

Restoration of a Novel Garry Oak Meadow: Increasing native flora and pollinator species diversity in Esquimalt Gorge Park, Victoria, BC

Abstract

Garry oak meadow and associated ecosystems are in significant decline, largely as a result of increasing urbanization, invasive species, and other anthropogenic stressors. Garry oak landscapes provide critical habitat for a variety of wildlife and native plant species which support an array of pollinators. There has been a significant push in the last decade to preserve, protect, and restore these culturally important ecosystems by removing invasive species, planting native species, and raising awareness, among other means. The purpose of this restoration project was to increase native pollinator species diversity and abundance within Esquimalt Gorge Park by removing invasive species, lasagna mulching, and planting native plant species typical of a Garry oak meadow in an urban setting. The plot serves as an experiment in comparing plant suppression methods between lasagna mulching of this site and woodchip mulching that occurred in the pollinator meadow, to determine which is more successful at aiding the establishment of native plant species.

1.0 Introduction

The Garry oak tree (*Quercus garryana*), which arrived some 8,300 years ago, is the only oak species native to British Columbia (Baker, 2018). In British Columbia, the Garry oak's range is limited to a narrow strip of the Coastal Douglas-fir zone of southeast Vancouver Island (Erickson, 1993). Their habitat includes a patchwork of meadows, grasslands, woodlands,

Douglas-fir stands, and open rocky areas characterized by enriched dark-coloured upper soil layers that also support a variety of wildflowers (GOERT, 2011). Garry oak ecosystems are primarily characterized by naturally occurring Garry oak trees and support ecological characteristics that once flourished pre-European settlement (GOERT, 2011). Changes in climate have influenced the range of Garry oak ecosystems considerably over time and has created pockets of suitable habitat with moderate temperatures and dry summers, which are the conditions experienced on Southern Vancouver Island (Erickson, 1993).

In 2008, the report *Taking Nature's Pulse*, assessed the conservation status of British Columbia's ecosystems, concluding that Garry oak and associated ecosystems of the Coastal Douglas-fir Biogeoclimatic Zone are in great decline (Austin et al, 2008). Garry oak ecosystems are now among the rarest and most endangered ecosystems in Canada, with 95% of their range gone (GOERT, 2011). This is largely a result of habitat loss due to urbanization, agricultural and other development, habitat fragmentation and degradation due to invasive species and the loss of natural disturbance (e.g. fire), and other anthropogenic stressors that continue to alter these ecosystems (GOERT, 2011). These ecosystems were once a rich mosaic, now reduced to isolated spots which can be seen throughout the Greater Victoria area, often as single Garry oak trees in pavement or turf. Correlating with this decline is the struggle of more than 100 species that once called Garry oak ecosystems home, which are now at risk provincially with 55 listed under the Species at Risk Act (GOERT, 2011). There is a clear need to continue restoring and enhancing Garry oak ecosystems, as they provide ecological, biological, and cultural benefits.

To increase Garry oak meadows and associated landscapes, there has been significant efforts to preserve the patches still present on Vancouver Island, in addition to restoring and enhancing these unique ecosystems. One of the main restoration practices has been to increase native plant habitat and remove invasive species. With this, this project restored a small plot of Garry oak trees within Esquimalt Gorge Park, adjacent to the existing pollinator meadow. The primary methods consisted of suppressing non-native grasses and planting an appropriate Garry oak meadow plant assemblage in a small plot, with the goal of increasing native pollinator species diversity and abundance. Ongoing monitoring of the site will be required, and a Monitoring and Adaptive Management plan can be found in Appendix A.

1.2 Site Description

Located on the unceded Lekwungen territory of the Esquimalt and Songhees Nations in the Coastal Douglas-fir (CDF) Biogeoclimatic Zone, the proposed restoration site experiences damp, mild winters and dry, warm summers. The site aspect is south-west, providing more sun and drier soil conditions in summer months. The restoration site is located between the gravel pathway and the established pollinator meadow; spot-planting plots and scale to be determined following consultation with Esquimalt Parks. The site's groundcover is currently dominated by dense non-native grasses and non-native plant species such as creeping buttercup and vetch. Native shrubs act as a barrier to the gravel pathway, including snowberry (*Symphoricarpos albus*) and Nootka rose (*Rosa nutkana*) as well as several young Garry oak trees (*Quercus garryana*).



Figure 1. Extensive site area and spot-plant site adjacent to the Pollinator Meadow in Esquimalt Gorge Park, Victoria, BC.

2.0 Methods

2.1 Study Site Selection

The study site was selected for its ideal location between the moderately trafficked gravel footpath and the pollinator meadow. The spot plant site area within the study site was determined based on density of Garry oak trees in a semi-open area for restoration that also included existing shrubbery. An additional consideration was selecting a plot parallel to the established pollinator meadow as this would create a natural flow of habitat for pollinator species.



Figure 2. Image of selected study area for restoration and spot planting.

2.2 Garry oak Baseline Inventory

A baseline inventory was conducted within the site boundary to determine the number of Garry oak trees present along with their height, diameter, and tree characteristics (see Appendix B). The boundary of the site and baseline inventory included all Garry oak trees between the footpath and pollinator meadow and did not include the large Garry oak tree west of the pollinator meadow as it was considered an outlier to the rest of the Garry oak trees. Prior to measuring the Garry oak trees, a site map was sketched to gain a spatial sense of the number of Garry oak trees present and their location beginning from the northwest of the site to southeast. Site photos were taken and coordinates recorded for the spot plant site in a field notebook, along with the date, weather, temperature, surveyor names, and task. Additionally,

the eye height of the individual measuring the angle was measured using a meter tape and recorded, noting that this was a constant variable for each tree.

A photo was taken to include the entire tree within frame along with a photo sheet that included the number of the Garry oak trees and the date (see **Figure 3**). Photos were taken from the same orientation, facing the gravel pathway for consistency (See **Figure 4**). Distance from the surveyor to the base of the tree was measured along the ground with a meter tape, with careful attention to staying in the exact spot between measuring the distance and the angle for accuracy. The angle from the base to top of the tree at the surveyor's location was determined using the Theodolite app by holding the smartphone in landscape and lining the top of the tree with the crosshairs on the screen and recording the angle shown on the right-hand side of the screen.

The circumference was measured using a meter tape by wrapping it around the tree at breast height, pulling the tape tight, and recording the marking on the tape where the 0m mark overlaps. All observations and measurements were recorded in a field notebook and later uploaded into a Microsoft excel spreadsheet (See **Appendix B**). The height of each Garry oak tree was calculated by taking the tangent of the angle and multiplying it by the distance measured. Following this, the total height was calculated by taking the height and adding the eye height previously recorded. The diameter of each Garry oak tree was calculated by taking the circumference measured and dividing this number by 3.14. This method was carried out for each of the 22 Garry oak trees within the site boundary (See calculation example below). The

data collected from this inventory will aid in future projects within Esquimalt Gorge Park

regarding decision making processes and act as a reference point in time.

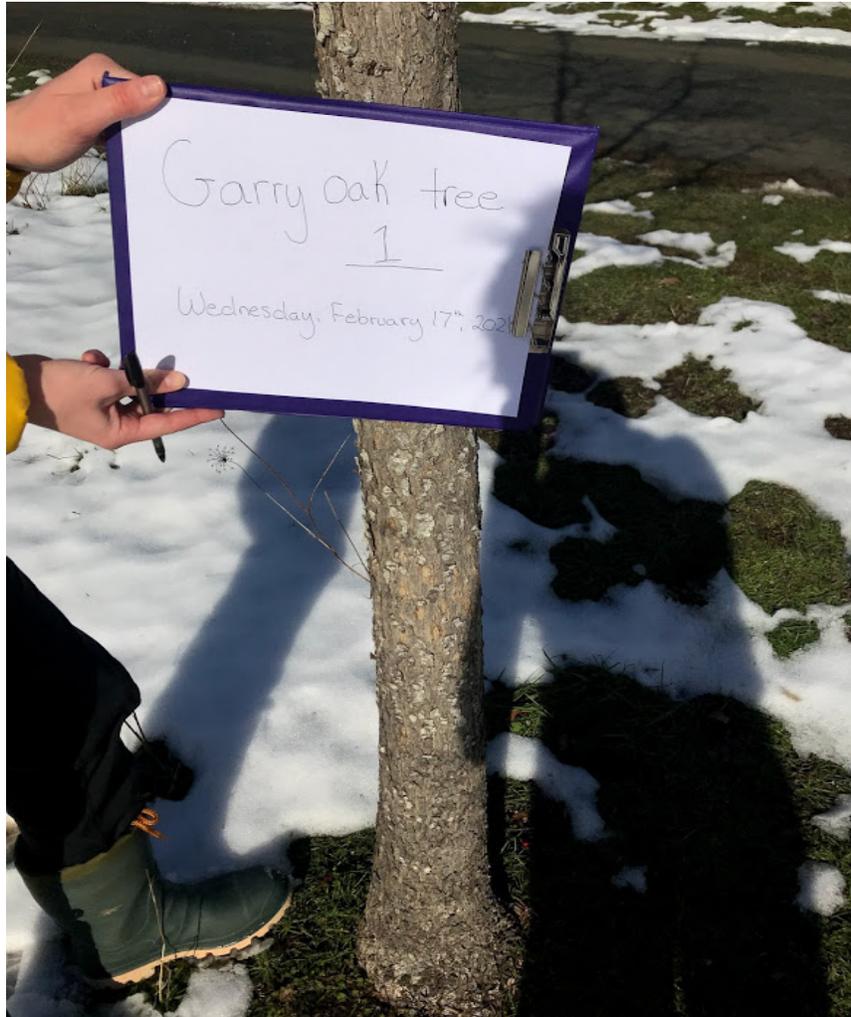


Figure 3. Image of Garry oak tree number one with photo sheet for Garry oak Baseline Inventory.



Figure 4. Image of Garry oak tree number one for Garry oak Baseline Inventory.

Eye Height= 1.66m

Circumference at Breast Height = 31cm

Ground Distance= 4.73 m

Angle= 35.1°

Notes= Growing straight, one branch previously cut/fallen off, signs of bird activity

Calculate height of the tree:

$\tan(\text{angle}) = \text{opposite}/\text{adjacent}$

Height = $\tan(\text{angle}) \times \text{distance}$

Height = $\tan(35.1) \times 4.73$

Height = 3.32 m

Total height = height calculated + your eye height

Total height = 3.32 + 1.66

Total height = 4.98 m

Calculate diameter after with circumference measurement recorded:

Diameter = (Circumference)/ π

Diameter = 31 / 3.14

Diameter = 9.86 cm

2.3 Garry oak Spot-Planting Plot Restoration

A Garry oak pollinator meadow restoration project was created and implemented in a small plot adjacent to the existing pollinator meadow in Esquimalt Gorge Park (see Appendix C). The goal for this project was to remove grass and non-native plant species, followed by lasagna mulching and planting an appropriate Garry oak meadow plant assemblage to attract native pollinator species and increase overall biodiversity within the park. Lasagna mulching involves putting down a layer of thin cardboard or newspaper followed by alternating layers of brown materials (i.e., dry leaves, peat, leaf mulch) with green materials (i.e., compost). The ratio of brown to green layer depths should be 5:3, applied with the brown layer at 5 inches deep. The brown layers provide carbon to the soil and the green provide nitrogen. The total material applied should be 2 feet deep and will shrink down in a few weeks as materials decompose. The surface was kept rough and irregular, especially as the site is sloped, to allow for the creation of microclimates and a variety of microhabitats, in addition to deterring sheet erosion.



Figure 5. Image of study plot with orange flag pole perimeter prior to restoration.

2.3.1 Invasive Species and Grass Biomass Removal

A plot perimeter was established by placing orange flag poles into the ground as a guide for removing grass biomass and non-native plant species around the Garry oak trees and shrubs. Grass biomass and non-native plant species were removed with trowels by digging on a slight angle and lifting upwards. Invasive species and grass biomass were placed in buckets which were then disposed of behind the garden shed within Esquimalt Gorge Park.



Figure 6. Image of invasive species and grass biomass removed with Garry oak leaves that were collected prior to restoration placed back onto site.

2.3.2 Lasagna Mulching - Base Layer

Prior to lasagna mulching, orange flag poles were removed, and large strips of brown paper were placed lengthwise and crosswise throughout the plot, with careful attention to overlap for a total of 6 layers (see **Figure 7**). Orange flag poles were used to pin down the paper throughout the process to keep from blowing away. The plot was then watered to saturate the paper before continuing with the next layers.



Figure 7. Layers of brown paper placed for suppression of new grass growth.

2.3.3 Lasagna Mulching - Compost and Leaf Mulch

A 1-inch layer of peat moss and leaf mulch were then added on top of the brown paper, with careful attention to keep mulch 6 inches away from the bases of the trees and shrubs to avoid fungus cankers and root rot. The subsequent layer was watered and topped with a 1-inch layer of compost, followed by another watering and a final 1 inch layer of leaf mulch and peat moss. A final watering was carried out and the orange flag poles were placed again around the perimeter of the plot with twine wrapped around each and tied at the end. A “Restoration in Progress” sign was secured to the perimeter to alert park visitors.



Figure 8. Image of completed lasagna mulch and wood chip mulch buffer.



Figure 9. Image of Restoration in Progress sign placed at plot to alert park visitors.

2.3.4 Native Plant Species Selection and Planting

The restoration plot contained existing native species of four Garry oak (*Quercus garryana*) saplings, one salal (*Gaultheria shallon*), one baldhip rose (*Rosa gymnocarpa*), and one snowberry (*Symphoricarpos*). Native species were chosen for planting based on a variety of criteria including, but not limited to: flowering period variation, deer resistance, typicality of a Garry oak ecosystem, pollinator friendliness, and cultural importance to Coast Salish First Nations (see **Table 1** and **Table 2**). With these criteria, the native plant species planted in the Garry oak plot included the following starter plants: four broad-leaved shooting star (*Dodecatheon hendersonii*), four sea blush (*Plectritis congesta*), three nodding onion (*Allium cernuum*), and three farewell-to-spring (*Clarkia amoena*); five small-flowered forget-me-nots and five western buttercup (see **Figure 10**) propagated from seed; and a wildflower spring mix that included field chickweed lovely (*Cerastium arvense*), junegrass (*Koeleria*), Roemer's fescue (*Festuca roemerii*), and wooly sunflower (*Eriophyllum lanatum*) (see **Appendix D**).

The native plant species selected were placed around the restoration plot to determine the best location based on sun and moisture requirements (see **Figure 11**) before being planted into the plot. Those propagated from seed were planted with a small amount of Island Finest Organic Compost Mix. Plants were planted using a trowel to dig a hole and loosening rootbound plants by hand (see *Native Plant Species Selection* below). Plants were then placed in their respective holes and gently filled in and patted down. Routine watering was then carried out to ensure plants were able to establish.

Table 1: Native Plant Species List for Garry oak Restoration Plot.

Native Plant Species	Flowering Period	Benefits	Notes
Small-flowered blue-eyed Mary (<i>Collinsia parviflora</i>)	March-May	Winter cover	
Spring gold (<i>Lomatium utriculatum</i>)	March-May		
White fawn lily (<i>Erythronium oregonum</i> ssp. <i>oregonum</i>)	March-April	Pollinators	
Grassland saxifrage (<i>Saxifraga integrifolia</i>)	March-April	Pollinators	
Sea blush (<i>Plectritis congesta</i>)	April-June	Winter cover Pollinators Deer Resistant	Annual herb
Common camas (<i>Camassia quamash</i>)	April-May		Plant bulbs ahead of seed mix deep in the ground instead of in seed mix
Great camas (<i>Camassia leichtlinii</i> ssp. <i>suksdorfii</i>)	April-May	Pollinators	
Broad-leaved shooting star (<i>Dodecatheon hendersonii</i> ssp. <i>hendersonii</i>)	April-May	Pollinators Deer resistant	
Chocolate lily (<i>Fritillaria affinis</i>)	April-May		
Yellow monkey-flower (<i>Mimulus guttatus</i>)	April-July		
Two-coloured lupin (<i>Lupinus bicolor</i> ssp. <i>bicolor</i>)	April-May	Bee forage	

Nodding onion (<i>Allium cernuum</i> var. <i>cernuum</i>)	May-July	Bee forage Deer resistant	
Woolly sunflower (<i>Eriophyllum lanatum</i> var. <i>leucophyllum</i>)	May-July	Pollinators Seed faster	
Hairy honeysuckle (<i>Lonicera hispidula</i>)	June- July		
American searocket(<i>Cakile edentula</i>)	June- September		
Common harebell (<i>Campanula rotundifolia</i>)	June- September		
Douglas' aster (<i>Symphiotrichum subspicatum</i>)	July-August	Pollinators Composite head for pollinators	
Harvest brodiaea (<i>Brodiaea coronaria</i>)	July	Pollinators	
Entire-leaved gumweed (<i>Grindelia stricta</i>)	June - Nov	Pollinators Deer Resistant	Perennial herb, late-blooming
Common yarrow (<i>Achillea millefolium</i>)	June - Dec	Composite head for pollinators Deer Resistant	Rhizomatous perennial herb

Table 2: Native Shrub Species List for Garry oak Restoration Plot.

Native Shrub Species	Bloom period (early-late)	Benefits	Notes
Red-flowering currant (<i>Ribes sanguineum</i>)	March-May	Pollinators	
Coastal red elderberry (<i>Sambucus racemosa</i> var. <i>arborescens</i>)	April-May	Bee habitat	Bees use hollow stems for habitat
Snowberry (<i>Symphoricarpos albus</i>)	May-September	Tend to form dense layers beneath which agronomic grasses do not dominate Cost effective and efficient	Easily propagated from cuttings Live stakes
Nootka rose (<i>Rosa nutkana</i>)	May-July	Pollinators	Provides rosehips
Oceanspray (<i>Holodiscus discolor</i>)	June-July	Pollinators	
Mock-orange (<i>Philadelphus lewisii</i>)	June-July	Pollinators	
Indian-plum (<i>Oemleria cerasiformis</i>)	February-March	Pollinators	Earliest to flower, fruit ripens late
Tall Oregon-grape (<i>Mahonia aquifolium</i>)	February-April	Pollinators	



Figure 10. Image of western buttercup and small-flowered forget-me-nots propagated from seed to be planted into the restoration plot.



Figure 11. Image showing starter plants placed throughout the plot to determine the best locations.

2.4 Community Outreach

Increasing pollinator species diversity and abundance, both within and outside of Esquimalt Gorge Park, is greatly dependent on community outreach. Sharing knowledge within the community facilitates awareness, learning, and action that can have significant positive ripple effects throughout communities. An important goal for this project was to increase community awareness on Garry oak ecosystems and the importance of habitat for biodiversity. Three educational flyers were created using Canva to be placed in the Nature House for park visitors to learn about these topics and how they can get involved. The three flyers are on Garry oak ecosystems, bees as pollinators, and composting. The flyers complement the newly created

Garry oak meadow restoration spot plant site, the established pollinator meadow, the newly purchased composting system, as well as the new bird boxes and riparian restoration plot, all of which park visitors can learn about and experience. It is an overarching goal that these flyers will encourage park visitors to implement similar restorative strategies in their own backyards.

3.0 Results

Restoration of the Garry oak meadow plot took a total of 2.5 days, with the invasive species and grass biomass removal on one day and the lasagna mulching the following day. Native plants were planted on 2 separate afternoons in the following 2 weeks after restoration. Some native plants were extremely crumbly and dry when taken out of their container, making it difficult to plant, which may impact the success of their establishment.



Figure 3. Completed restoration plot, with non-native species and grass biomass removed, lasagna mulching conducted, and native species planted along with added structural habitat.

4.0 Discussion

This restoration project aimed to restore and enhance a small Garry oak meadow, which will provide a host of short- and long-term benefits ecologically, biologically, culturally, and socially. Completely removing invasive species such as creeping buttercup and geranium, as well as grass biomass, provided a higher chance for the lasagna mulching to provide effective suppression. It is recommended that there be a two-foot-tall bed; however, this is recommended for a restoration strategy with no grass biomass removal. Therefore, the 4-6-inch bed created was sufficient for this experimental plot and can be adapted for future projects based on success. Lasagna mulching was a simple and cost-effective method for suppressing future growth of invasives and grass, as leaf mulch cost approximately \$25.00 and the nature house already had compost and peat moss for use. Lasagna mulching added more nutrients and structure to the soil, which aided with surface water run-off and moisture retention. Leaving an irregular surface further created microclimates and habitat for invertebrates.

To limit invasive species and grasses from creeping into the plot from the outside, a thick perimeter of wood chip mulch was applied twice and will require ongoing monitoring and weeding. Native plants were placed throughout the plot with certain species being planted close together as preferred by native pollinator species. The newly planted native species like sea blush and broad-leaved shooting star will provide more habitat and foraging opportunities for native pollinators. These planted species also provide a variety of shape and color - key attributes in attracting native pollinators which are selective through colour, fragrance, and flower formation. For example, bees prefer bright whites, yellows, and blues, butterflies prefer

bright reds and purples, and birds enjoy reds, oranges, and whites. Structural habitat features, such as small rocks and a log, were also added to aid native pollinator species with nesting and overwintering.

In developing this project, a compost plan was also developed for Esquimalt Gorge Park along with recommendations on different composting systems. A composter was purchased and can now be used to provide a boost of nutrients and mulch throughout the park (see **Appendix E**). Having a local and sustainable source for compost within Esquimalt Gorge Park will be beneficial for the newly established restoration sites and plantings and can also be a great learning demonstration for people of all ages who are interested in composting.

Restoring more areas of Esquimalt Gorge Park from urban grass areas to more functional and resilient spaces can, over time, help to increase habitat connectivity on Southern Vancouver Island. In turn, this initiative can aid in increasing overall biodiversity by creating a mosaic of habitats. Creating and diversifying more green space in Esquimalt Gorge Park also plays an important role in providing psychological benefits for visitors and nurtures long term relationships between people and their natural surroundings. The interpretive sign to be placed near the restoration plot will further inspire visitors to rewild our spaces for a more regenerative and sustainable future. Throughout the program park visitors were excited and enthusiastic to see the work being carried out.

5.0 Conclusion

Ecological restoration is an emerging discipline that is being increasingly recognized as essential to enhancing biodiversity and habitat as well as mitigating climate change. This

restoration project successfully removed invasive species and grass biomass and will require ongoing monitoring to determine the success of planted native species. Ongoing monitoring will also help to determine if there are new sightings of pollinator species using the newly restored plot. This restoration project will inform future projects on best methods for grass suppression and fostering plant establishment and growth over time compared to the adjacent pollinator meadow in Esquimalt Gorge Park. Additionally, both this project and the Garry oak ecosystems flyer will bring attention to the importance of restoring these culturally valued, endangered ecosystems.

6.0 Acknowledgements

Thank you to the Township of Esquimalt for their partnership and permission to carry out this restoration project in Esquimalt Gorge Park. This restoration project was completed with the guidance and field work assistance of coordinator Stephanie Gurney and fellow YCP participants, with a special thank you to the restoration stream for all their hard work and support.

7.0 References

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8.0 Appendices

All appendices are links to folders within the GWAS Google Drive. For access from outside the organization, please consult a member of the GWAS board of directors or staff, or email gorgewaterway@gmail.com to inquire.

Appendix A

Garry oak meadow restoration project proposal found [here](#).

Appendix B

Garry oak Baseline Inventory found on google drive [here](#) and raw excel data can be found [here](#).

Appendix C

Garry oak meadow restoration methods found [here](#).

Appendix D

Garry oak meadow restoration spot plant species list found [here](#).

Appendix E

Composting plan for Esquimalt Gorge Park can be found [here](#) and a compost flyer [here](#).