Restoration of relict Garry oak *(Quercus garryana)* ecosystem along the Colquitz River: A study conducted in Cuthbert Holmes Park Saanich BC, Canada

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Restoration of Natural Systems

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Abstract

The focus of this study is to restore an area underneath the Garry Oak *(Quercus garryana)* canopy by utilizing cutting, trimming and thinning techniques in an attempt to mimic natural successional processes. The objective is to open-up the shrub layer, which may increase the potential for native species colonization. Prior to the restoration activity, site surveys and monitoring were conducted by E. Strachan in an urban forested area located within Saanich. BC, on the traditional territories of the Esquimalt and Songhees First Nations. Vegetation surveys were conducted in the summer and fall season to identify native and invasive plant communities found in the area. Based on observations, the study found limited native vegetation, potentially due to the overcrowded invasive vegetation found in the shrub layer. In addition, previous restoration initiatives were discussed to identify ways to increase public participation and build strong relationships with community leaders, which is recommended for future restoration activities.

Acknowledgements

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1.0 Introduction

1.1 Garry Oak Meadows

Garry oak *(Quercus garryana)* ecosystems are considered a unique national treasure, with less than 5% remaining in their natural state in Canada (GOERT, 2007). Garry oak *(Quercus garryana)* trees are a species that typifies rain-shadow forests, which are often dry and have an open canopy (Pojar, J, MacKinnon A., 1994). Human disturbance and the lack of natural successional processes has left a lasting impact on the area, which can be seen in the lack of species diversity, the growing presence of invasive plant species and the overcrowding of vegetation in the shrub layer (see figure 1). Garry oak *(Quercus garryana)* meadow ecosystems have a fairly open forest, with an understory rich in species diversity (CRD, 2019).The replacement of native species with invasive species has led to the decline of habitat and food sources for a wide range of local wildlife (GOERT, 2007). The presence of these invasive plant species may hinder the natural succession of native plant species in the future. In addition, overcrowded vegetation may contribute to hiding undesirable activities such as illegal camping within the park, which has been a noted problem by the District of Saanich (District of Saanich, 2019).

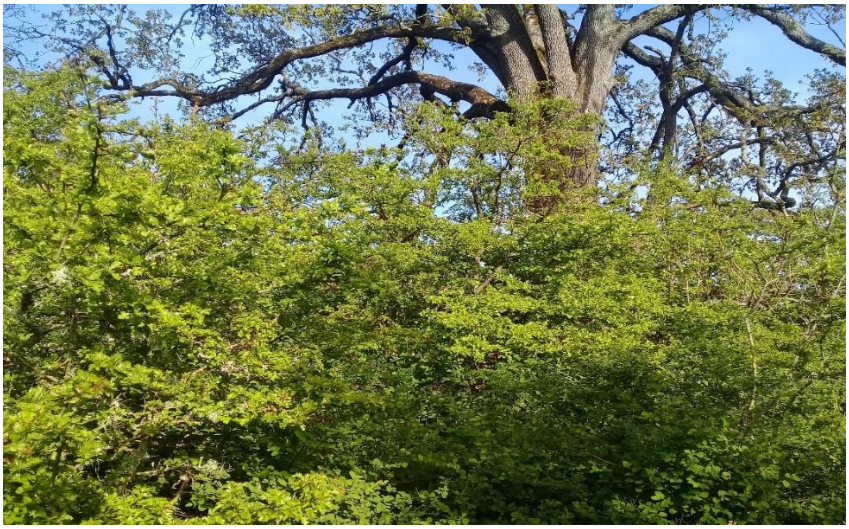

Figure 1: *The vegetation underneath the canopy of the Garry Oak (Quercus garryana) where the study was conducted. (Photo taken in May 2019).*

1.2 Cuthbert Holmes Park

Cuthbert Holmes Park in Saanich BC is described by locals as an oasis located within the City of Saanich (District of Saanich, 2019). Presently, the park receives intensive use from recreational activities, which has resulted in unauthorized trails, soil loss and the spread of invasive vegetation (Milo, C., 2013). The total area of the park is approximately 26.5 hectares and is located along the Colquitz river estuary on Esquimalt and Songhees First Nation traditional land. In the 1950's, the area was used for farming but was maintained as a park in the late 1960's (District of Saanich, 2019). The previous owners of Tillicum Mall (RioCan) near the park, had committed to restoring the riverbank closest to their property as a conditional variance to building two towers. Since then, the ownership of the mall changed to Anthem Properties in 2017 and the status of the proposal remains unknown.

1.3 Project Goals

This project presents a learning opportunity to study a relict *Garry Oak* (*Quercus garryana*) ecosystem that is found near the fish fence located behind Tillicum Mall (see figure 2). The project may provide public exposure to what the area could look like if successfully restored and could potentially revive habitat used by Coho Salmon and other species. The presence of exotic plant species in the area, may threaten native plant species due to overcrowding. Overcrowding and the lack of natural successional processes has potentially limited the colonization of native plant species such as *Camas* (*Camassia*), *Indian plum (Oemleria cerasiformis*), *fawn lily (Oregonum)*, and *salmonberry (Rubus spectabilis*) (see figure 5). Historically, periodic burning helped maintain the Garry oak *(Quercus garryana)* meadows which enhanced the production of Camas *(Camassia)* (Milo, C., 2013). Overcrowding of vegetation found in the shrub and herbaceous layers appears to have contributed to the accumulation of leafy debris, which is a fire-fuel and presents a hazard. The restoration activity seeks to initiate the recovery of the site and restore native plant communities.

Figure 2: *The yellow circle represents study plot 1. The red circle represents the restoration site and where study plot 2 was conducted. The blue line represents the fish fence location on the Colquitz River. (Retrieved from: imaps.bc.gc.ca)*

2.0 Methods

2.1 Rationale for research

The location of this restoration initiative was strategically chosen due to it being an access point into the park, and the communal educational values provided by the fish fence nearby (see figure 2). Two study plots were conducted and used for this initiative. The first plot was conducted on the perimeter of the restoration site, due the overcrowded vegetation hindering the sites' accessibility (see figure 3). The purpose of the first sample plot was to get an idea of what types of native and invasive vegetation could be found at the study site, prior to carrying out the restoration activity. The second plot was conducted within the restoration site and was analyzed post-restoration activities. Photo-point monitoring and weekly site visits were conducted in the late spring and early summer to determine plant species composition of the area and identify any bird or mammal nesting sites within the proposed restoration site. Photo-point monitoring and vegetation surveys were conducted in the late summer to identify native and invasive plant species found near the site to determine the potential success of natural recolonization of native vegetation. Restoration of the Garry oak *(Quercus garryana)* understory was conducted in the mid to late fall season, with on-going vegetation surveys and photo-point monitoring to evaluate the success of the restoration initiative. During the restoration process, community engagement was established through word of mouth, to provide opportunities for public feedback on the restoration initiative.

Figure 3: *Photo-monitoring done in the spring. Picture shows the overcrowded vegetation found in the Garry Oak (Quercus garryana) understory (Note: dense brush provides habitat for some biota found in the park e.g. Eastern cottontail rabbit (Sylyilagus floridanus) (Photo taken May 2019).*

2.2 Plot One Site Assessment

Plot one was assessed by E. Strachan and M. MacLean on May 6th, 2019, and metadata was collected (date, time, weather, gps co-ordinates). The plot was chosen based on level of accessibility, and the vegetation representative of the area closest to the restoration site (see figure 2). A visual inspection of the plot was conducted to determine types of vegetation, using observational methods and "Plants of Coastal British Columbia" (Pojar, J, MacKinnon A., 1994) field guide as reference. A 10-metre by 10-metre quadrat was measured out using a measuring wheel. A visual inspection was conducted at the centre of the quadrat looking upwards to determine the percentage of canopy coverage, using the "Field Study in Ecological Restoration 2" (Hebda R., 2018) as reference for all field methods. A visual inspection of ground coverage was conducted. Structural stage and site modifiers were determined. A visual inspection was conducted to identify any wildlife values found in the area. Pictures of the site were taken for future reference.

Table 1*: Vegetation found at first study site.*

Trees	**Shrubs**	**Herbs/Ferns**
English hawthorn *(Crataegus monogyna) (Invasive)*	Snow berry *(Symphoricarpos)*	Trailing blackberry (*Rubus ursinus)*
Garry Oak *(Quercus garryana)*	English Ivy *(Hedera helix) (invasive)*	Grass (unable to identify)
Red Alder (*Alnus rubra)*	Baldhip Rose *(Rosa gymnaocarpa)*	Bracken fern *(Pteridium)*
English Holly *(Illex aquifolium) (invasive)*	Ocean Spray *(Holodiscus Discolor)*	

2.3 Restoration Activity

Restoration activities were carried out in-situ by E. Strachan between August 26th, 2019 until October 20th, 2019, and similar metadata was collected as in plot one. A vegetation inventory was compiled during the restoration process to identify plant species, using "Plants of Coastal British Columbia" (Pojar, J, MacKinnon A., 1994) field guide as reference (refer to Tables 2 and 3 for vegetation inventory). Restoration of underneath the Garry Oak (*Quercus garryana*) canopy was carried out, using cutting, trimming and thinning techniques to remove invasive vegetation from the shrub canopy; to allow for optimal light penetration for native species saplings. Bi-weekly photo-point monitoring using a phone camera, was used to track progress of the restoration initiative and to identify potential bird and mammal nesting sites. A natural fence was established, to prevent the public from entering the site, using cuttings from invasive species (see figure 10).

Table 2: *Vegetation found at the site during the restoration activity (note: all native species identified were left alone excluding snow berries* (*Symphoricarpos), while invasive species were cut and left in-situ to biodegrade).*

Trees	Shrubs	Herbs/Ferns
Garry Oak *(Quercus garryana)*	English Holly *(Illex aquifolium) (invasive)*	Lady slipper *(Epipactis helleborine)*
English hawthorn *(Crataegus monogyna) (Invasive)*	Daphne laurel *(Daphne laureola) (invasive)*	Horsetail (*Equisetum arvense) (invasive)*
	Himalayan blackberry *(Rubus armeniacus) (invasive)*	Bracken fern *(Pteridium)*
	June plum (Oemleria cerasiformis)	
	Portuguese laurel *(Prunus lusitanica) (invasive)*	
	Snow berry *(Symphoricarpos)*	
	Oregon grape *(Mahonia aquifolium)*	
	Baldhip Rose *(Rosa gymnaocarpa)*	

Table 3*: Additional plants found in-situ during the restoration activity (see table 1 for rest of list).*

Trees	Shrubs	Herbs/Ferns
Cascara buckthorn (*Rhamnus purshiana)*	*Common privet* (*Lingustrum vulgare l.*) (Invasive)	
Grand fir (*Abies grandis)*	English Ivy *(Hedera helix) (Invasive)*	
	Trailing blackberry *(Rubus ursinus)*	

2.4 Plot Two Site Assessment

Plot two was assessed on November 1st, 2019, by E. Strachan and M. MacLean post-restoration activities, and similar metadata was collected as in plot one. Soil moisture and nutrient regimes of the site were identified, using the "Field Study in Ecological Restoration 2" (Hebda R., 2018) as a reference for all field methods. The total area of the site was measured using a measuring wheel and a map as a reference (see figure 4). Slope percentages on site were measured using a Clinometer. Diameters of the Garry oaks *(Quercus garryana)* found on site were measured, using a measuring wheel. A tree count was conducted using observational methods, to determine the number of Garry oak saplings *(Quercus garryana)* found on site. Humus form was determined by digging a hole at the centre of the site that was 0.5-metres width and 0.5-metres depth (see figure 12). Mineral soil was determined using the worm method by wetting soil in the hand and rolling it. Soil pH, and Nitrogen content was determined using a soil testing kit. Soil profiling and sampling were conducted to determine the soil moisture and nutrient regimes for the site and to compare typical pH and Nitrogen levels found at a sustainable Garry Oak (*Quercus garryana)* meadows ecosystem. Ground coverage on site was determined. Site series of the site was determined. Height of the main Garry oak *(Quercus garryana)* canopy was determined using a measuring wheel. Wildlife values were identified. A Terrestrial Ecosystem Map (TEM) was created to identify vegetation found near the site (see figure 15 and table 4). A visual inspection was conducted at the centre of the site looking upwards to estimate canopy coverage. Observational methods were used to determine vegetation found onsite, using "Plants of Coastal British Columbia" (Pojar, J, MacKinnon A., 1994) field guide as a reference. Pictures of the site were taken for future reference and recommendations were made. Ongoing monthly photo-point monitoring using a phone camera was conducted between November 24th, 2019, and December 5th, 2019, to track the progress of the restoration initiative upon completion. Observation notes were taken for future reference.

Figure 4: *Estimated 64metre perimeter and the estimated area of the canopy that is being restored (Retrieved from maps.bc.gc.ca).*

3.0 Results and Interpretation

Study Plot #1

Study Participants: E. Strachan, M. MacLean

Date: August 26th, 2019

Biogeoclimactic zone: CDFmm (Coastal Douglas Fir Moist Maritime)

Weather: 0/10 cloud cover, sunny

Lat: 48.45626°N – **Long:** 123.39631°W

Time: 3pm

Contact Information: Eddiedantes21@gmail.com

Map reference: GPS

Canopy Coverage: E. Strachan determined the canopy coverage was an estimated 60 percent.

Ground Coverage: E. Strachan determined the estimated ground coverage was 70% woody debris and 30% Snow berry *(Symphoricarpos)* leaves.

Structural Stage: 4 Pole/Sapling was determined based on Garry oak (Quercus garryana) trees in-situ and ex-situ greater than 10 metres tall and densely stocked.

Site modifier: Irregular (i) was determined based on the site having a very open overstory but overcrowded understory.

Wildlife values: Thick brush provides habitat for birds and mammals.

3.1 Restoration Activity Day 1

Activity Participant: E. Strachan

Date: September 14th, 2019

Time: 11:00am

Weather: 7/10 cloud cover, mostly sunny

Temperature: 11 degrees

Lat: 48.45603°N **Long:** 123.39658°W

Biogeoclimactic zone: CDFmm

Tools: Loppers, hand pruners, hand saw, thick gardening gloves,

Restoration site size: Estimated 64 metres

Map reference: GPS

Contact Information: Eddiedantes21@gmail.com

Site Observations: Very difficult to see anything on site due to the thicket of Snowberry *(Symphoricarpos)* and English hawthorn *(Crataegus monogyna) (See figure 5).*

Figure 5: *Left image shows View from the path looking at the restoration site. Right image shows thickets of Snow berry (Symphoricarpos) found underneath the Garry oak (Quercus garryana) canopy).*

Ground Coverage: E. Strachan determined the estimated ground coverage was 95% leaves and 5% woody debris.

3.2 Restoration Activity Day 2

Activity Participant: E. Strachan

Date: September 20th, 2019

Time: 11:30am

Weather: 7/10 cloud cover, mostly sunny

Temperature: 15 degrees

Lat: 48.45603°N **Long:** 123.39658°W

Biogeoclimactic zone: CDFmm

Tools: Loppers, hand pruners, hand saw, thick gardening gloves,

Map reference: GPS

Contact Information: Eddiedantes21@gmail.com

Site Observations: Great Blue Heron observed on one of the Garry oak (Quercus garryana) branches. Crows also observed around site. Girdling of hawthorn trees can be seen from previous day activities *(See figure 6).*

Figure 6: *Girdling technique used on English Hawthorn (Crataegus monogyna) to hinder growth and create snags for wildlife values.*

3.3 Restoration Activity Day 3

Activity Participant: E. Strachan

Date: September 27th, 2019

Time: 11:30am

Weather: 8/10 cloud cover, sunny + windy

Temperature: 14 degrees

Lat: 48.45603°N **Long:** 123.39658°W

Biogeoclimactic zone: CDFmm

Tools: Loppers, hand pruners, hand saw, thick gardening gloves,

Map reference: GPS

Contact Information: Eddiedantes21@gmail.com

Site Observations: Upon arrival to the site E. Strachan observed several birds on site, using snags created from cut hawthorns to hunt for insects on the ground *(See figure 7).*

Figure 7: *Biodegradation happening on site. All woody debris was left on site in contact with the ground for soil development. (Note: Snags created from cut hawthorn can be seen).*

3.4 Restoration Activity Day 4

Activity Participant: E. Strachan

Date: October 4th, 2019

Time: 10:40am

Weather: 8/10 cloud cover, slight rain

Temperature: 10 degrees

Lat: 48.45603°N **Long:** 123.39658°W

Biogeoclimactic zone: CDFmm

Tools: Loppers, hand pruners, hand saw, thick gardening gloves,

Map reference: GPS

Contact Information: Eddiedantes21@gmail.com

Site Observations: Upon arrival to the site E. Strachan observed reddish droppings underneath the Garry oak *(Quercus garryana*) canopy, next to the base of the trunk. In addition, two holes were discovered in-situ, potential den sites for a mammal (see figure 8).

Figure 8: *Picture on the left shows one of the two holes discovered in-situ, West on site. Right picture shows Reddish droppings potentially from a river otter at the base of the Garry oak (Quercus garryana) tree.*

3.5 Restoration Activity Day 5

Activity Participant: E. Strachan

Date: October 6th, 2019

Time: 3:30pm

Weather: 0/10 Sunny

Temperature: 14 degrees

Lat: 48.45603°N **Long:** 123.39658°W

Biogeoclimactic zone: CDFmm

Tools: Loppers, hand pruners, hand saw, thick gardening gloves,

Map reference: GPS

Contact Information: Eddiedantes21@gmail.com

Site Observations: Several birds were observed on site using snags to hunt for insects. Biodegradation of woody and plant material appear to be happening quickly in-situ (see figure 9).

Figure 9: *Photo-point monitoring taken from path East of site, shows the Garry oak (Quercus garryana) saplings and biodegradation happening in-situ.*

3.6 Restoration Activity Day 6

Activity Participant: E. Strachan

Date: October 11th, 2019

Time: 2:00pm

Weather: 0/10 Sunny

Temperature: 13 degrees

Lat: 48.45603°N **Long:** 123.39658°W

Biogeoclimactic zone: CDFmm

Tools: Loppers, hand pruners, hand saw, thick gardening gloves,

Map reference: GPS

Contact Information: Eddiedantes21@gmail.com

Site Observations: Cut vegetation in-situ significantly biodegraded possibly due to rainy, and sunny weather conditions. Garbage such as empty cans and tossed dog waste bags were found in-situ, and on the paths. Natural fence and cut English hawthorn *(Crataegus monogyna)* in-situ were seen to be deterring dogs and people from walking on site (see figure 10).

Figure 10: *Left image shows leaves of cut vegetation steadily biodegrading. In addition, natural fence still stable but slowly degrading. Right image shows Garbage that was found in-situ. (Note: Dog poop bags were a frequent find within the thicket of vegetation found near paths).*

3.7 Restoration Activity Day 7

Activity Participant: E. Strachan

Date: October 18th, 2019

Time: 11:00am

Weather: 10/10 Very rainy, with slight wind

Temperature: 2 degrees

Lat: 48.45603°N **Long:** 123.39658°W

Biogeoclimactic zone: CDFmm

Tools: Loppers, hand pruners, hand saw, thick gardening gloves,

Map reference: GPS

Contact Information: Eddiedantes21@gmail.com

Site Observations: One of the holes located North West in-situ, shows signs of activity. Some sticks and branches of cut English hawthorn *(Crataegus monogyna)* and Snow berries *(Symphoricarpos)* appear to be propped up inside the hole (see figure 11). Additional animal droppings were found under the Garry *oak (Quercus garryana)* tree.

Figure 11: *What is believed to be a river otter den site located on the West side of the site. (Note: twigs and sticks from cut vegetation potentially used by a river otter to stabilize den site).*

3.8 Study Plot #2

Activity Participants: E. Strachan, M. MacLean

Date: November 1st, 2019

Time: 11:00am

Weather: 2/10 Sunny

Temperature: 12 degrees

Lat: 48.45603°N **Long:** 123.39658°W

Biogeoclimactic zone: CDFmm

Tools: Loppers, hand pruners, hand saw, thick gardening gloves.

Map reference: GPS

Contact Information: Eddiedantes21@gmail.com

Soil moisture regime (SMR): SMR was determined to be 1-2. Based on the site being located on the upper slope, having a soil depth greater than 40cm, and particle size in the soil less than 20cm.

Soil nutrient regime (SNR): SNR was determined to be Rich to Very Rich. This is due to the soil on site being wet and forest floor being less than 20cm. Humus form on site is Moder with dark coloured soil in AH horizon being greater than 5cm.

Site Size: Estimated 64 metres (See figure 4).

Slope: From the Garry oak *(Quercus garryana)* tree to North edge of site, -2 degrees.

- From the river edge South West of the site to the Garry oak *(Quercus garryana)* tree, + 18 degrees.
- From East of the site near the path to the West of the site, +2 degrees.
- Highest point on the site is the tree crest.

Diameter at breast height of main Garry Oak (DBH): DBH was measured at 40 metres.

Average Garry Oak (Quercus Garryana) sapling DBH: 0.3 – 0.4 metres

Garry Oak (Quercus Garryana) sapling count: 17 Saplings were counted in-situ.

Humus form: Moder was determined to be the humus form in-situ, based on the L, F, H horizons being prominent and having a rich potting soil smell. Plant roots were abundant in the AH horizon.

Mineral Soil: Silty Clay (SiCl) was determined, using the worm method (see figure 12).

Figure 12: *Soil found at dig site (Note: soil pits should be 1metre width and 1metre depth, was unable to do, due to root and equipment restrictions)*

Soil pH: 6.5 - Slight Acidic (see figure 13).

Soil N: N.0 – Depleted (see figure 13).

Figure 13: *Soil samples taken from the soil pit. (Note: Sediments have yet to settle in pictures)*

Ground coverage: Ground coverage for the site was an estimated 20% woody debris and 80% leaves (see figure 14).

Site Series: Fd 03 (Onion grass), due to the Garry oaks *(Quercus garryana)* trees being the dominant canopy. Headed towards FdBg 04 (Oregon grape), due to the presence of successional species such as Grand fir *(Abies grandis)* bordering the site.

Tree height of main Garry Oak: Estimated 13 metres.

Wildlife values: Woody debris and logs left on site creates habitat for animals and insects (National Wildlife Federation, n.d.). Snags created from hardwood trees make good nesting sites for birds (National Wildlife Federation, n.d.) (e.g. E. hawthorn). Dead wood on site provides a food source by attracting insects and other microorganisms (National Wildlife Federation, n.d.) (see figure 14).

Figure 14: *Left image shows large logs of cut English hawthorn (Crataegus monogyna) resting against a thicket of Snow berries (Symphoricarpos) along the river. Right image shows dead wood on site and many Bald-hip rose (Rosa gymnaocarpa) plants preserved in-situ.*

TEM map:

Figure 15*: Shows a Terrestrial Ecosystem Map (TEM) and site series of the area*

Table 4: Shows TEM data

UTM Coordinates	**Site Series**	**Structural Stage**	**Plant Communities**		
Lat: 48.45603°N	Fd03 – FdBg 04	4i	**Trees**	**Shrubs**	**Herbs/Ferns**
Long: 123.39658°W			Garry oak *(Quercus garryana)*	Snow berry *(Symphoricarpos)*	Grass (Unable to identify)
			English hawthorn *(Crataegus monogyna)*	Himalayan blackberry *(Rubus armeniacus)*	Sword fern (Polystichum munitum)
			English Holly *(Illex aquifolium)*	June plum (Oemleria cerasiformis)	Bracken fern *(Pteridium)*
			Grand Fir *(Abies grandis)*	Daphne laurel *(Daphne laureola)*	Lady slipper *(Epipactis helleborine)*
			Red Alder (*Alnus rubra)*	English Ivy *(Hedera helix)*	Horsetail (*Equisetum arvense)*
			Red-osier dogwood *(Cornus stolonifera)*	Baldhip Rose *(Rosa gymnaocarpa)*	
			Cascara buckthorn	Oregon grape *(Mahonia aquifolium)*	

			(Rhamnus purshiana)		
				Trailing blackberry *(Rubus ursinus)*	
				Ocean Spray *(Holodiscus Discolor)*	
				Common privet *(Lingustrum vulgare l.)*	

Canopy coverage: Canopy coverage from the Garry oak (*Quercus garryana*) was an estimated 30% (see figure 16).

Figure 16: *Underneath the canopy of the Garry oak (Quercus garryana) that is being restored*

Site Observations: Garry oak *(Quercus garryana)* leaves from the canopy have covered the entire restoration site (see figure 17). E. Strachan saw more twigs and smaller branches at the potential den site in-situ to the West. Further investigation of den site has led to the appearance of the small mammal using the site. E. Strachan believes the mammal is a North American river otter *(Lontra canadensis*), with its black shiny fur and its long body.

Figure 17: *Left image shows photo-point monitoring from path looking on site. With understory cleared out Garry oak (Quercus garryana) leaves were able to reach the ground. Left Image shows ground coverage of leaves in-situ.*

3.9 On-going Monitoring and Observations

Date: November 24th, 2019

Time: 11:10am

Weather: 0/10 Sunny

Lat: 48.45603°N **Long:** 123.39658°W

Biogeoclimactic zone: CDFmm

Map reference: GPS

Contact Information: Eddiedantes21@gmail.com

Site Observations: Flower buds showing on June plums (*Oemleria cerasiformis*) and Garry oak (*Quercus garryana*) saplings. Deer scat observed in-situ. More changes found at river otter (*Lontra canadensis)* den site (see figure 18).

Figure 18: *Left image shows June plum (Oemleria cerasiformis) buds appearing. Right image shows changes at the river otter den site, and biodegradation of plant material left on site.*

Date: December 5th, 2019

Time: 11:30am

Weather: 10/10 Cloudy

Lat: 48.45603°N **Long:** 123.39658°W

Biogeoclimactic zone: CDFmm

Map reference: GPS

Contact Information: Eddiedantes21@gmail.com

Site Observations: More feces observed at the base of the Garry oak (Quercus garryana) tree, believed to be from the resident River otter (*Lontra canadensis*). Potential oil run-off observed in the water South West of the site (see figure 19). Birds observed using snags in-situ to hunt for insects on the ground.

Figure 19: *It is believed to be oil on the surface of the river potentially from road run off. (Note: District of Saanich was notified immediately)*

4.0 Discussion and Recommendations

4.1 Disturbance Processes

Disturbance processes were historically operated in Garry oak (*Quercus garryana)* ecosystems by First Nations, which included fires, mowing, and weeding (GOERT, 2007). Prescribed burns are known to remove invasive shrub species such as Snowberry *(Symphoricarpos)* and create the space native forbs need in order to survive (Parks Canada, 2006). Based on observations, it appeared as though the thickets of common Snowberry *(Symphoricarpos),* English hawthorn *(Crataegus monogyny), and* English Ivy *(Hedera helix)* were affecting light penetration reaching the ground, thereby likely hindering species diversity and suppressing native plant colonization (see figure 3 and 5). English Ivy *(Hedera helix)* tends to grow in dense patches, which can block sunlight for low growing vegetation and can hinder seeds' ability to germinate (GOERT, 2007). In addition, their presence may create ivy deserts, effectively out-competing native vegetation and eliminating wildlife habitat (GOERT, 2007). The presence of English hawthorn *(Crataegus monogyna)* creates habitat for non-native biota

impacting the park which includes Eastern cottontail rabbit *(Sylvilagus floridanus)* and the Eastern grey squirrel *(Sciurus carolinensis)* (GOERT, 2007). The goal was to utilize cutting, trimming, and thinning techniques to mimic natural disturbance processes. There by, reducing vegetational density found in the shrub layer, and opening the area for potential colonization of native species.

4.2 Restoration Site and Soil Sampling

It is highly recommended to increase the restoration zone to surrounding areas. The area underneath Garry oak *(Quercus garryana)* canopies located near the restoration site may require additional efforts. Expanding the restoration zone has the potential to inhibit the encroachment of invasive species found in the surrounding areas, such as English hawthorn *(Crataegus monogyna)*. With the absence of natural successional processes such as fire, native species such as Snow berries *(Symphoricarpos)* can become invasive (GOERT, 2011). It is recommended to utilize cutting, trimming and thinning techniques, to manage Snow berry *(Symphoricarpos)* thickets and allow for continuous light penetration to the ground, when controlled burns are not an option. Techniques that mimic natural successional processes help open-up the landscape, which allows the re-establishment of native species (Barlow, C., 2012). Natural recovery processes found within the ecosystem can often be accelerated by replanting activities (Hartman, K, McCarthy B., 2004). After treatment, vegetation and site surveys should be conducted to monitor and remove non-target species from the site (Barlow, C., 2012).

Garry oak *(Quercus garryana)* meadows tend to have rich, black, loamy soil through yearly growth and decomposition of vegetation (Acker, M., 2012). Soil pH levels found in a sustainable Garry oak (Quercus garryana) meadows ecosystem can tolerate a range of pH 4.5 to 7.5 (Pottinger Gaherty Environmental Consultants, 2015). Samples taken at study site 2 showed pH levels to be at 6.5, therefore appearing to be at an acceptable level. Nitrogen levels in Garry oak meadows are typically poor, resulting in less competition with other species (Parks Canada, 2006). The opened landscape, and nitrogen deficient soils found at the restoration site may give opportunities for additional Garry oak *(Quercus garryana)* saplings to colonize. Seasonal soil sampling and vegetation surveying is recommended to analyze the effects of biodegraded Garry oak *(Quercus garryana)* leaves on soil composition. It is recommended to install additional disposal containers or moving a current one to the South of the site near the fish fence, to ensure waste is being properly disposed of and invasive species aren't spread (see figure 10).

4.3 Protecting River Otter Habitat

River otters (*Lontra canadensis*) live in dens called holts, with the main entrance being in the water, leading to a space above ground that allows air flow (FSU, 2020) (see figure 18). Populations of North American river otter (*Lontra canadensis*) have been on the decline due to habitat loss (CRD, 2019). As top predators in the food chain, North American river otters (*Lontra*

canadensis) are vital to the ecosystem they inhabit (CRD, 2019). Smaller prey is consumed in the water, while larger prey is brought up to the shore which provides nutrients to the riparian zone and surrounding ecosystem (SeaWorld, 2020). River otters (*Lontra canadensis*) presence is known to have human benefits, due to eating fish that compete with commercially valuable species (CRD, 2019). Scientists have used river otters as a bioindicator for issues facing aquatic ecosystems (FSU, 2020). Utilizing on-going monitoring techniques and protecting the river otter found at the restoration site, there is potential to find bioindicators on the health of the Colquitz River and track the success of the restoration activity.

4.4 Considerations for Restoration

Considerations in restoration activities should include restoring community structure and ecosystem level processes (Hartman, K, McCarthy B., 2004). In the paper "Restoration of a Forest Understory After the Removal of an Invasive Shrub Amur Honeysuckle *(Lonicera maackii),*" the primary objective was to increase diversity of native plant species found in the shrub layer, and restore the ecosystem level processes through replanting of native vegetation. The study found that by reducing the abundance of *L. maackii* found in the shrub layer, survival of native seedlings increased (Hartman, K, McCarthy B., 2004). The assumption is that, by reducing the thickets of Snow berry *(Symphoricarpos)* and invasive species found in-situ, a similar result will occur. In the paper cited above, the study found that cutting techniques alone were a less than adequate method of control for invasive species in open habitats, due to it increasing the stem numbers found in-situ (Hartman, K, McCarthy B., 2004). English hawthorns that have be cut, have the potential to re-sprout if the root system is intact (NWCB, 2020). Cutting and herbicide application through injection proved to be the most effective technique used in eradicating woody invasive plant species (Hartman, K, McCarthy B., 2004). The assumption is by utilizing herbicides as a complimentary method with cutting, eradicating woody invasive species is possible. However, due to the site being close to a fish spawning river, herbicide usage may have undesirable negative benefits that prevents its usage as a viable management strategy.

Due to the impacts of fire suppression, land usage, climate change, and the presence of invasive species it is unlikely the desired site will be restored to a historical condition (GOERT, 2007). Presently, climate change has ensured many historical restoration targets will be unsustainable in the coming decades (Jackson, S.T. and Hobbs, R.J., 2009). When possible and sustainable, restoration efforts should seek to preserve and restore historical ecosystems (Jackson, S.T. and Hobbs, R.J., 2009). This project seeks to preserve and restore the historical ecosystem of Garry oaks *(Quercus garryana)* found at the site. However, as climate change contributes to altered biomes, it may be necessary to anticipate and accommodate new species as they migrate and colonize new areas. The restored site may have combinations of species that never previously occurred (Jackson, S.T. and Hobbs, R.J., 2009).

5.0 Conclusion

5.1 Partnered Stake Holders and Interested Parties

Successful restoration initiatives are reliant upon the coordinated efforts of partnered stakeholders and the values of the public and communities in which these ecosystems exist (GOERT, 2007). In the "UVIC Garry Oak Meadow Restoration Project," advertisements were crafted, and media outlets were approached to give interested parties an opportunity to register for the charette and other planned events (Bein, M., 2003). Focus groups were established to evaluate common elements found within the restoration project which included education, landscape design, plant selection, adaptive management, and outreach (Bein, M., 2003). First people's speakers such as Cheryl Bryce from the University of Victoria, were invited to the charrette to speak about Indigenous connections to the site and possible partnerships (Bein, M., 2003). Projects such as the "UVIC Garry Oak Meadow Restoration Project" can be used as a guideline for how to establish stronger Indigenous and public partnerships in future restoration projects within Cuthbert Holmes Park.

5.2 Threats to Species Diversity

Invasions of exotic species impose on biotic thresholds and limit the success of ecological restoration projects (Norton, D., 2009). These thresholds are difficult to reverse and may have long-term consequences for restoration initiatives (Norton, D., 2009). More action is needed to control the spread of invasive species such as English hawthorn *(Crataegus monogyna),* which poses a threat to biodiversity in the area. More public knowledge is needed on the fragility of Garry oak (*Quercus garryana*) ecosystems and the threats invasive species have on their survivability. It is recommended to mimic successional disturbances by utilizing cutting, trimming, and thinning techniques to manage thicket density found in the shrub layer. Thinning techniques emulate natural processes that kill trees from the bottom up (Powell, D, C, et al., 2001). Utilizing thinning techniques allows for more sunlight, water and nutrient availability for the remaining vegetation, improving their physiological condition (Powell, D, C, et al., 2001). On-going monitoring of the site is recommended to continuously track seasonal changes in vegetation and invasive species encroachment.

5.3 Self Reflection

Throughout the restoration process the project faced many limitations, the main being tool constraints. Due to the presence of Garry oak *(Quercus garryana)* saplings amongst the thicket of shrubs, the most effective way to ensure limited native species were cut during the process, was using hand tools and selective cutting techniques. This process proved to be extremely labour intensive, requiring many hours on site identifying and cutting vegetation.

Unfortunately, this process is not perfect and some native vegetation was cut during the restoration activity. Upon reflection of the restoration activity process, it would have been preferable to put more time reaching out to community organized programs such as the "Pulling Together" program in Saanich BC, to recruit more restoration participants and reduce the labour intensity of the activity. In addition, community and Indigenous engagement should be incorporated in future restoration activities within the area.

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