

Felice Griffiths, Royal British Columbia Museum. Co-op Student
Email: feliceg@uvic.ca. Phone: through Richard Hebda @ 250-387-5493

Some rare mosses of the Garry oak ecosystem

A number of rare mosses are found in Garry oak ecosystems. These include *Syntrichia (Tortula) laevipila, Endosthodon fascicularis,* and an as-yet-unidentified species of *Ephemerum*, a new genus to the province. The author found that *S. laevipila* var. *meriodinalis*, characterised by leaf-like gemmae in the axils of the upper leaves, was relatively widespread in more southerly Garry oak habitats. Further work was conducted with Dr. Terry McIntosh on the larger var. *laevpila.* Additional work is required to establish good parameters from small specimens of other *Syntrichia* species.

Wynne Miles. wynnemiles@shaw.ca

Ecosystem Dynamics and Analysis of Garry Oak Ecosystems

Biological considerations and recovery planning for five at-risk plants

Golden paintbrush (*Castilleja levisecta*), seaside bird's-foot trefoil (*Lotus formosissimus*), pacific sanicle (*Sanicula arctopoides*), paintbrush owl-clover (*Castilleja ambigua*) and rosy owl-clover (*Orthocarpus bracteosus*) are nationally imperiled species known from Garry oak or associated ecosystems on federal lands in the Victoria area. Field studies in 2002-3 have led to more precise mapping of these locations and documented their seasonal patterns of development and population processes. The presentation will show how this information can inform recovery planning.

Matt Fairbarns. Matthew.Fairbarns@gems1.gov.bc.ca

The Crow's Nest: Garry oak conservation by Trinity Western University on Salt Spring Island

Trinity Western University has stepped into the realm of Garry oak conservation with the Crow's Nest Property on Salt Spring Island, BC. Following an overview of the site, this presentation examines the range of currently pursued projects with onsite meadows.

Hannah Shriner; Honors Biology, Trinity Western University.
Email: hannahshriner@hotmail.com
Inquiries to Dr. David Clements: clements@agape.twu.ca

Invasive Species' Biology and Impacts

Sudden Oak Death -a new disease caused by *Phytophthora ramorum*

Sudden Oak Death, a disease caused by the fungus-like organism *Phytophthora ramorum*, was first observed in the early 1990's. Symptoms were seen on *Rhododendron* and *Viburnum* in Europe, and the disease was attributed to a new *Phytophthora* species. In the mid 1990's large-scale death of native oak species was observed in California. Through 2000, as reports of the disease spreading within California grew, so did concern within and outside of the US. In 2001, a UK researcher visiting the US identified the SOD organism as the same species reported in Europe. In response, the Canadian Food Inspection Agency (CFIA) developed a strong regulatory response to prevent the movement of the disease organism to Canada. In March 2001, Canada imposed import restrictions on commodities deemed to be high risk and originating from areas of the US and Europe known to have the disease. These included all propagative and non-propagative material including nursery stock, logs with bark attached, lumber, bark, mulch, acorns, sawdust, pulpwood and firewood, of all species of oak (*Quercus* spp.), tan oak (*Lithocarpus* spp.) and rhododendron (*Rhododendron* spp.), as well as soil alone or in association with plant material. As scientific understanding of the disease has progressed, Canada has relaxed some import measures such as regulatory controls applying to lumber, sawdust, fruits, etc. At the same time, new hosts have been reported and their import subsequently regulated. At present, Canada regulates the entry of 17 genera, many of which are imported horticultural species. The current version of the regulations may be viewed at:
http:///www.inspection.gc.ca/english/plaveg/protect/dir/d-01-01e.shtml.

The host range of this disease continues to grow. As of spring 2003, the following genera were reported as hosts in nature: *Acer* (maple), *Aesculus* (horsechestnut), *Arbutus* (madrone), *Arctostaphylos* (kinnikinnick), *Heteromeles* (California holly), *Lithocarpus* (tanbark oak), *Lonicera* (honeysuckle), *Pittosporum* (Victorian box), *Pseudotsuga* (Douglas-fir), *Quercus* (oak), *Rhamnus* (buckthorn), *Rhododendron* (rhododendron and azalea), *Rhus* (poison oak, sumac), *Rubus* (e.g. salmonberry, raspberry, blackberry), *Sequoia* (coast redwood), *Trientalis* (western starflower), *Umbellularia* (California bay or Oregon myrtle), *Vaccinium* (blueberries, huckleberries, etc.), and *Viburnum* (arrowood).

The known geographic distribution has also been expanding as intensive survey efforts are undertaken. SOD first observed along central Californian coast and it is presently confirmed in 12 CA counties & 1 county in Oregon. In Europe, SOD has been reported on *Rhododendron, Vibernum*, *Pieris* and *Camellia* in the Netherlands,the UK, Germany, France, Poland, Spain and Belgium. The pathogen has NOT been found on oaks or other forest trees in Europe. The disease has a highly variable symptomology: on oaks & tanoak:

sudden wilting, rapid decline, bleeding or oozing cankers, below-bark necrosis, leaves yellow then brown, and mortality are seen. On other hosts: leaf spots, tip or stem dieback, bark lesions, branch cankers are observed. Mortality is less common but occurs in some hosts, including huckleberry, arbutus, and rhododendron. The susceptibility of oak species is also variable (Table 1).

Table 1. Susceptibility of Oak species to *Phytophthora ramorum*

***Quercus* section Lobatae (red and black oaks)**	
Quercus kellogii	Natural host
Quercus parvula var. shrevei	Natural host
Quercus agrifolia	Natural host
Lithocarpus densiflorus	Natural host
*Quercus rubra**	Inoculated host
*Quercus palustris**	Inoculated host
***Quercus* section Quercus (white oaks)**	
Quercus douglasii	no inoculation success
Quercus lobata	no inoculation success
*Quercus garryana**	no cankers in forest but positive by inoculation

* native Canadian species

To date, following two years of concerted effort, Canadian regulatory and science professionals have not detected any occurrences of Sudden Oak Death (SOD) or its causal agent *Phytophthora ramorum* in Canada. Nevertheless, Canada's trade in horticultural and forest products, eco-tourism and other related trade with infested areas of the United States posed significant potential pathways for the introduction of this disease. For example, in 1999, prior to the establishment of any of regulatory controls for sudden oak death, Canada imported 1,865,900 units of live plant material from the state of California. Some of these plants bore the potential for introducing the pathogen. Canadian phytosanitary regulators, science professionals and horticultural and forest sectors were concerned about the potential impact of this disease and encouraged the establishment of regulatory controls. However, the resulting quarantine actions have not been without economic impact. Canadian importers and distributors of propagative plant material have had difficulty in accessing traditional product sources as result of controls or prohibitions applied to some of these commodities. At the same time, significant government resources have been expended in implementing regulations, providing personnel for surveillance activities and in engaging foreign authorities in monitoring exports. These activities that support Canada's current pest-free status are an integral part of on-going efforts to combat SOD.

A Canadian pest risk assessment (PRA) was completed which identified the potential distribution and host range of *Phytophthora ramorum* should it be

introduced to Canada, the means by which introduction could occur, and the potential magnitude of the economic and environmental impacts that could result. Limited knowledge about *P. ramorum*, its geographic distribution, host range, climatic requirements and biological impacts contributed to a high level of uncertainty in the assessment. Nonetheless, the PRA concluded that the potential consequences of introduction were high and that economic loss to both the forestry and horticulture industries and damage to susceptible flora in natural environments could be expected to occur in those areas where the organism could become established. Potential impacts were estimated to include direct and indirect losses to the horticulture industry through loss of markets and increased costs of production for rhododendrons and other species, and direct and indirect costs to the forest sector through impacts on oaks and maples in particular. Environmental impacts were estimated to be high due to the environmental significance of many of the known host species, particularly as understorey species in natural forest stands. Mitigation measures, including prohibiting the importation of plants or plant parts of known hosts, were recommended. The PRA provided the scientific basis for amendments to the import restrictions to minimize the risk to Canada with minimal negative impacts on international trade.

In addition to the direct impact on industry resulting from market access restrictions, significant financial and human resources have been expended in developing and implementing regulations. A small part of this was in the actual crafting of the necessary documentation, including the PRA, import policy documents and publications for public dissemination. A much more significant effort was made in undertaking a national survey to determine whether *Phytophthora ramorum* was present in Canada. The survey targeted Canadian nurseries that imported potential *P. ramorum* host material from California and Oregon from 1997-2002 as well as established botanical gardens known to feature susceptible host genera. Plant material from these nurseries and gardens and from known hosts within a 100 meter buffer around such the nurseries was sampled and cultured for diagnostic purposes. To date there have been no positive finds of *Phytophthora ramorum* in Canada.

In summary, while Canada currently remains free of Sudden Oak Death, its mere presence elsewhere in the world has resulted in an estimated domestic economic impact approaching 1 million CAD. This figure will grow as further trade impacts are felt and as surveys for the disease continue.

Eric Allen, Ph.D., Research Scientist, Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, 506 W Burnside Road, Victoria V8Z 1M5.
Email: eallen@pfc.forestry.ca

The gypsy moth: an alien insect threatening Garry oak ecosystems

The gypsy moth, *Lymantria dispar*, is a native insect of Eurasia. It feeds on a variety of broad-leaf trees, especially oak species. It was introduced to North America in the 19th century and is established throughout hardwood forests of the continent east of the Great Lakes and north of Virginia. Movement of people and commodities from these infested areas to western North America has resulted in repeated introductions. In 1999, an infestation centred in the city of Victoria resulted in a controversial aerial spray program that successfully eradicated the gypsy moth. Monitoring continues throughout the province and small infestations are watched closely.

The rate of new introductions to British Columbia has decreased in the past decade because of lower densities of gypsy moth in the source areas of eastern Canada and because fewer people have been moving into the province. However, gypsy moth populations are again increasing in the east and changing economic conditions will undoubtedly continue to influence movement of people and goods so that new introductions of gypsy moth will continue to be occur. Although the monitoring and treatment methods in current use are effective, more could be done to prevent these introductions at their source.

Vince Nealis, Ph.D., Research Scientist, Pacific Forestry Centre, 506 W Burnside Road, Victoria, BC V8Z 1M5. Email: vnealis@pfc.forestry.ca

Ecology, biology and management of invasive plants on federal lands near Victoria, B.C.

Gorse, Scotch broom, daphne, and English ivy are prominent, invasive plants that pose a serious threat to Garry oak and associated ecosystems. These plants colonize disturbed areas quickly, are persistent and difficult to eradicate, form dense monospecific stands that suppress and inhibit the growth of native plants, and ultimately have the ability to arrest forest succession. Several federal departments, including the Dept. of Environment, Dept. of National Defence, Dept. of Fisheries and Oceans, Dept. of Indian Affairs, and Parks Canada, have expressed concern regarding the rapid incursion, adverse impacts and arrest of these invasive plants. With a grant from the Dept. of Environment and the Dept. of National Defence, Dr. Raj Prasad at the Pacific Forestry Centre has been conducting research to examine the population dynamics, phenology and control of these invasive plants on federal lands near Victoria, BC. Of the several methods of control including manual cutting, application of a registered herbicide (*Release)*, a bioherbicide (*Chondrostereum purpureum*) and plastic mulch, it was found that few treatments (mulch and herbicide) confer 100% effectiveness on resprouting behaviour. The bioherbicide produced a variable response and manual cutting was least effective. A prospective bioagent was isolated from Daphne and preliminary results, under laboratory and greenhouse conditions, suggest that it may hold great potential for control. Continued and additional

research is necessary to determine the effectiveness of the different control treatments over a period of years. Details of these findings were presented and discussed at the Symposium.

R. Prasad, J. Sargent, J. Benner and S. Singh, Canadian Forest Service, Pacific Forestry Centre, 506 West Burnside Road, Victoria V8Z 1M5;
Email: RPrasad@pfc.cfs.nrcan.gc.ca

Herbivory and non-native plant competition in the Southern Gulf Islands

We will conduct comparative and manipulative experiments in insular Garry oak ecosystems to investigate the impact of herbivory, non-native plant competition, and the interaction between these two processes ('enemy release' hypothesis) on native plant diversity. Community ecology theory combined with biogeographic vegetation surveys will establish reference ecosystems to quantify restoration targets.

Emily Gonzales, Ph.D. student, Centre for Applied Conservation Research
Forest Sciences, 3004-2424 Main Mall, University of British Columbia
Vancouver, BC V6T 1Z4. Phone: 604-822-5841; Email: emilyg@interchange.ubc.ca

Effect of habitat loss and invasion by Scotch broom (*Cytisis scoparius*) on rare butterflies of Garry oak meadows

This project examines populations of rare butterfly species to specifically address several problems in Garry oak ecosystem conservation. These are 1) the effect of loss and fragmentation of habitat, and 2) the effect of degradation of habitat quality of Garry oak meadows due to rapid expansion of an invasive weed, Scotch broom.

Two networks of meadows (Maple Mtn. in Duncan ~ 100 sites, and Mount Maxwell, Saltspring Island ~ 120 sites) were surveyed for butterfly populations and composition of the plant community in Garry oak meadows. Several butterfly species were examined as focal species, but the following presentation of results is in regard only to Propertius duskywing *(Erynnis propertius*).

Preliminary analysis demonstrates significant positive relationships between butterfly populations and both increasing meadow size and density of oak trees, which is the only known obligate host plant. A negative relationship was found between butterfly populations and increasing isolation of meadows. From this preliminary analysis, the relationship between increasing cover of Scotch broom and butterfly populations was not significant, though this analysis covers only the data from one of two meadow networks. Data for year two are currently being collected to assess whether results remain consistent between years.

The butterflies are of interest themselves as threatened species, and also act as a representative indicator of the health of the ecosystem, which insects are often used to do. This study and analysis will allow assessment of the importance of individual meadows for overall metapopulation persistence, and will help identify the best locations for restoration, reintroduction, and conservation purposes to promote regional persistence of the species of interest.

Wayne Hallstrom, M.Sc. candidate, Dept. Biological Sciences, University of Alberta, Edmonton. Phone: (780)485-5024 or (250)537-0408 wayne.hallstrom@ualberta.ca

Decision support tool for managing invasive species in Garry oak ecosystems

ESSA has developed a decision support tool (DST) for GOERT that will help make decisions regarding whether, and how, to manage invasive species in Garry oak and associated ecosystems (GOEs) in BC.

The DST is intended for groups of people who are interested in engaging in well-planned stewardship activities over a period of several years. This includes agencies with management authority over GOEs (e.g. municipal or regional governments), local non-governmental groups interested in GOEs under the leadership of someone knowledgeable about these ecosystems, and private landowners interested in managing GOEs on their property, if they have some knowledge of GOEs or will work in association with someone who has this knowledge.

The DST was designed to be “accessible” to all users in the target audience, both physically and technically; to use standard, easily collected site attributes as inputs; and to incorporate principles of adaptive management. It is an easy-to-use, paper tool based on a decision framework in three sections: Part A) Ecosystem Characterization and Part B) Risk Assessment, to help users decide whether to manage for invasive species, and Part C) Management Actions to help users decide which actions to take, when, and where.

The DST will help with on-the-ground decisions regarding action against invasive species, and also help build knowledge regarding what works best in achieving GOE management goals, and help identify the key management uncertainties that need further research – linking research to management needs.

Acknowledgement:
This project was funded by the Habitat Stewardship Program of the Government of Canada, and by the Nature Conservancy of Canada. The

Invasive Species Steering Committee of GOERT provided project planning, coordination, and administration.

Carol Murray, Senior Systems Ecologist, ESSA Technologies Ltd. 1435 Brooke Street, Victoria, BC, V8S 1M4. Phone: 250-383-1190. Fax: 250-383-1174 E-mail: cmurray@essa.com Website: www.essa.com

Underground invaders: A proposal for research

Virtually all the earthworms now found in the Garry oak and associated ecosystems are relatively recent invaders of European origin. In other North American forest ecosystems these exotic earthworm species have had a tremendous impact, changing not only soil properties but also the composition of plant communities. On southern Vancouver Island, the situation is complicated by the occurrence of an indigenous species of earthworm, whose distribution, ecology and possible interaction with the invasive species are very poorly known. We propose research to investigate the implications of invasive earthworms for biodiversity, ecosystem conservation and restoration.

J. A. Addison, Science, Technology and Environment, Royal Roads University, 2005 Sooke Road; Victoria BC. V9B 5Y2 Jan.Addison@RoyalRoads.ca

Restoration Programs and Progress

Recruitment dynamics in an invaded oak ecosystem plant community

Recruitment dynamics were investigated at two oak ecosystem locations with seed and seedling addition experiments, and with seed bank analysis. The two locations differed in soil depth (>85 cm vs. < 10 cm). Experimental treatments included burning (twice in 2000); all plots were monitored for two years (2000-2002). Ten native plant species were added. Burning increased total survival of all seedlings derived from added seed by 4X (N = 2108 plants vs. 560 plants). Adjusting for the quantity of added seed, survival per species averaged 7.7% in burned plots and 2.1% species^{-1} in unburned plots. Total survival (seeds) was higher at the deep soil site due to greater abundance of the fire-sensitive *Poa pratensis*. There was almost no native plant recruitment in burned and unseeded plots, except those containing previously established adults. Survival of planted seedlings per species averaged 74.5% in burned plots and 28.6% in unburned plots. Close to 100% of the seed bank contained annual ruderal species, perennial exotic forbs, or Scotch broom. Less than 1% were native herbaceous species. Burning increased seedling establishment of Scotch broom by almost 25X (unburned = 3 seedlings plot^{-1}; burned = 70 seedlings plot^{-1}).

Andrew MacDougall, Dept. of Botany, University of British Columbia, Vancouver, BC. Tel: 604-822-2700 amacdoug@interchange.ubc.ca

Garry oak meadow restoration at the University of Victoria

The ecological integrity of Garry oak ecosystems on the University of Victoria campus has been a long-term concern. Recently, the Restoration of Natural Systems Program has partnered with Facilities Management to develop, plan and implement a Garry oak meadow restoration project. This project will provide an excellent opportunity for research as well as education.

Lisa Heinbuch, Restoration of Natural Systems Student, University of Victoria PO Box 1700 STN CSC. Victoria, BC V8W 2Y2; Email: lheinbuc@uvic.ca

Garry Oak on Department of National Defence lands

Canadian Forces Base Esquimalt is the major federal landowner in Southwestern BC, with 16 properties totaling 4,400 ha in area. Nine of these properties contain Garry oak stands covering 360 ha of land. Some of the challenges these stands face are invasive species, conifer encroachment, species at risk and slow recruitment. Through the implementation of a natural resources program the Canadian Forest Service and the Department of National Defence are protecting these stands as well as associated species

at risk. Researchers who wish to study these stands and associated species are welcome; there is a process in place to accommodate them.

Arthur Robinson, Federal Lands Program Officer**,** Canadian Forest Service, 506 West Burnside Road, Victoria, BC. V8Z 1M5 Tel.: (250) 363-0729;
Fax: (250) 363-0775; Email: arobinso@nrcan.gc.ca

Re-inventing "Broom Hill" restoration of Garry oak ecosystems and their associated plant species at risk, at Mill Hill Regional Park, Victoria, BC

Southeastern Vancouver Island contains some of the most threatened and sensitive ecosystems in Canada. This coast of the island is experiencing phenomenal urban and economic growth, often at the expense of native ecosystems and the organisms that inhabit them (Sensitive Ecosystem Inventory 1997). In particular, intact Garry oak ecosystems that were plentiful on southeastern Vancouver Island and the southern Gulf Islands prior to European settlement have been diminished to an estimated 5 per cent of their original range in Canada. Invasive plant and animal species have substantially degraded those that remain.

Capital Regional District Parks (CRD Parks) protect 10,230 hectares of natural landscapes on southern Vancouver Island in a total of 28 regional parks. Several regional parks protect remnants of Garry oak ecosystems (about 150 hectares), including approximately 20 hectares protected at Mill Hill Regional Park. However, the establishment of Scotch broom (*Cytisus scoparius*), a persistent and highly invasive non-native shrub, has degraded these ecosystems.

Garry oak and associated ecosystems provide habitat for 91 species of plants, mammals, reptiles, birds, butterflies and other insects, and an earthworm, that are currently listed officially as "at risk of extinction" (GOERT 2002). Several species have already been eliminated. At Mill Hill Regional Park, there are 10 species of rare vascular plants, 2 non-vascular plant species and a rare butterfly associated with the Garry oak ecosystems (CRD Parks 2001). One plant, deltoid balsamroot (*Balsamorhiza deltoidea*), is listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered and two more, purple sanicle (*Sanicula bipinnatifida*) and white-top aster (*Aster curtus*), are threatened.

The primary strategic direction described in the CRD Parks Master Plan (2000) is protecting and maintaining the natural environment of regional parks. In 2002, CRD Parks initiated a restoration planning process, which led to a draft Restoration Plan for the Garry oak ecosystems and their associated species at risk of Mill Hill Regional Park. Ecological restoration is a complex process, and a concerted, planned approach is preferable to addressing conservation issues in a piecemeal manner. The plan at Mill Hill outlines a long-term, multi-phase approach devised to make a concerted effort to

manage Scotch broom and other invasive plant species, with the objective of enhancing the habitat of rare plant populations.

Late in 2002, phase I of the restoration plan was initiated with the removal of Scotch broom and daphne (*Daphne laureola*) from approximately 1.2 hectares of the Garry oak ecosystems in the park. This effort required an estimated 500 person-hours of labour and resulted in over 5.5 metric tonnes of invasive shrubs being heli-lifted from the park. The logistical constraints involved in a coordinated restoration effort will be discussed. As well, the next steps in this restoration project will be outlined, including long-term vegetation and soil monitoring pre and post removal of Scotch broom. Permanent photo-points have been established to keep a qualitative visual record of the ecosystem changes over time.

Tracy L. Fleming, Environment Protection Specialist, Capital Regional District Parks
Email: tfleming@crd.bc.ca and **Louise K. Blight**

GOERT's propagation of native plants for Garry oak ecosystem restoration

The Native Plant Propagation Steering Committee (NPPSC) was established as part of Restoration & Management Recovery Action Group (R&M RAG). The objective of the NPPSC is to promote development of an adequate supply of native plants for restoration and management activities. The tasks undertaken by the NPPSC to achieve this objective and the progress made on each are as follows:

1) Establish steering committee – DONE
2) Compile & disseminate information – in progress
3) Develop research strategy – in progress
4) Grower support – in progress
5) Develop ethical guidelines – drafted
6) Develop and distribute public educational information – in progress

Species propagation fact sheets for about 100 species are being developed by the Committee. The plants have been selected from keystone species and species important in restoration. Information being compiled includes; names; description; range and habitat requirements; restoration uses (wildlife, traditional, etc.); propagation details; and references.

Work towards development of a research strategy has as its initial step the identification of research needs. We will focus on 15 – 20 species, and invite students to work on specific species or groups of species. We expect there will be a need for ecological as well as propagation information for the selected species.

In the area of grower support, the NPPSC sent questionnaires to nurseries to determine what support was needed. Six larger nurseries and 8 smaller

growers completed the questionnaire. All large growers are wholesale, while three quarters of small growers are wholesale. Fifty-seven percent of the nurseries contacted have grown native species for 5-10 years, while 43% for more than 10 years. A variety of ways to encourage the industry has been considered, including ordering quantities of a variety of species; encouraging a diversity of growers specializing in different groups; and coordinating growing with restoration work that is being undertaken.

The NPPSC has developed a draft set of basic guidelines on the collection and use of native species. These stress the importance of using caution when collecting to avoid damage to populations; to collect inconspicuously; to know the flora to avoid collecting the wrong species and to avoid collecting rare species. The key elements of the guidelines are to never endanger populations.

The NPSSC is working on providing information for the public on plants to select for landscaping (avoiding alien invasive species); information on how to grow native species and the benefits of using native species.

Dave Polster, Polster Environmental Services Ltd. 5953 Deuchars Drive, Duncan, BC. V9L 1L5; Email: dpolster@telus.net

Habitat Stewardship Program for species at risk: A brief overview

The HSP program is designed to encourage stewardship projects across Canada: conservation work within communities / done by communities. The Program's goal is to contribute to recovery and protection of habitat for priority listed (COSEWIC) species at risk (SAR), so there is a focus on projects that have sites hosting SAR or work that will benefit SAR. Projects range from: control of invasive species, restoration work, developing community plans/guidelines, focused outreach: eg. landowner contact to protect riparian habitat for endangered yellow-breasted chats; Game Guardian Workshop training wardens about SAR & their threats.

NB: HSP does not fund research, and broad outreach projects. The submissions guide will be available around September. We are hoping to make it available by links on the Canadian Wildlife Service and Environment Canada homepages.

HSP works closely with Recovery Teams. For Garry Oak Ecosystem projects, Marilyn Fuchs coordinates most of the work on behalf of the Recovery Team, so if you would like to apply for HSP funding, it would be good to contact Marilyn (Marilyn.Fuchs@goert.ca) to find out what GOERT and other partners are doing already, and how your project can complement work underway. For information on the Species at Risk Act (SARA) consult www.speciesatrisk.gc.ca

Tasha Smith, email: Tasha.Smith@ec.gc.ca

Education and Public Outreach

GOERT: What is it; What does it do; How can you help?

"GOERT" is the acronym for the Garry Oak Ecosystem Recovery Team, a group of about 80 people dedicated to assisting the recovery of Garry oak and associated ecosystems. GOERT is a partnership of more than 30 organizations, including: non-governmental groups, all levels of government, one First Nation, academic institutions, volunteers, and contractors. It is guided by a Recovery Strategy approved by federal agencies responsible for Species At Risk legislation and is endorsed by three quarters of the local governments within the range of Garry oak ecosystems. This was one of the first recovery strategies to address entire ecosystems as well as individual species.

GOERT is comprised of eight Recovery Action Groups (Rags) and three steering committees (SCs). Some of the RAGs and SCs are involved in promoting and facilitating scientific research to increase knowledge about Garry oak ecosystems, species at risk, invasive species, plant propagation and other related information. Others are tasked with identifying and securing priority sites for protection; inventory and mapping work and stewardship initiatives. GOERT is engaged also in public education and extension activities to increase awareness of, and ways to protect and restore these rare ecosystems. Primary audiences include: local government staff and elected representatives, neighbourhood and ratepayers' associations, land owners and managers, the development community, academics and students, natural history groups and other sectors of the general public. GOERT disseminates information through workshops, seminars and presentations, articles and media interviews, brochures, posters, field manuals, a display at public venues and events, and the GOERT website (www.goert.ca).

The GOERT website contains several references and resources that may be of interest to researchers: the Recovery Strategy, a literature review, annotated bibliographies, field manuals for invasive species and species at risk, and a Decision Support Tool (DST) for Invasive Species (Scotch broom, English ivy, and non-native blackberries). The DST and field manuals encourage scientific analysis of each site prior to commencing restoration activities to prevent inadvertent damage of rare species.

For more information about GOERT, please contact:
Chris Junck, Public Involvement and Extension Specialist,
Garry Oak Ecosystems Recovery Team,
202 - 26 Bastion Square, Victoria, BC. V8W 1H9.
Email: Chris.Junck@goert.ca"
Website: www.goert.ca

GEEK: Developing and Encouraging GEEKiness

In January 1999 a group of Garry oak ecosystem enthusiasts gathered around a boardroom table at the Saanich municipal hall and began an ambitious project to help educate people about Garry oak ecosystems. The group was made up of representatives from a number or organizations involved in recovery and education efforts including: Swan Lake/ Christmas Hill Nature Sanctuary, the Municipality of Saanich and the Garry Oak Restoration Project, the Garry Oak Meadow Preservation Society, the Native Plant Study Group, CRD Parks and Wild BC of the Habitat Conservation Trust Fund as well as other interested individuals. This group has become known as the "GEEKs", which stands for Garry oak Ecosystem Education Kit (the first name of our project).

The project the committee is working on has become a draft resource titled, *Garry Oak Ecosystems of British Columbia: an Educator's Guide*. This resource is being developed as an important tool for formal and non-formal educators and will fit into the school curriculum for kindergarten to grade 8. Once the resource has been completed and printed, it will be managed by Wild BC within their "family" or network of environmental education resources (such as Project WILD and BC resources such as Wildlife Trees of British Columbia). Wild BC will conduct workshops for educators so that they will receive the Educator's Guide along with hands-on training on Garry oak ecosystems and the activities within the resource.

The Educator's Guide includes background information on Garry oak ecosystems, a conceptual framework which the activities have been based on, 14 hands-on activities, education tools to reproduce, and extensive appendixes including lists of organizations, restoration sites, activity cross-references, resource lists and websites. Draft #1 of the Guide has undergone pilot workshops, reviews and activity pilots with a variety of education professionals. Draft #2 will soon be ready for final piloting/review before it goes for technical review and printing. It is anticipated that the resource will be completed by this year.

Education is one of the key tools we have in Garry oak ecosystem protection and recovery. It will be a great leap to have education and action projects for young people being conducted within the schools, community youth organizations, increasing in parks and in other protected areas. Through the pilot process of this project we have already seen an incredible level of enthusiasm from all the teachers and other educators involved. Converted GEEKs are multiplying!

To find out more or to contribute to the GEEK project, contact:
Carolyn MacDonald, Environmental Education Officer, Municipality of Saanich, 770 Vernon Ave
Victoria, BC V8X 2W7.
Phone: 475-5494 local 3477 Email: macdonac@gov.saanich.bc.ca