GARRY OAK ECOSYSTEMS RECOVERY TEAM

RESEARCH COLLOQUIUM 2006

Pacific Forestry Centre
Canadian Forestry Service
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ABSTRACTS OF PRESENTATIONS

Garry Oak History, Distribution and Biology

Historical Garry oak ecosystems of Vancouver Island: A summary - 1800 to 2005

Maps have been compiled that compare the 1800 and early 2000s distribution of Garry oak ecosystems on Vancouver Island. This includes a series of maps of historical oak ecosystem mapping that started in the greater Victoria area and subsequently has covered the Cowichan Valley, Saltspring Island, Nanaimo/Nanoose and Comox/Hornby Island areas of Vancouver Island, BC.

Overall, less than 10 percent of the original ecosystems remains, and this is only in isolated, fragmented areas that mostly have no connection to other Garry oak communities, thereby preventing migration of populations or mixing of genetic material of most species from one area to another. The maps of historical distribution of Garry oak ecosystems depict 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.

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 deep soil 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 ecosystem, 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.

Final results indicate that less than 1.5 per cent of deep soil Garry oak ecosystems remain, and that less than 45 per cent of shallow soils Garry oak ecosystems remain, on Vancouver Island. Overall, less than 10 per cent of the original Garry oak ecosystems that occurred prior to European settlement

remain on Vancouver Island. Development is still occurring on the remnants, as no protection exists for these ecosystems at risk, unless they occur in protected areas.

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, sketch maps of land cover and land use, historical photographs and paintings, soil and terrain mapping, and other sources. Additional information was collected in field studies between 2000 and 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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Growth rates and acorn frequency of Garry oak

Growth rates, collected opportunistically from Garry oak stumps of inconsistent height on various sites near Victoria, BC, were obtained by counting rings, recording decadal radius, then calculating and plotting both decadal area and total area, plus stump diameter to harvest. Estimated tree ages ranged from about 170 to 360 years. Stump diameters showed steady growth, as did total stump area. Decadal stump area growth was highly variable, even after 200 years, perhaps reflecting change in habitat. Such data are useful in answering questions re “How old is my tree?” “It depends” is the only proper reply.

Acorn crops on 16 trees in Victoria, apparently from natural regeneration, were examined using binoculars for 4 years to assess variation in a single stand and among years. Assessment was conducted by quarter (N, S, E, W) of the crown of open-grown trees. The west and south crown quarters bore more fruit than the east and north sectors. All but one tree bore fruit in most years and all but one other tree produced the heaviest crop in 2004, which was a “mast” year. Assessment was most difficult in lighter crop years, when leaf “scorching’ by insect predation reduced ease of seeing acorns. Possible factors affecting crop variation were discussed.

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Grasshoppers and crickets of the Garry oak ecosystem

Of the thirty-one species of grasshopper and cricket recorded from Vancouver Island, at least eighteen occur in Garry oak and associated ecosystems. Most occur also in other habitat types and other geographic areas. At least two species are restricted in both range and habitat preference, and may be at risk in Canada. Identification and natural history of all eighteen species are discussed.

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Fragmentation and plant and pollinator diversity (and why it matters in the GOE)

Ecologists increasingly include pollination as an ecosystem service, along with such processes as water purification and decomposition, because as much as 30% of our global food production relies on insect pollinators. Fragmentation of the Garry Oak Ecosystem (GOE) has the potential to disrupt plant-pollinator interactions with negative consequences for both the wildflowers (whose seed production could be reduced without insect visitation) and the pollinators (whose population sizes may decline when habitat disappears).

In 2005, I assessed pollinator diversity in eight fragments of the GOE. At two-week intervals, I surveyed wildflower diversity using stratified-random placement of 0.25 m^2 quadrats (20 quadrats per site and date), and pollinator diversity using 60 pan traps per site and date. Pan traps are small colored bowls (blue, white, or yellow) filled with soapy water; bees are attracted to the bright colors and drown.

I trapped 3899 bees, plus approximately 700 flies and wasps at the eight sites. Identification of bees is ongoing, but has been completed to genus and morphospecies within genus; 51 morphospecies in 22 genera and 6 families, including 5 cleptoparasites and the European honeybee, were identified. Bee diversity and the distribution of bee families captured varied among fragments, as did patterns of visitation by bees to wildflowers. The introduced honeybee was found at only three locations and was observed visiting only Camas, suggesting that native bees are responsible for almost all of the pollination services in the GOE. Bee diversity (measured as species richness) increased with the size of the GOE fragment, but plant diversity was unrelated to fragment size. Further analysis of the importance of introduced plants for the diversity estimate is ongoing, and future work aims to determine whether reduction in bee species richness in small populations translates into a pollination deficit (reduced seed production) for native wildflowers.

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Rare bryophyte elements in Garry oak ecosystems, including new species to Canada

Many bryophytes (including mosses and liverworts) are restricted to Garry oak and nearby ecosystems, and some of these are rare both provincially and federally. As research expands into discrete habitats within these ecosystems, especially vernally-wet seeps, distributions of rare taxa are being expanded and new species to BC and Canada are being discovered.

A number of discoveries were made in 2005 in a large open seep on Channel Ridge in the northerly section of Salt Spring Island. For example, the largest known patches in Canada and possibly North America of the rare moss, *Entosthodon fascicularis* (the banded cord-moss), were found. Also, we discovered four species of the liverwort genus *Riccia* that are new to Canada, found, to date, only in the southern US. Only one of these species, *Riccia ciliata*, has been confirmed at this time, and identifications of the other species are pending. We may also have discovered a new species, to science, of the liverwort genus *Asterella*, but this also needs confirmation.

We encourage researchers not to overlook these often inconspicuous taxa in their studies. Thanks especially to the Salt Spring Island Conservancy, as it is mainly through their efforts towards inventory of threatened habitats that the richness of rare bryophyte in vernal seeps is being clarified.

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Ecosystem Dynamics and Analysis of Garry Oak Ecosystems

Garry oak savannah dynamics in the Gulf Islands National Park Reserve: pattern and process of stand change

The conditions that maintain temperate savannahs are poorly understood and probably variable. Garry oak (*Quercus garryana*) savannahs in BC are particularly complex due to a history of First Nations influence. Historical photographs and writings suggest that many Garry oak savannahs were open grasslands with scattered oaks at the time of European arrival.

We are using tree-ring analysis to reconstruct stand composition and structure at eight sites on southern Vancouver Island and the southern Gulf Islands. Sites were selected to represent a variety of environmental conditions and land use histories. Most of the stands, regardless of their history, appear to be encroached by conifers (*Pseudotsuga menziesii*). In addition, the frequent presence of large numbers of oak seedlings in many of these stands, but few saplings, suggests that Garry oak and its understorey associates may eventually be excluded at most sites. Site-specific differences in stand composition, structure, and understorey associates will be interpreted in the context of environmental and geographic factors, land use history, patch size, and adjacent land use.

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High-resolution fire and vegetation history of Garry oak (*Quercus garryana*) ecosystems in coastal British Columbia

Fossil pollen and macroscopic charcoal (>125 µm) from sediments of three lakes were used to investigate effects of climate and human activity on fire and vegetation histories of Garry oak ecosystems (GOEs) in coastal British Columbia. Sediment records from Roe and Quamichan Lakes span the last 250 years; Florence Lake's record spans the last 560 years. Sampling intervals span 3 to 10 yrs.

Roe and Quamichan records show low fire activity before ca. 1780 AD. Increased fire frequency and variability ca. 1780-1860 reflect climate instability observed elsewhere in the region, and possibly changes in First Nation burning practices. Following a large fire event, Garry oak at Quamichan Lake decreases significantly ca. 1830 and does not recover. Following European settlement ca.1860, fire event frequency decreases but overall charcoal abundance increases, indicating slash burning for agriculture and logging. After ca.1940, charcoal abundance declines, reflecting active fire suppression. Grasses also increase at this time. Variations in pollen

abundance and species composition confirm forest clearance and introduction of exotic plants.

At Florence Lake, oak is present from ca.1440-1620 at low abundance. After ca.1620, during and following a prolonged period of regional fire activity, oak and alder (*Alnus spp.*) increase. From ca.1720 oak remains stable, until ca.1925 when it decreases significantly, during extensive logging. Florence Lake charcoal record corresponds well with regional climate data until ca. 1850, when logging, followed later by suburban development, become the primary disturbances.

This research shows that the fire and vegetation histories in the study area have varied in response to climate and possibly First Nations activities, but ecosystem response has become decoupled from these disturbance factors by modern land-use activities.

Keywords: fire history; *Quercus garryana*; macroscopic charcoal; high resolution; fossil pollen; Garry oak ecosystems
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The stabilizing role of plant diversity following sudden environmental change in the Garry oak ecosystem

The role of diversity in buffering environmental change remains poorly tested in most natural systems. Diversity might enhance stability if different species have different disturbance susceptibilities (i.e., functional complementarity). Alternatively, diversity might decrease stability because, at high diversity, populations are predicted to be more temporally variable and therefore more vulnerable to extinction following perturbation.

I examine these issues with experimental burning along a natural diversity gradient in the Cowichan Garry Oak Preserve, Vancouver Island, where fire is believed to have been suppressed for 150 years. I examined how two components of stability, resistance (invasion by added and naturally recruiting species) and resilience (recovery of the pre-disturbance light levels, the primary limiting resource), varied with diversity. I also examined how the abundance of dominant species and soil depth affected stability, as both are negatively correlated with diversity and could have hidden impacts (e.g., invasion resistance on shallow soils correlated with diversity but caused by moisture stress). Species-rich locations were “stable” because

they contained fire-tolerant native species that, despite their rarity, significantly increased in cover after fire, reduced light availability and limited seedling survival. Species–poor communities, dominated by exotic grasses, were rapidly invaded, apparently due to the combined effects of (1) trade-offs between competitive ability and disturbance tolerance (invaders were competitive but fire sensitive), and (2) low functional complementarity. The abundance of exotic dominants and soil depth were negatively correlated with native plant diversity because the dominants determine diversity patterns in the absence of fire, but native diversity alone accounted for variation in stability. Without burning, most native plant species are confined to shallower soils where they play a minor role in controlling resource flows and production. Native diversity, therefore, was more important for buffering the effects of change than controlling ecosystem function under undisturbed conditions. These results indicate that loss of native flora in the Garry Oak ecosystem will compound the negative effects of environmental change (e.g., climate change, fragmentation) by limiting the ability of ecosystems to respond.

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Landscape and environmental drivers of plant distributions in Garry oak ecosystems

In fragmented landscapes, the size of the remaining fragments and their spatial configuration relative to each other can influence the relative frequencies of colonization (seeds are more likely to disperse between patches that are closer together) and extinction (small populations are more vulnerable than large populations to stochastic extinction). My research is aimed at understanding how habitat fragmentation may affect vascular plant diversity in Garry oak ecosystem patches throughout southeastern Vancouver Island. For my Master's research, I will assess the relative contributions of local environmental and regional landscape factors as drivers of plant distributions and diversity by making empirical observations of vascular plant diversity in Garry oak habitat patches on southeastern Vancouver Island varying in their environmental characteristics (e.g. soil, light, topography) and landscape context (e.g. patch size, connectivity). I will also examine whether particular life-history traits, such as dispersal mode and degree of habitat specialization, confer certain advantages in the face of habitat fragmentation and also look at whether exotic plant species show different responses to habitat fragmentation, which may indicate traits or adaptations that facilitate their invasions or persistence abilities in fragmented habitats.

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Inter-trophic invader interactions: impacts of Canada goose disturbance on non-native plant species in British Columbia's protected Gulf Islets

Non-native herbivores can introduce novel disturbance regimes, which may in turn affect the relative success of native and non-native plant species. In BC's Gulf of Georgia Islets, increasing numbers of Canada geese (*Branta canadensis*) are disturbing endangered Garry oak plant communities through grazing, soil erosion, and feces deposition. To measure impacts on community composition and diversity, we established open and exclosed plots on 8 islets and estimated spring and summer biomass and flower production by species.

First-season surveys show that areas with intense goose disturbance have fewer native perennial forbs and are dominated by non-native annual grasses. Results of greenhouse germination trials also indicate that geese are capable of dispersing the seeds of these grasses through ingestion and feces deposition.

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Herbivory explains plant community composition in endangered oak meadows

The invasion of exotic grasses is a global problem that has reduced the abundance of native plants in natural ecosystems. Ungulates also affect the composition of plant communities, but their effects are variable and depend on the characteristics of ecosystems and the intensity of herbivory.
We examined the effects on native plants in endangered oak meadows of shading and litter accumulation by exotic grasses and herbivory by native and feral herbivores. First we compared patterns of plant community composition in an archipelago of islands with different densities of native black-tailed deer to test if the intensity of herbivory explained native plant richness and abundance. Our results showed that native plant richness and abundance in the southern Gulf Islands of BC increased with moderate herbivory, but declined precipitously with high herbivory. Next, we tested if exotic grasses or herbivores influenced the establishment of native seeds, or the productivity of native plants, by comparing their performance in experimental plots with or without grass and herbivores. Eight native seed species were added to plots on three islands with native deer and >50% exotic grass biomass. The deep-soil site had no other herbivores present but the two shallow-soils sites also had feral herbivores, one with goats and the other with sheep. We found that herbivory had no significant effect on the establishment of native forbs. Although exotic grasses had no effect on the establishment of native forbs at the shallow-soil sites, four species

established at lower rates in the presence of exotic grasses in the deep-soil site.

We planted established native plants on an island with sheep and deer and found that herbivory reduced the growth and flower production of native forbs but had equivocal effects on native trees. The presence of exotic grasses facilitated the growth of the forbs but had no effect on the trees. Exotic grasses now dominate most oak ecosystems, but their invasion may not be driven solely by competitive exclusion because herbivores can reduce the growth and fitness of native plants. They may also facilitate the spread of exotic grasses by reducing seed production and mediating competition in ecosystems already compromised by fragmentation and development.

Keywords: plants, herbivores, competition, endangered ecosystem
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Invasive Species Biology and Impacts

Scotch broom removal and its impact on grazing of white-top aster

This project, initiated in 2004, is part of a collaboration between CRD Parks (Mill Hill) and the National Research Council (Observatory Hill[1]) to assess the grazing pressure on the COEWIC-listed threatened white-top aster (*Aster curtus* or *Sericocarpus rigidus*) by the introduced Eastern Cottontail (*Sylvilagus floridanus*) and native Columbian Black-tailed Deer (*Odocoileus hemionus columbianus*). In 2005, the study was expanded on Mill Hill to more accurately assess relative populations of these mammals. It is anticipated that the same assessment will be conducted on Observatory Hill in 2006.The results of this study provide important information about future work needed to successfully manage rare plants in Mill Hill Regional Park and Observatory Hill.

The objectives were to 1) continue to monitor the grazing pressure of Black-tailed Deer and Eastern Cottontail on white-top aster and 2) establish transects to estimate Eastern Cottontail and Black-tailed Deer relative density.

To satisfy the first objective, we installed exclosures that differentiated grazing of Eastern Cottontail and Black-tailed Deer in subpopulations of white-top asters that could accommodate these two, and two control enclosures. A total of 438 (2004) and 514 (2005) white-top aster shoots were marked and measured on Mill Hill in 11 subpopulations. On Observatory Hill 637 (2005) white-top aster shoots were marked and measured in five subpopulations. A total of 1 (2004) and 7 (2005) white-top aster shoots flowered on Mill Hill whereas 8 (2004) and 79 (2005) flowered on Observatory Hill. Exclosures that allowed Eastern Cottontail access had

higher grazing pressure than exclosures that provided access only to deer. The grazing pressure was least in the exclosures that excluded both Eastern Cottontail and Black-tailed Deer, and highest when both species had access. It also appears that protection from grazing results in more vigorous shoots.

Fecal pellet counts along four transects determined that Eastern Cottontail densities were highest in areas with little slope and there was a higher concentration of rabbits in the Garry oak – broom site series. It appeared that clearing broom reduces the Eastern Cottontail density. Deer pellet group counts along the transects determined that Black-tailed Deer did not exhibit bias towards different canopy closures, in areas with rocks, steeper slopes or different site series. The deer density equivalence was estimated to be 49 deer/km^2 on Mill Hill.

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1: Previously known as Little Saanich Mountain.

Restoration Programs and Progress

Regional strategies for restoring invaded prairies: a multi-site, collaborative approach for controlling invasive weeds

Invasive plants, especially non-native perennial grasses, pose one of the most critical threats to protected prairies and oak woodlands in the Willamette/Puget/Georgia ecoregion. Our current knowledge regarding the effectiveness of exotic weed control methods, especially in sites that retain a significant component of native vegetation, is largely anecdotal or based on results from only a few site-specific studies.

In conjunction with numerous collaborators, we developed a research program designed to 1) Evaluate and improve strategies for controlling the abundance of invasive non-native herbaceous weeds, while maintaining or enhancing the abundance and diversity of native plant species; and 2) Develop an approach to generalize these results so that they can be applied by land managers engaged in prairie stewardship throughout the region.

We have replicated experiments at 11 sites in Washington, Oregon, and British Columbia, which will be monitored from 2005-2010. Experimental treatments include combinations of spring and fall mowing, burning, a grass specific-herbicide, and re-seeding of native species. Baseline vegetation data from 2005 show that exotics account for over half the diversity at all sites, and from 40-60% of the percent cover. Diversity declined across sites with increasing litter and moss layers. First-year treatments were completed and the post-treatment data will be available in summer 2006. More information about the project can be found at: www.appliedeco.org/prairie_restoration.html.

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Garry oak meadow restoration through Douglas-fir removal

The Garry oak (*Quercus garryana*) meadows on Trinity Western University's Crow's Nest Ecological Research Area are experiencing encroachment by Douglas-fir (*Psuedotsuga menziesii*), which threatens the health and survival of *Q. garryana* and the meadow as a whole. Traditionally, aboriginals maintained Garry oak meadows by frequent burnings, but with European settlement and the suppression of fire, *P. menziesii* have been able to successfully encroach much of the present day Garry oak meadows. Two methods of *P. menziesii* removal that have been practiced at other *Q. garryana* restoration sites include Douglas-fir removal and/or the use of fire. However, with the removal of *P. menziesii*, the disturbance of the soil potentially allows for the establishment of other invasive species. A pilot project involving the removal of *P. menziesii* in the fall of 2006 based on results from a mapping project conducted in the summer of 2005, will see

the complete removal of all of the *P. menziesii* within four proposed sites. These results will be compared with four meadow sites and four control sites through studies of vegetation, soil, crown growth, epicormic branching, and tree height. All sites will consist of circles with a ten-m radius. The goal is to integrate Douglas-fir removal in conjunction with native species restoration techniques to see whether a more-diverse Garry oak ecosystem community can be developed over time.

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Ecological restoration of Garry oak ecosystems: is it working?

This study presents an assessment of ecological restoration activities undertaken during 2002-2005 at Chatterton Hill Park, Victoria, to allow an evaluation of activities to aid in the adaptive management of the site, as well as providing an example of the benefits of ecological restoration activities through comparison with a similar nearby site where no restoration activities have taken place (referred to as Broom Hill). Surrounded by human development, Chatterton Hill Park is a vulnerable, ecologically complex, community of Garry oak-associated threatened species and fragile micro-ecosystems (e.g., rocky outcrop). It is being invaded by aggressive exotics which are suppressing the growth of natives as well as changing the edaphic nature of the soil, thereby encouraging further invasion and success by exotics. The entire ecosystem is being altered and may have been lost - impoverishing the entire landscape, both natural and cultural.

Chatterton Hill was identified as a Garry Oak Restoration Program (GORP) site by Saanich Municipality with a site action plan to restore geobiological function and native-species diversity while engaging and educating the public. Thus, Chatterton Hill Park became a “public demonstration” site for ecological restoration within the Garry oak ecosystems of Saanich Municipal District. Through this evaluation and comparison, qualitative and quantitative results suggest that biodiversity on the GORP site is increasing.

The findings also suggest that restoration activities are successfully encouraging native species variety and abundance through the ongoing removal of exotic invasives and planting of native species. The tree layer is a healthy, open canopy dominated by Garry oak with an understorey vegetation cover dominated by grasses, a native herb, camas, and to a lesser degree, a native shrub, snowberry. At Broom Hill, the tree layer was similar, but the understorey vegetation cover was dominated by grasses and an invasive exotic, Scotch broom, which was suppressing native species. The public educational and engagement component of the restoration activities are shown to have positive effects with an increase in interest and care of the GORP site. The ecological restoration of Chatterton Hill benefits not only the

biotic community it supports, but the surrounding community which sustains it.

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The role herbicides play in shaping plant communities

Managing oak savanna habitats for a particular species composition will require restorationists to actively manipulate plant communities using a number of different techniques. However, the plant-community response to many of these restoration techniques is poorly understood. The objective of this study was to test chemical herbicides as a means to direct a plant community to a desired community structure, such as reduced abundance of non-native species.

Treatments included the use of a broad-spectrum herbicide (glyphosate), grass-specific herbicide (Fusilade), and pre-emergent herbicides (Pendulum or Surflan) in various combinations as well as varying concentrations (low or high) and different dates of application (August or September). We recorded the effectiveness of the treatments at reducing abundance of species in broad functional groups defined by life-history, including grasses, annuals, as well as non-native species in general, and target species such as an invasive perennial grass, false-brome. We also wanted to determine the compatibility of these herbicides with a threatened species, Kincaid's lupine, so we measured its abundance in the treated plots as well.

Kincaid's lupine abundance, as measured in number of leaves and flower stalks per plot, was unaffected by all of the herbicide treatments we applied. Also, non-native species were not affected differently than native plants by these treatments. However, we believe that specific invasive weeds may be controlled with limited impacts to native species when information on their functional groups defined by life-history is available. For example, false-brome was significantly reduced by application of grass-specific Fusilade with pre-emergent herbicide in September, which killed established plants and reduced re-invasion from seed without reducing abundance of native species.

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Evaluating methods for Garry oak meadow plant community restoration

Experimental treatments for restoring a Garry oak meadow plant community were conducted in an old-field on the University of Victoria campus. Planting treatments included combinations of 7 native herbaceous species as seedlings and 13 species as seeds at low (146 seeds and/or 9 seedlings per m^2) and/or high (300 seeds and/or 18 seedlings per m^2) densities in 1 * 1 m plots. They were nested within soil treatments including solarization, mulch, scalp, mulch/scalp, and tilling in 3.5 * 8 m plots. Treatments were replicated at least 8 times with twice the number of controls and randomly allocated. Site preparation was conducted in the summer of 2004 and the seedlings and seeds were planted in winter 2004/2005. To evaluate the treatments, plant cover was measured (summer 2005) and flowering of planted species (spring 2005 and 2006).

Scalp/mulch and mulch treatments were most effective in eliminating or decreasing plant cover. Till and scalp treatments were also effective but had some neutral and negative effects (e.g. increase *Anthoxanthum odoratum,* or *Leucanthemum vulgare*). In all cases exotic species not present in the control became present with less than 5% cover. Mulch contained specific species (*Portulacca, Sisymbrium officinale, Senecio sylvatica*) as well as others that also appeared in scalp and till plots, probably present in the seed bank (*Rhaphanus* sp., *Erigodium, Medicago* sp., *Polygonum* sp., *Matricaria perforata*, *Lepidium* sp.).

The response of native species ranged from: germination of species not planted in scalp and till treatments (*Montia linearis, Navarretia squarrosa, Lupinus polycarpus,* and *Juncus bufonus*); to emergence of herbaceous perennials in un-mown controls (*Danthonia californica, Spiranthes romanzofinna*) and mulch treatments (*Sanicula crassicaulis, Ranunculus occidentalis*); and to germination of *Quercus garryana* in till and scalp plots (not planted). The seedlings that became well-established were *Camassia* spp. and *Elymus glaucus. Lomatium utriculatum, Achillea millefolium,* and *Bromus* sp. germinated from seed. All species produced flowers and were grazed by deer and rabbits.

There were specific results for each soil preparation and only the general effects have been discussed. Several more years of monitoring and deeper analysis are needed before applications of this field test become apparent.

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What restorers need to know: a view from the ground

"The new pioneers are the restorers of native land." – Paul Hawken.
This short presentation, given without visual aids, was to remind the researchers and land managers that, in order to protect this special ecosystem and the rare plants within, countless hours of skilled manual labour will be needed. Volunteers, though vital to restoration efforts, cannot be solely relied upon, especially to co-ordinate multi-year projects. The restorers on the ground require a certain amount of practical information that can be derived only from high quality research, but just as important, restorers need stable funding, community and government support, and a realistic plan that covers multiple years. The final point, the need for a truly realistic plan, is probably the most dangerous factor to ignore. When a restoration job goes poorly, the public becomes discouraged and is driven to mechanical, more ecologically damaging means to control invasive plants and develop their property. From the landscape perspective, protecting the beauty, spirituality, and diversity that is a Garry Oak Ecosystem requires having the property owners on the program, and a legion of professional restorers on the ground.

(NOTE: During the discussion period following the presentation, the point was made that perhaps I undervalue the importance of all the research that is helping us to understand the flora, fauna and processes within GOEs. I regret that I may have made that impression, but when I drive by roadsides crawling with blackberries, or countless fields of old-growth broom, I start twitching. Like many restorers, I just want to get busy because the problem is growing exponentially.)

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