

GARRY OAK ECOSYSTEMS RECOVERY TEAM

RESEARCH COLLOQUIUM 2005

Pacific Forestry Centre
Canadian Forestry Service
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Garry Oak Ecosystems Distribution and Classification

Historical Garry oak ecosystems of the Comox Valley and Hornby/Denman Islands

A map compares the 1800 and 2004 distribution of Garry oak ecosystems in the Comox Valley and Hornby/Denman Islands. This is the fourth map of a series of historical oak ecosystem mapping that started in the Victoria area and subsequently has covered the Cowichan Valley, Saltspring Island and Nanaimo/Parksville areas of Vancouver Island, BC.

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 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 or Woodland Garry oak communities. Common understorey plants included snowberry, Indian plum, camas, bracken fern, grasses 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 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 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 for agriculture or housing. 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).

Methods

Historical Garry oak ecosystems were mapped at a 1:20,000 scale. These maps include areas where Garry oak was a dominant or co-dominant component of the ecosystem. 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. Additional information was collected in field studies in 2004. 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 this area.

More detail is available at www.goert.ca.

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Biology of Garry Oak and Associated Species

Mating system of Garry oak

Nut collections were made from 2 populations near Victoria, B.C. to permit evaluation of mating system. Buds from one-year-old seedlings, 10 seedlings per parent, were screened for enzyme systems and the results analysed separately for female and male components via the MLTR program. Single and multi-locus analyses of outcrossing rate, and pollen-pool heterogeneity, are compared by population. Most seedlings arose from outcrossing, but correlated males imply local relatedness or pollen-cloud irregularity.

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Surveys for terrestrial gastropods in Garry oak woodlands

To obtain information on species composition and presence of species at risk, we surveyed Garry oak woodlands and other habitats at DND properties (Rocky Point and Mary Hill) on southern Vancouver Island in 2002. We located 16 native and 7 introduced species of gastropods. The gastropod fauna of Garry oak habitats consisted of a mixture of interior forest and open area species. Garry Oak woodlands are susceptible to invasions by introduced gastropods, which were particularly common at one of the sites surveyed (Mary Hill). Another, ongoing pilot study in Garry oak woodlands investigates terrestrial gastropod faunas on Mt. Maxwell, Salt Spring Island, in relation to grazing by ungulates.

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Follow-up to bird surveys conducted from 1999 – 2000 in Garry oak woodlands

Systematic point count and brood surveys of birds were conducted in the spring of 1999 and 2000 at 28 sites (82 plots established) in Garry oak-dominated habitats in the Greater Victoria area. We propose to re-survey these sites using the same methods, plot locations and observers, provided funding can be obtained. The purpose of the study is to monitor trends in the abundance and productivity of birds in Garry oak woodlands and secondarily, to determine whether there were any long-term effects of the application of Btk-pesticide in 1999. We also propose to assess the quality of bird habitats within Garry oak woodlands in the areas surveyed.

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Ongoing research activities on the Mt. Maxwell Ecological Reserve, Salt Spring Island

The Mt. Maxwell Ecological Reserve houses the most extensive stands of Garry oak and associated vegetation in the province. Many scientists have visited the Ecological Reserve over the past many years, and have accumulated important information on rare species, plant communities, and other features. However, a great deal of research needs to be completed before the full natural values of this property can be assessed. Ongoing research initiatives include documentation of rare plants, including *Lomatium grayi*, and rare animals, including the sharp-tailed snake. An investigation of the effects of feral sheep and deer on vegetation is being undertaken with the aid of three large exclosures. The area is heavily infested with a number of exotic species, and the large-scale removal of Scot's broom is underway. Research projects are encouraged, although a permit through BC Parks is necessary.

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Studies on the adaptation and dynamics of contrasting butterfly species at their edge of the range

We present protocols and preliminary results from studies on butterfly populations at the edge of their geographic range in Garry oak meadows. Population size, resource availability, climate, genetic similarity, and local adaptation using caterpillar growth are measured to assess if populations are marginal or adapted to their range edge. Abundance is observed for all species, but studies focus on two contrasting species - *Erynnis propertius* and *Papilio zelicaon*. Data are collected over several years to account for inter-annual variation. These studies will be used to predict which species will increase or decrease under climatic change.

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Seed dispersal and disturbance by Canada geese (*Branta canadensis*) and their effects on plant community composition in British Columbia's protected Gulf Islets

Canada geese nesting in the Gulf Islets appear to be disturbing native plant communities by trampling, grazing, and nutrient addition. Geese may also be dispersing non-native seed. For my M.Sc. research, I will measure impacts on community composition using open and exclosed plots at 25 sites on 13 islets.

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Phylogeography of the rare slim-leaf onion in BC

Molecular phylogeographic studies of triploid and tetraploid populations of the slim-leaf onion in BC show that these cytologically distinct populations are also genetically divergent. However, overall levels of genetic diversity in this species are very low in BC compared to CA. This is consistent with a pattern that is emerging which shows that within a species, genetic variation decreases with increasing latitude.

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Garry oak insects of British Columbia: identification and feeding habits

This presentation gave those attending the Colloquium a brief overview of some of the more than 100 species of insects known to feed on Garry oak in British Columbia. A colorful 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 innocuous species, were presented. Groups covered included defoliators (mostly Lepidoptera), gall formers, leaf miners, tent formers, acorn feeders, wood borers and sucking insects.

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Ecosystem Dynamics in Garry Oak Ecosystems

Roots of the deep past: Values and applications of integrative ethnoecological research on camas landscapes

The future for Garry oak ecosystems should have its “roots” in the deep past, rather than in the shallow present. To reconstruct, or tell the story of, our cultural landscape, the language used can have Indigenous origins (traditional environmental knowledge), and can be based in western ways of thinking (academic-focused science). Each has important information to contribute to this story. The integration of these languages is at the heart of ethnoecological research. Camas, with its long cultural and environmental histories, is an apt case study for this reconstruction. No other food plant in the oak-camas parklands has such a past. I used an interdisciplinary and multiscale research design to study former Straits Salish management of camas bulbs, and how specific human-environment interactions affected the cultural landscape.

Results from the nursery study showed limited mortality and patterns of dormancy (opting-out of annual growth) of *Camassia leichtlinii*. Most of the plants were flowering regularly by the end of the study period, but camas has the capability for both flower production and bulb division. The number of offset bulbs increased over time, and many of the offsets also produced flowers. Furthermore, the bulbs substantially increased in size and became heavier over time. Results from the field study revealed that the study sites in shallow-soil ecosystems are extremely variable, so assessing treatment effects proved difficult. The two species of camas (*C. leichtlinii*, *C. quamash*) have different ecological requirements, but they actually grow together more often than I previously knew. The two species do not generally co-dominate (in this context: dominant = flowering) when they grow together. The dominant species appears to depend on disturbance patterns, and likely site history. These ecological results along with results from the analyses of qualitative research were integrated into a Camas Management Model, the principal outcome of this research. This model showed the ethnoecological effects of three integrated scales of cultivation and the major landscape features of the dynamic camas landscape. It was the totality of multiscale management activities working in concert with one another that maintained available and reliable quantities of camas bulbs of a culturally desirable quality.

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Scotch broom's ecological effect on the Garry oak ecosystem via soil nutrients

Scotch broom, an invasive shrub with nitrogen-fixing bacterial associations, has the potential to alter levels of available soil nutrients in Garry oak habitat. There is concern that increased available soil nitrogen will facilitate invasion by other introduced plant species. In this project, soil nutrient and other broom-related ecosystem effects are quantified.

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Effects of herbivory and competition from exotic grasses on the composition of Garry oak coastal bluff ecosystems in the Gulf Islands of BC.

Protecting land is a key response to the loss of biodiversity, but protection does not always maintain species diversity or ecological integrity. Mechanisms such as herbivory and the spread of exotic plants can continue to degrade ecosystems. I am examining the relative influence of herbivory and competition from exotic grasses on the composition of Garry oak coastal bluff ecosystems in the Gulf Islands of BC. I will present the results of an exclosure/neighbour removal/species addition experiment that illustrates the impacts of herbivory, competition and dispersal. Comparisons of sites in the archipelago show that high levels of herbivory have a negative impact on native vegetation.

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High-resolution fire and vegetation history of Garry oak ecosystems in coastal British Columbia

We used macroscopic charcoal (>125 µm diameter) and fossil pollen from two ²¹⁰Pb-dated lake sediment cores to reconstruct local fire and vegetation histories within the northern range limit of Garry oak (*Quercus garryana*) ecosystems (GOEs), from ca. 1748 AD to present, at 2-5 year intervals. Several peaks in charcoal abundance prior to European settlement are interpreted as wildfires. Post-1860 charcoal peaks are interpreted as mainly land clearing fires. A significant decline in charcoal abundance after ca. 1935 is attributed to fire suppression. Variations in pollen abundance and species indicate land clearing and related disturbances; introduced exotics were also found.

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The effects of herbivory and invasive species competition on Garry oak seedling growth

Garry oak (*Quercus garryana*) seedling growth is a key indicator of the health of Garry Oak meadows. Herbivory by ungulates and competition from invasive grass species have raised concerns over long-term seedling recruitment. Although other species may be affected, results show that Garry oak seedlings are robust against grazing pressure.

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Restoration Programs and Progress

Removing conifers to restore habitat for Taylor's checkerspot butterfly in Helliwell Provincial Park

Studies of the habitat requirements of Taylor's checkerspot butterfly suggest that forest encroachment has eliminated high-quality habitat in Helliwell Provincial Park. Ten Douglas-firs were removed from grassland areas in 2003. Treatment has resulted in a mix of native and exotic vegetation. Species underrepresented in treated areas are native graminoids and plants important to Taylor's checkerspot. Tree removal has therefore been partially successful at restoring grasslands, but has not restored butterfly habitat.

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Research and monitoring on the Crow's Nest Ecological Research Area: an overview

Since 2000, the Crow's Nest Ecological Research Area on Salt Spring Island has been used by Trinity Western University for teaching and research. This Garry oak meadow complex is an ideal site for studying species biology, ecosystem dynamics, and ecological restoration. This talk will provide an overview of current and future research on the Crow's Nest.

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Douglas-fir encroachment and management in Garry oak meadows

Douglas-fir (*Pseudotsuga menziesii* spp. *menziesii*) encroachment threatens the Garry oak meadows on the Crow's Nest Ecological Research Area. Douglas-fir release, in conjunction with planting native species, is a potential restoration method. This project begins a long-term study on Garry oak ecosystem response to Douglas-fir release.

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Soil transfers as mycorrhizal inoculant to increase growth of Garry oak (*Quercus garryana*) seedlings

The use of soil transfers to inoculate Garry oak seedlings with native ectomycorrhizal fungi and their effects on growth were investigated. After the first season in the greenhouse, seedlings grown in native soil showed 80% greater mycorrhizal abundance and 230% greater diversity in morphotypes. These seedlings also showed greater differences in root collar diameter (14%) and seedling weight (10%). During the second year in the field, seedlings grown in native soil showed greater growth but these differences were not statistically significant.

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Impacts of climate change and fire on the ecological integrity of Garry oak ecosystems: an active management approach for Parks Canada

Parks Canada has established a national park reserve in the Gulf Islands of southern BC and Garry oak ecosystems exist within the park. In order to manage the park the understanding of fire history is essential. We are undertaking a multi-year study examining the paleoecology, dendroecology, ecological and climate modeling of Garry oak ecosystems. The first phase of this study uses pollen, charcoal, and dendroecological analyses to examine ecosystem responses to European colonization, subsequent changes in land use and fire suppression. We examine the characteristic changes in community structure and examine implications to the long-term conservation of these "at-risk" ecosystems.

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Taking action - adaptive management of plant species-at-risk

The Garry Oak Meadow Ecosystem Recovery Strategy identifies invasion by exotic species, including plants and vertebrates, as a serious and increasing threat to the Garry oak ecosystem and its associated species. Federal land managers, faced with the task of providing stewardship to rare plants that are being threatened by invasive species want to know, for sure, that these actions do not further jeopardize the species-at-risk (SAR). Adaptive management enables action to occur. Adaptive management does not postpone action until "enough" is known but acknowledges that time and resources are too short to defer *some* action, particularly actions to address urgent problems such as declines in the abundance of valued biota. The overall objective of this project is to implement adaptive management activities to recover five species-at-risk (*Lotus formosissimus*, *Sanicula arctopoides*, *Lupinus densiflorus* var. *densiflorus*, *Sanicula bipinnatifida*, and *Seriocarpus rigidus*) in the Garry oak ecosystem on federal lands. Observations of the species on a continual basis enable alteration of management regimes to mitigate negative impacts.

In the case of *S. arctopoides* and *L. formosissimus*, the threats arise from invasive plant species degrading habitat and from deer/rabbit browsing. It is postulated that these factors impact the species' vigour at the site. Our goal is to remove the woody invasive species from the area adjacent to the selected subpopulations and place mesh cages over individuals to protect them from browsing. An additional component of this project is to determine the level of protection Scotch broom provides to *S. rigidus*. The subpopulations are threatened by invasive species from habitat degradation and loss. However, experts have debated the impact of Scotch broom on this SAR questioning whether the invasive provides protection from deer browsing. Consequently, to prevent management errors and put the species at further risk; we must first determine the impact of this removal on predation from herbivores (deer and rabbits) on a small scale. Future management strategies can then be developed based on these results. *Sanicula bipinnatifida* and *Lupinus densiflorus* var. *densiflorus* is being threatened by habitat degradation (soil erosion facilitated by human activities) and encroaching invasive species. At the site, people taking shortcuts to the shoreline have created pathways down a steep slope and through the subpopulations. Our goal is to plant a living fence on the crest of the upper slope of the subpopulation and thus redirect foot traffic to the formal pathways and away from the species at risk. This will prevent trampling and further soil erosion. In addition, signage will be installed to educate the public on the species at risk and the Garry Oak ecosystem.

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Testing site preparation and planting methods for restoring a Garry oak community, University of Victoria campus

Randomized and replicated planting schemes nested in different site preparations are complete at the entrance to University of Victoria campus, in a historic and remnant Garry oak ecosystem. We are monitoring the plots to answer the question: what are effective ways of converting old-fields and lawns, dominated by exotic species, into communities with a high component of native species? The site preparations, including solarization, mulching, scalping, and tilling, were designed to be practicable by landowners on small to large scales.

The planting was done with seedlings available from several growers and seeds were sourced in an ethical manner from local diverse populations. The successful result will be a vernal wet meadow ecosystem with over a dozen re-introduced native species. The work was preceded by meetings with specialists and local residents, since the project is part of a long-term restoration program. Volunteers from the campus and neighbourhood have helped with designing, initial sampling, planting, and sowing. Results will be collected for several years and maintenance processes, such as mowing or burning will be considered when an initial community has stabilized. This project has been made possible by cooperatively working with students, groundworkers, and the community, involving several partners including the Songhees Nation, Garry Oak Ecosystems Recovery Team, Pacific Forestry Centre, School of Environmental Studies, the UVic Sustainability Project, and UVic Facilities Management.

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