Native Plant Forage Forest

Analysis, Design & Educational Proposal

for The Galiano Conservancy Association

University of Victoria

ES 441/ER 411

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Summary

The following report will detail an implementation and management plan for the Galiano Island Conservancy Association's planned Native Plant Forage Forest. The allotted land for the project is roughly one acre; it will be enclosed and cordoned off into three sections. The three sections we propose including are the historically and culturally important Garry Oak meadow Ecosystem, the present, dominant Coastal Douglas-fir Ecosystem and an area for fruit bearing trailing plants and shrubs. The proposed site will be composed exclusively of native species found on Galiano Island and therefore will require extensive exotic species removal and consistent monitoring and management over time. Our proposal will include detailed sections on site analysis, site preparation, site design, long-term management and monitoring, as well as education and community engagement recommendations. Our site design will feature educational spaces and a traditional pit cook area to complement the proposed camas meadow.

Introduction

With the rapid loss of indigenous culture and community connection to the land, demonstrating the traditional ethnobotanical uses of plants and re-engaging people with natural aesthetics is a top priority for the Galiano Conservancy Association. The aim of this project is to improve upon the educational spaces and opportunities on the Learning Center site at DL 57 for sharing traditional ecological knowledge with the community in such a way that will foster mutually beneficial human-nature relationships and greater levels of ecosystem stewardship. The report presents the designs for the three separate forage areas within the Native Plant Forage Forest as shown in figure 1 below; A Garry Oak Savannah which features important indigenous cultivated root crops such as camas and nodding onion; A Coastal Douglas-fir ecosystem, reflecting the area's dominant ecosystem and the native plants found historically on Galiano Island; and lastly a Trailing Plant and Shrub Demonstration Garden that will encompass food plants such as salmonberry and red huckleberry. For each of

the forage areas, our report will include the following components: background, the ecological conditions and structure, suggested species and a monitoring and management regime. A comprehensive restoration program will be suggested for the proposed site to mitigate the impacts of past logging and the abundance of invasive exotic species. Finally, our report will recommend educational and community connections to engage local communities and local First Nations with the diverse system of foraging species that grow on Galiano Island. A key focus of our groups project will be respecting and involving traditional knowledge holders in the design, implementation and educational aspects of the native forage forest.

Map data created using google imagery.

Figure 1: Visualization of the Native Plant Forage Forest ecosystem prescription.

Background/Site Analysis

The chosen site within the Galiano Conservancy Association's District lot 57 has been specified as Ecological Community 27 (Erickson & Simon, Galiano Learning Centre Baseline Report, 2015, p. 129). Ecological Community 27 is an area heavily shaped by human impacts. A few sparse stands of trees populate the site including Douglas-fir (*Pseudotsuga menziesii*), red alder (*Alnus rubra*), and western red cedar (*Thuja plicata*) but it is largely graminoid-dominated. The space has been recently logged in the last ten years, this and related activities have led to soil compaction and there is evidence of mechanical disturbance (p. 129-130). The recent logging have led to increased exposure of the land and led to dryer conditions in the summer and moister conditions during the fall. The historical cedar forest present on the site prior to logging provided moderately acidic soils. There have also been a large number of vegetative species introduced to Galiano Island mainly from Eurasia. There is a relative abundance of introduced vegetation on site, including: *Agrostis capillaris* (colonial bentgrass), *Anthoxanthum odoratum* (sweet vernal grass), *Bromus* (*Hordeaceus* & *Rigidus*; not *Carinatus*), *Cirsium* (*Arvense* & *Vulgare*; not *Brevistylum*), *Crepis capillaris* (smooth hawksbeard), *Dactylis glomerata* (orchard grass), *Digitalis purpureai* (common foxglove), *Holcus lanatus* (common velvet grass), *Hypochaeris radicata* (hairy cat's ear), *Lactuca muralis* (wall lettuce), *Lychnis coronaria* (rose campion). Ecological Community 27 also has a number of native species present on site including *Gaultheria shallon* (salal), *Isothecium*, *Juncus effusus* (common rush), *Juncus mertensianus* (Mertens' rush), *Juncus Bolanderi* (Bolander's rush), *Kindbergia oregana* (Oregon beaked moss), *Lonicera hispidula* (hairy honeysuckle), *Madia sativa* (Chilean tarweed), *Polystichum munitum* (western sword fern), *Pteridium aquilinum* (bracken fern), *Rubus leucodermis* (blackcap raspberry), *Rubus ursinus* (trailing blackberry), *Taraxacum sp.* (ruderalia), *Urtica dioica* (stinging nettle), *Vaccinium parvifolium* (red huckleberry), Thuja Plicata (western red cedar), *Arbutus menziesii* (Arbutus). The site has

an East to Northwest drainage gradient. Community 27 is also littered with many physical structures including logs, stumps and large rocks. The stumps have been marked in green on the map shown in figure 2.

Goals and objectives:

- **Regenerate a Disrupted Site ~ Assessment, Implementation, Management & Monitoring**
  - Prepare a site analysis that examines the soil, hydrology, topography, recent history, current exotic and native plant communities as well as other physical characteristics
  - Prepare a site design that incorporates the native ecosystem proposal separated by pathways, retained site structures and organisms and proposed learning areas.
  - Describe options for the removal of competing exotic species on the Forage Forest site.
  - Suggest management techniques for maintaining the Forage Forest as well as recommended monitoring processes

- **Engage and Educate the Community using the Native Plant Forage Forest**

  - Propose a native plant ecosystem organisation that reflects the range of historically occurring natural communities of Galiano Island. The ecosystems are Garry Oak Savannah, Coastal Douglas-fir Forest as well as a trailing vine and shrub edible Berry area and nursery tree stumps

- For each ecosystem and area, prepare a suggested list of appropriate food and medicine plants that have been used by indigenous people in the Gulf Islands
- Suggest opportunities for engagement of the local and indigenous communities, in the planning, preparation, and ongoing management of the Forage Forest.
- Prepare suggestions of educational experiences for all ages of learners participating in the growth and development of the Forage Forest

Our Ecosystem Approach Rationale

The Southeast corner of Vancouver Island and the Gulf Islands, including Galiano Island, in the Salish Sea are situated in a rain shadow that creates a relatively warm and dry climate. Ecologists working in British Columbia have described biogeoclimatic zones that are defined based on their vegetation, topography and climate within this region (Meidinger, D. and J. Pojar, 1991). Galiano Island is located in the relatively warm and dry zone called the Coastal Douglas-fir zone that is dominated by Douglas-fir (*Pseudotsuga menziesii)* and associated tree species such as grand fir (*Abies grandis)*, broad leaf maple (*Acer macrophyllum)* and western red cedar (*Thuja plicata)*. We also find in the very driest regions, open savannahs which are characterized by and dominated by Garry oak (*Quercus garryana)* and appropriately called a Garry Oak Meadow. These open prairies are dominated by native grasses and beautiful spring flowering perennials. The most important of these perennials for the Coast Salish are the two blue camas species as well as other members of the lily family whose edible bulbs were an important source of stored carbohydrate. (Duer, D. and N. Turner, 2005)

The Galiano Conservancy Association is very aware of the pressures of high population and private land ownership on remaining intact ecosystems in this region. At this point in time there are very small protected areas of intact Coastal Douglas-fir ecosystems and less than 5% of the Garry Oak Meadows remain in the entire region. (Curran, D. 2013) For this reason, an

ecosystem approach that demonstrates the diverse plants used by indigenous people for millennia is an appropriate application as an educational demonstration and ongoing community interaction.

The Learning Center site itself has been logged multiple times. Aerial photos demonstrate how DL 57 has been opened up by logging of the red cedar which dominated the central area. This site is now open which is unusual in this ecosystem but is useful for food purposes since a mature highly shaded forest will have very few edible plants. (Duer, D. and N. Turner, 2005)

Many berry species do not grow well unless they receive sufficient sunlight and for that reason often are found along the edges of vegetation such as on along stream banks or in clearings. Edible roots and rhizomes were also found in open areas and were actively cultivated by the Coast Salish to ensure a sufficient food supply. Their methods included processes such as transplanting desired species to areas where they were more accessible for harvesting and removing competing vegetation, shrubs and trees by controlled burns. (Duer, D. and N. Turner, 2005)

Approximately 300 species of plants were used by the Northwest Coast peoples for food, medicine , home, fishing and hunting supplies with approximately 100 species demonstrating multiple uses. (Duer, D. and N. Turner, 2005) Our proposal will only include a much smaller sample but based on the open area in which many important edible plants thrive, we would like to reflect the composition of native species traditionally used from Garry Oak Meadows, Coastal Douglas-fir forests and the various plants harvested as fruits and berries.

Risks of Cultural Appropriation

This project aims to create an educational space on the Galiano Conservancy land with Indigenous knowledge as a central feature. With this ambition comes great responsibilities to represent this knowledge truthfully, respectfully and with input from traditional Indigenous knowledge holders. Without this key focus comes great risks of cultural appropriation, which can be defined as:

> Cultural appropriation is the adoption of some specific elements of one culture by a different cultural group. It can include the introduction of forms of dress or personal adornment, music and art, religion, tradition, language, or behavior. These elements are typically imported into the existing culture, and may have wildly different meanings or lack the subtleties of their original cultural context. Because of this, cultural appropriation is sometimes viewed negatively, and has been called ″cultural theft.”
>
> (Haig-Brown, 2010. p 929)

Given this understanding of the risks involved in using indigenous knowledge educationally there is a great need to reach out to traditional knowledge holders of the Hul'qumi'num peoples or if possible those of Penelakut descent. Both the final design and implementation of the project should involve serious input and acceptance from traditional knowledge holders. These traditional knowledge holders should be given the option to have as large or small a role in the project and its educational aspects as they desire and it should not move forward without their explicit consent (Noble, 2015; Fournier, Lecture, July 7, 2016). The educational component of the forage forest would preferably be designed in concert with traditional knowledge holders. Elders could be given an educational role in sharing information on culturally significant plants and indigenous history to school groups and volunteers. If this kind of role is impractical then they should at least be consulted and valued as an equal partner in the creation and use of the forage forest as an educational space for indigenous knowledge.

Site Design

This report provides a comprehensive design approach for the Galiano Island Conservancy Association’s proposed Native Plant Forage Forest and also discusses the possible plans and actions that can be taken to manage and monitor the Forage Forest after implementation. The Native Plant Forage Forest is meant to imitate the natural features and functions of the historic conditions on Galiano Island (Hobbs, 2009). It should act at as a habitat for interesting

native plants, along with food, water, and nesting sites for wildlife. Shrubs, dense plantings, nurse logs, and snags provide all of these components. The Native Plant Forage Forest can help restore the connections within the local ecosystem by selecting plant combinations that would naturally occur in the landscape. Implementing a Native Food Forest will require active management such as adding new plants over time, selective weeding of invasive or aggressive species, and careful project placement. The ecosystem monitoring and management can also become a focus for education as it can expose students and teachers to new stewardship approaches based on natural cycles. For example, how to prune and weed herbaceous perennials so that they bear more fruit and seeds and also maintain the health and well-being of the plant. The Native Plant Forage Garden would make an excellent source of learning on the Galiano Conservancy Learning Center as it would provide an arranged “mini-ecosystem” that would provide an interactive educational experience as well as habitat for wildlife and plants. Paths, seating areas, a grandmother learning circle, and interpretive signage would aid in making the Native Food Forest welcoming and practical. We are prescribing the use of the site for the replication of the historical ecology of Galiano Island with an area allocated for the development of a Garry Oak Meadow Ecosystem, a Coastal Douglas-fir Ecosystem, and an Edible Shrub and Berry Nursery.

Map data created using google imagery

Figure 2: Native Plant Forage Forest Design Conceptualization

Enclosure

Our group designed the enclosure of the site to limit the ability for deer to jump over the fence. With guidance from Keith Erickson, the conservation coordinator at Galiano Conservancy, our group decided that the fence along the enclosure should stand away from steep slopes that may give deer the extra leverage needed to hop over the fence (K. Erickson, personal communication, July 5, 2016). As shown in figure 2, the fence will sit at the peak of the slope on the southwestern edge of the Native Food forest next to the old logging road that passes through site DL57. On the adjacent northeastern side of the Native Food Forest, the

sloping ground will result in having to add few inches added to the uphill side of the enclosure, also the fence will have to stand away from any major slope. This will ensure that the deer do not have a slope next to any fence that may give them ease of access into the enclosure by leaping in. Black-tailed deer, which are the native deer in the gulf islands, can jump as high as 6.3 feet but generally only tend to do so when chased (Oregon Department of Fish and Wildlife, 2008), consequently the fence should be approximately 6.3 feet high. The material our group recommends for the fences are welded wire fences, which are recommended where a long-term solution to deer foraging is desired. It has a long lifespan and is effective in reducing deer foraging.

The posts used to hold up the welded wire fences should be 8 inch studded steel T-posts which are ideal for straight fences (Oregon Department of Fish and Wildlife, 2008). The fence should be tightly fastened at the corners and at intervals along lengthy sections of fence. Woven wire should be used from the ground to at least 4.8 feet above the ground. Two widths of woven wire may need to be spliced together liberally with hog rings to get the 5 feet minimum woven wire height, depending on the width of the rolls available from the supplier. We recommended the portion of the fence above 4.8 feet may be constructed of filler wires with barbed wire strands stretched across each T-post and spaced no more than 5 inches apart to achieve the overall height of 6.3 feet. The bottom of the fence should be at ground level as deer can go under gaps as small as 6 inches. The dips in the ground should be filled with gravel, rocks, logs, or any other appropriate material. Stretch the welded wire fence tight and firmly secure to t-posts with t-post clips at the rate of at least 5 clips per post (Diydiva, 2009). Gates can be constructed in a number of ways and can be made of different materials as long as the height is maintained. Additional information on aspects of fence building such as corner bracing and stretching wire can be obtained from suppliers of fencing materials.

The approximate price for a woven wire fence to enclose 1 acre or 836 feet of fencing would be $2.50 per foot totaling $2,090 (Mayer, 2002). Although this is the estimated cost of building a fence for the Native Food Forage Forest, the conservancy should contact as many suppliers as possible to compare prices. It is important in restoration practice that the process is done as effectively and efficiently as possible (Keenleyside et al, 2012). Finding a low-cost reliable suppliers is an important aspect to establish the Native Food Forage Forest as prices can vary

significantly from one supplier to another. Also shipping costs and exact supply dates should be determined ahead of time

The Native Food Forage Forest should be built to be approximately 1 acre in size (K. Erickson, personal communication, July 5, 2016) and was designed to be approximately 13 meters from the road loop between the Native Plant Forage Forest site and the Galiano Conservancy Learning Centre. This was done for future application of a staging area where people can gather before entering the Native Plant Forage Forest. The staging area consists of an information sign and the entrance gate.

Pathways

The Native Plant Forage Forest is recommended to have different types of paths and trails for each of the different sections allocated to the forage areas. A wide and moderately direct path would be appropriated to the pathway that loops around the inside of the enclosure(shown in figure 2). The large width pathways encompassing the Forage Forest can be used as areas that allow a large number of people to enjoy the garden and also provide easy access for tools and materials in and around the Native Plant Forage Forest. The wide width path also leads into the Grandmother Cedar Learning Circle as this one of the many focal points where people could go to share stories about the Native Plant Forage Forest and also act as place for rest and contemplation. Narrow winding paths that lead to undisclosed places make up most of the pathways within the design of the Forage Forest. They invite people to slow down, observe and better experience the Forage Forest. Furthermore, in order to promote a sense of discovery and anticipation to the interesting plant attributes that lay await within the Native Forage Forest winding tails have been implemented into the design of the Native Food Forage Forest (Bohan, H and Klob, A, 2007). The stumps, logs and rocks that are scattered across the site may also be used as a seating locations along the pathways as a way to encourage a deeper appreciation of the Native Forage Forest and wildlife.

We suggest that the pathway for the Native Plant Forage Forest be similar to that of the current wildlife trails and the old logging roads, using the groundcover already present. The first step to creating the path would be to plot out where the path will go. Next, clear obstructions from the trail path such as fallen trees or large rocks. Using shears or a chainsaw, cut through saplings and other unwanted plants that are obstructing the pathway. Once the saplings are trimmed, what's left are sapling stumps which can pose as a tripping hazard especially in a low light conditions. Thereby, saplings should be trimmed as close to the ground as possible. Sapling stumps can also be removed with an axe by chopping where the root is located. At other times it may be possible to pull them out of the ground. If coming across a plant on the pathway route that can be of use within the Native Plant Forage Forest, transplant the plant to a different location within the site. After the obstructions have been cleared, create the trails by lawn mowing along the pathway route. Next take the garden rake and clear the debris off the trail (Adameater, 2015).

The trails that lie on drier ground will be easier to groom than that of the Coastal Douglas-Fir ecosystem, which resides in a riparian zone. The dry Garry Oak Ecosystem region can be groomed simply by removing sapling stumps and raking the debris from the trail. The trails in the riparian portion on the other hand will be much more difficult to groom as it consists of marshy soil. Riparian plants and marsh grasses also tend grow back with ease and also assemble in clumps. As a result, the trail in this area may become muddy and uneven. The trails on the moist riparian sites of the CDF ecosystem region should be laid down either with gravel or wood chips to flatten the trail and prevent the riparian plants from growing back. Utilize gravel if access to inexpensive gravel is available as gravel is an excellent trail material because it prevents most vegetation from reestablishing itself and is also great at percolating away water. Cedar wood chips, although not as good for drainage as gravel, provide a good alternative as it will prevent marshy grass from returning due to its high tannin content (Garden Walk Garden Talk, 2014). Finally, After the trail has been constructed, treading on the

trail helps keep the trail in good condition as a result of the constant foot-traffic, aiding in keeping the path packed down (Adameater, 2015).

Nurse Stumps

As a result of the extensive logging that occurred on site DL 57, a large collection of stumps occupy the Native Plant Forage Forest site. Although the large cedar trees were tragically felled, stumps can serve as hosts for new life and act as nurseries' for seedlings, moss, fungus, and other plants. These stumps can be modified artificially to provide a nutrient-rich habitat for growing plants and young trees and would provide an aesthetic appearance to the large number of stumps on the Native Food Forage Site. Furthermore, utilizing the stumps as raised beds for native vegetation will allow for the preservation of the existing structural characteristics and the establishment of structural complexity to the Native Forage Forest.

The first step in artificially constructing a nurse stump is to create a depression roughly 1foot deep and 6 to 12 inches wide by using an axe, mattock and/or chainsaw on the top surface of a stump. Add a few large handfuls, or more, of decaying wood (preferably from an already existing nurse stump) to introduce microbes and speed up natural decay. Then add humus-rich soil to the cavity and place a plant or plants that thrive within nurse stumps. Some plants native to Galiano Island that do well in nursery stumps are red huckleberry (*Vaccinium parvifolium*), spiny wood fern (*Dryopteris expansa)*, salal (*Gaultheria shallon)*, western hemlock (*Tsuga heterophylla*) and western red cedar(*Thuja plicata*) (Bohan, H and Klob, A, 2007).

Pit cook area

Our group prescribes an area for traditional pit cooks to be built in the Native Forage Forest next to the proposed Garry Oak Ecosystem site, which would also act as a traditional

root garden, to engage students and community in meaningful focal practice. Pit cooking is a process that requires teamwork and cooperation in order to cook a large quantity of food instantaneously. Having a space for culturally important food practices would provide a space for community growth through interaction, engagement, and transmission of knowledge. In the article Nature by Design by Eric Higgs, he uses the example of attending a pit cook to illustrate the concept of focal practice as the act of building value through participation (Higgs, 2003). Pit cooks are a traditional cooking technology that was once the dominant cooking method along the West Coast and into the interior for its effective ability to cook and transform complex carbohydrates the body otherwise could not digest into digestible forms (Chambers, 2016). For example, camas and onions contain inulin, a complex carbohydrate that tends to cause digestive upset generally because gut flora cannot properly break down complex carbs. However, when pit cooked or slow roasted the inulin is broken down in the slow cooking process, creating a caramelized sweet layer on the outside that is both delicious and easily digested (Kays, 2008). Thus pit cooking is not only culturally and socially important but nutritionally as well.

The recipe that our group suggests for the coastal style pit cook is from Ditidat and Pacheedaht First Nations' Ida Jones who had pit cooked as a young woman (Kittredge, 2009). The first step is to dig a pit and place cooking rocks at the bottom of the pit. As the fire is being built, add more rocks to the center of the fire. When the cooking rocks are hot, quickly remove any charcoal and burning leftover wood to ensure that a fire does not continue burning in the pit cook. Once the rocks are hot and the burning wood is removed (which should be done quickly as to lose as little heat as possible) someone holds a post upright in the middle of the pit. Then quickly take the salal and place it on the bottom of the pit, the branches keep food off the hot rocks and stops the food from getting burnt. Then progress in layers; as you place the sword fern fronds down over the salal, then the food and then sword fern fronds and then salal. Afterwards, pull out the wooden post and pour water down the hole made by the post. The pitcook should then be completely covered by a layer of cardboard or heavy canvas tarp. Next shovel soil or sand on the sides and overtop until no more steam is escaping to create an

insulating layer. Place a border around the edge such as a circle of rocks to ensure that no one walks over the pit as it'll be very hot. Finally, after being left for several hours (3-5 hours, traditionally left overnight) and the food is cooked, carefully uncover the soil, cardboard, salal, and sword fern and retrieve the food. The pit can then be sealed over so that bystanders do not fall into it.

The development of reserves on the Gulf Islands for the Coast Salish people initiated the construction of single-family houses, eliminating the use of traditional longhouses that sheltered on average twenty or more Coast Salish families (Gadacz, 2007). As a result, the Coast Salish People began using western style kitchen appliances which meant that the affected Coast Salish communities were not eating communally and were not having traditional pit cooks. In most aboriginal reserves today, longhouses are continued as political and ceremonial structures but do not hold the same relevance in housing as they did in the past (Harris, 2002). Reestablishing pit cooking to Galiano Island and Site DL57 would be an powerful act of ecocultural restoration, as it would reintroduce, educate as well as engage community members, students, and volunteers in culturally important food practices that were once widespread along the West Coast. Furthermore, reestablishing a pit cook can also contribute to building a stronger and more interactive learning environment at the Galiano Conservancy Learning Center that educates people on a wide range of First Nations ethnobotanical practices.

Ecosystem Prescription

Garry Oak Meadow Ecosystem

Although the ecological reference for the site was most recently a severely logged western red cedar forest, prior to that it was possibly Douglas-fir dominated which was also logged. Although it is unknown if over the historical record a Garry Oak Meadow was present

on the actual site, there are Garry oak trees along the area's shoreline and common camas *(Camassia quamash)* was found in large quantities at the village site of the current Dionisio Point (Erickson, K. July 5, 2016). Since one of the underlying principles of the Galiano Conservancy Association is to be collaborative and thereby respect, protect and restore the indigenous uses of the land, (Curran, D. 2013) the inclusion of a model Garry Oak Meadow within the educational Native Forage Forest is appropriate.

Figure 3: Current state of the proposed Garry oak site. Image by A. Kucher

The southeast edge of the proposed site closest to the current circle road is the driest area and is considered most suitable for placement of the Garry Oak Meadow demonstration site. Various perennial spring flowers with edible roots would be dominant. Large numbers of both common and great camas *(Camassia quamash and C. leichtlinii)* would populate the site as they did in traditional areas (Duer, D. and N. Turner, 2005). A selection of the other species described in Appendix A can also be included as the site develops. More details on appropriate plants and placements can be found in the GOERT Garry Oak Gardener's Handbook (Dunster, 2009). Grasses are often found in Garry Oak Meadows but have very few uses by the indigenous people. They can be useful for out competing Orchard Grass but may become dominant themselves and may want to be avoided with in this planting space. We would suggest planting one or two Garry oak seedlings in the Northeast corner so that the openness of the site would be retained while illustrating this majestic dominant species.

However, it should be noted that variable soil texture and drainage requires further soil identification for appropriate planting of species to specific soils within the site (Pringle, 2013).

This can be tested by transplanting a variety of plants to see which species are successful in different zones of the Native Food Forage Forest.

Coastal Douglas-fir Ecosystem

The Coastal-Douglas-fir (CDF) ecosystem occurs in a wide range of sites from dry outcrops to moist valley bottoms and covers a small area along British Columbia's southern coast. It is at the northern limit of its distribution on the Gulf Islands and southeastern Vancouver Island, this includes CDF species of seaside, rock outcrop, and forested habitat associations (British Columbia Ministry of Forests, 1999). On Galiano Island, a large majority of CDF species compositions result from the diversity of topographic attributes across the Island. Widespread human disturbance, such as the high intensity logging that occurred on site DL57, also has a significant impact on the CDF ecosystem associations found on Galiano Island.

On the Native Plant Forage Forest site there is a 3% - 5% slope gradient towards the wetland area which results in distinct soil moisture regimes (Pringle, 2013). The Coastal Douglas-fir ecosystem that may be implemented on site can be designed to represent plant communities that occupy a gradient of soil moisture regimes ranging from very dry to moist. In order to employ the distinct soil moisture regimes on site our group recommends two common site associations of the Coastal Douglas-fir ecosystem. In the dryer regions of the site a rock outcrop/seaside associated CDF ecosystem, and in the moister regions a densely canopied CDF ecosystem.

The region in the Forage Forest CDF area that has a very dry soil moisture regime should represent a Coastal Douglas-fir ecosystem that exists on rocky outcrops and pockets of shallow

soil (Nuszdorfer, 1991). The eastern region of the CDF site, next to where the proposed Garry Oak Meadow will go is the most disturbed area on site (due to the heavy logging that occurred) and is dominated by non native grasses and very little coniferous regeneration. In CDF ecosystems that exist on dry rocky outcrops the canopy consists of vegetation such as arbutus (*arbutus menziesii*), garry oak *(Quercus garryana)*, and occasionally lodgepole pine *(Pinus contorta)* that grow alongside Douglas-fir *(Pseudotsuga menziesii)*. Wild rose *(Rosa gymnocarpa)*, snowberry *(Symphoricarpos)*, and ocean spray *(Holodiscus discolor)* are also well adapted to open, dry ecosystems.

The moister regions of the Native Plant Forage Forest can be utilized as a canopied cover area (Nuszdorfer, 1991). A large portion of the western region where the Coastal Douglas-fir area is assigned, closest to the wetland area is, comprises of slopes, depressions and moister soils in which common rush, horsetail, and sedges can be found.Already present in this area is a combination of Douglas-fir*(Pseudotsuga menziesii)*, red alder *(Alnus rubra)*, western red cedar (*Thuja plicata)* and sword fern. This is a good indication that transplanting trees adapted to moist areas would thrive and vegetate quickly. In CDF forested habitats, Douglas-fir *(Pseudotsuga menziesii)*, grand fir *(Abies grandis)*, western redcedar *(Thuja plicata)*, bigleaf maple *(Acer macrophyllum)*, and western flowering dogwood *(Cornus nuttallii)* flourish together with understorey plants such as sword fern *(Polystichum munitum)*, three- leaved foamflower *(Tiarella trifoliata)*, and trillium *(Pacific trillium)* (Nuszdorfer, 1991). If needed, the soil can be made more moist by aerating and decompacting the soil using a mattock or shovel (K. Erickson, personal communication, July 4, 2016)

Edible Shrub and Berry Nursery

The edible shrub and berry nursery is situated along the southern border of our chosen site. We chose this site largely due to its slope which provides suitable planting sites for trailing plants, hardy shrubs and berries which have been shown to control erosion and improve slope stability (Norris et al., 2008). The suggested species list is by no means exhaustive, but features a wide variety of native species from across the island many of which were chosen to highlight indigenous knowledge and ethnobotanical uses. Several of the species suggested are already present on site including *Gaultheria shallon* (salal), *Rubus leucodermis* (blackcap raspberry), *Rubus ursinus* (trailing blackberry), *Vaccinium parvifolium* (red huckleberry). They should in most cases be identified, marked to be retained, transplanted if necessary and encouraged to propagate. The slope is currently dominated by *Gaultheria shallon* (salal), *Polystichum munitum* (western sword fern), *Rubus ursinus* (trailing blackberry), two large Berberis aquifolium (Tall Oregon Grape) and exotic grasses. It is our recommendation that the sword fern and exotic grasses be largely removed from the site through one of our management regimens detailed below in the 'Invasive Exotic Species Management' section. While we recommend retaining much of the salal and trailing blackberry, some will inevitably have to be removed or at least transplanted so that clear stands or sections of each remain.

Large shrubs like the red elderberry (*Sambucus racemosa)* and Tall Oregon Grape (*Berberis aquifolium)* would provide the dominant structures in this area and plants like the trailing blackberry and salal would make up the lower layers and trail up the base of shrubs.

Invasive Exotic Species Management

As described in the a site analysis, the proposed Forage Forest Area has a dominant population of exotic graminoid, thistle and other unwanted plant species. The site is further complicated due to the presence of many tree stumps, some desired native plants and trees as well as soil

compaction due to previous logging. The staff and volunteers of the Galiano Conservancy Association have great expertise in site restoration as observed in the mill site and the Cove area at DL 57 and in other areas around the island. This report is not intended as a restoration prescription but rather some suggestions to guide the preparation, management and monitoring of the Forage Forest site during its development.

The removal of unwanted exotic species should be done in small patches due to the variation in physical characteristics of the site. The large populations of these exotics both on and surrounding the Native Forage Forest site make the restoration process difficult. Soil disturbances and the opening of soil through tilling allow the introduction of seeds from these unwanted plants. The most significant invasive species on the site are the orchard and velvet grasses (*Dactylis glomerata* and *Holcus lanatus)*. The Canada thistle (*Cirsium arvense*) component is considered to be less significant (Eastman et al, 2011). The best practices for the removal of Orchard Grass are to cut the root Crown using a hook knife. This is much less disruptive than pulling the plants themselves but does require repeat treatments. If the Conservancy chooses instead to dig up the orchard grasses then the hole should be planted with Native grasses immediately in the fall after rain begins (Eastman et al, 2011). Alternatively, if all invasive plants are removed in a site area then replanting and mulching with alder chips immediately may limit the intrusion and regrowth of unwanted species. The best times for the removal of Canada thistle is in the spring around the month of April (Eastman et al, 2011). An alternative practice in small patches is the use of selective flaming during the wet season. Clumps can be burnt one at a time and the area can then be reseeded. although the plants will not resprout, seeds may still be present (Eastman et al, 2011). Some expertise is required in doing the selective flaming but it does reflect the traditional practices of indigenous people in maintaining their camas and other food plantings using controlled burns (Duer, D. and N. Turner, 2005).

Another important process that needs to occur early in the restoration is fencing the entire site to protect it from the impact of deer browsing. Research has shown high populations of

deer present on Galiano and other Gulf islands prefers edible native species such as Ocean Spray and have a deleterious impact on understory plants, many of which are being planted on this site (Arcese, Schuster, Campbell, Barber, & Martin, 2014). Our site design is based on having fences at the tops of the slopes leading down into the site to limit the ability of deer jump over.

The preliminary restoration methods are responsive to “intelligent tinkering” where the site managers must be responsive to methods and strategies that work and don't and then apply them further as they move through the process (Clewell, A. F., and Aronson, J., 2013).

The Galiano Conservancy is currently producing a seed bank and growing native species using genetic material that is native to the island and thus is appropriate for use in the Forage Forest (Erickson, K. July 5, 2016. Keenleyside et al, 2012). If possible, when transplanting species, it can be useful to build up the soil and add some into the planting hole using natural organic material that are sourced from within the protected or adjacent areas (Keenleyside et al, 2012).

Adaptive management using the expertise of Conservancy staff, the indigenous community, local volunteers and student collaborators is essential to responding to variations in weather and climate on the site (Keenleyside et al, 2012). Ongoing, scheduled, long-term monitoring is critically important for local stakeholders to track any changes on the Forage Forest site (Clewell, A. F., and Aronson, J., 2013). Consistent photo records using specific photo points provide an easy to track record (Keenleyside et al, 2012). It is recommended to take these photos at different seasons as the species composition will change over time. Recorded changes can then be applied to future planning as the site is developed.

Proposed Educational and Community Connections

Galiano Conservancy is an organization whose primary purpose is "To preserve, protect and enhance the quality of the human and natural environment" on Galiano Island (Curran, D.

2013). This has been reflected in their ongoing commitment to conservation, stewardship and restoration of land such as DL 57 and to Environmental Education and the building of community through public awareness. This ethic is reflected in the work of the IUCN, the International Union for the Conservation of Nature, which is a global leader in ecological restoration. Their three underlying principles for restoration ecology are that it must be **effective** in terms of re-establishing and protecting both cultural and natural values. It must be **efficient** in terms of the utilisation of labor and funds which is also an important condition for the work of the Conservancy which is a non-profit Society. And finally, it values **engagement** which promotes the participation of both the community and visitors but most importantly requires prior consent and collaboration from indigenous peoples. (Keenleyside et al, 2012)

The following suggestions for educational and community activities reflect the spirit of collaboration that we observed in the interactions of people involved in the Galiano Conservancy as well as the underlying principles of Ecological Restoration.

The Conservancy staff and volunteers are already working as much as possible to maintain the connections and collaboration with the indigenous people from Penelakut Island. This reflects the principles of Traditional Resource Management which emphasize the need for collaborative and collegial Indigenous Partnerships. This respect is based on the understanding that indigenous people often have knowledge of natural thresholds within ecosystems and are aware of adaptations that may be more appropriate. Here on Galiano many indigenous practices shaped the historical ecological structures and vegetation composition (Keenleyside et al, 2012) which is part of what the native Forage Forest will be reflecting.

During the planning stages for the development of the Native Forage Forest, students from both Galiano, Penelakut and other Gulf Islands are encouraged to work together on the selection of appropriate plants in each ecosystem section. This research could involve reaching out to the elders for stories about different plants and names that were used to describe them.

Students could work collaboratively between the schools to put together a storybook telling the history of these plants in the native cultures tradition. It would be appropriate to request permission to plant the species on this Conservancy land from the native communities and request their expertise at all planning stages.

There is a great deal of work required in preparing a site for restoration. It might engage and enhance responsibility to have different school classes take on one section of the forest site and do all of the required steps over an extended period of time: exotic species removal, site preparation, planting, monitoring and management.

Edible bulbs in the lily family such as camas take a very long time, four to five years, to develop from seed to a size appropriate for planting. A long-term activity for students would be to gather common or great camas seeds from a local natural area site at the end of June. They would then plant these seeds into large rectangular gardening trays the next fall when the rains begin. The seed trays could stay out for the winter and students could then monitor them in the spring for initial growth and also ensure that they do not dry out excessively if there is a drought in the spring. Once the plants have completed their spring growth they will die back and the trays can be stacked for the summer. The trays can then be spread out again when the rain returns and the plants will once again grow through the winter and into the spring. Once the growth is almost complete the small plants and bublets may be separated into larger pots for the next two years growth cycles using the same dry and wet treatments. This cycle would continue until when the bulbs are of sufficient size to be planted in the Forage Forest. This would happen in the fall four or five years after the beginning of the project. This would give the students an understanding of how long life cycles can be and how important thorough management is throughout the life cycle. Indigenous people managed the camas fields to be able to remove larger bulbs for consumption while keeping smaller bulbs to grow. It has been estimated that an extended family of ten people would consume 10 000 bulbs each year (Duer, D. and N. Turner, 2005). An excellent example of sustainable management!

The harvesting process itself can be done in a way to benefit both the plant and animal populations by way of stewardship. Knowledge, skills and worldviews that support sustainable resource use within the harvesting practice should be an important aspect of education in the Native Plant Forage Forest. There is a phrase by the kwakwaka'wakw peoples that translates to "keeping it living", which would be the idea of maintaining the ability of plants and animals to continue to grow and reproduce by not over harvesting or inflicting other damage (Deur, 2005). Students can be taught these ideals by working with the natural reproductive and regenerative processes of plants. For example, salmon berries are a perennial fruit bearing species, which lose vigor after a few years due to their abundant fruiting and flowering with a final decline caused by viral diseases (Lloyd, 2014). There are many ways we can steward and look after these perennials in a way that keeps them living longer and healthier than they would naturally. Pruning is done by breaking off some of the mature wood from the plant which stimulates nodes on the stem. The new stems are then able to divide into new side shoots and branches thus the plant is able to bear more fruit and seeds and loses diseased parts of the plant (Chambers, 2016). The kwakwaka'wakw ideology of "keeping it living" can be taught during the harvest of the berries and other plants in the Native Food Forage Forest; through stewardship techniques such as weeding, fertilizing, tending, pruning, and selective/partial harvesting. Managing the landscape in this aspect demonstrates the symbiotic relationship that can be created between plants and people through stewardship.

Students could conduct research on different case studies of ecological restoration projects and compare them to the work they are doing on Galiano. There are many excllent reserouces for this listed with the Society for Ecological Restoration (http://ser.org/restorations/restorations-list-view) and through the Global Restoration Network (http://www.globalrestorationnetwork.org/).

Our bodies have a heart and so does the Native Forage Forest: the last remaining partially cut Western Red Cedar or Grandmother Cedar! Near her base are many stumps which could be transformed into a learning circle by placing boards between them to make room for many to sit a while and listen to stories from the land. Students could hear shared traditional stories or

make their own plant histories come to life. Other visitors may find this a place of solace and meditation in the heart of the forest.

Sharing information about the plants and ecosystems can be done with appropriate signs that can be developed by students or community members working on different facets of its development. A large welcoming entrance sign and Grandmother Cedar sign are recommended. Smaller signs to help identify species, their role in the ecosystem and uses by people could also be developed.

Restoration work requires a lot of labour. With the development of the campsite and learning center, it may be possible to host 3 to 4 day or even week long volunteer weeks where people pay to come and remove invasive species! Some programming development and tours of local restoration projects would make it worthwhile for many concerned individuals to play a part in shaping the Forage Forest.

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Appendices

Table 1. Garry Oak Meadow - Suggested species and uses

Species Name	**Common Name**	**Traditional Uses**
Grasses		**Not used except to outcompete exotic grasses**
Bromus carinatus	California Brome	"
Danthonica californica	California Oatgrass	"
Elymus glaucus	Blue Wildrye	"
Festuca idanoensis ssp roemeri	Roemer's Fescue	"
Early Spring Bloomers:		
Camassia quamash	Common Camas	Bulbs a staple food. Pit cooked.
Camassia leichtlinii	Great Camas	Bulbs a staple food. Pit cooked.
Fritillaria affinis	Chocolate lily	Bulbs eaten
Lomatium utriculatum	Spring Gold	Roots eaten
Mid-Spring Bloomers:		

Achillea millefolium	Yarrow	Medicinal uses
Allium acuminatum	Hooker's onion	Entire plant eaten. Pit cooked.
Allium cernuum	Nodding onion	Entire plant eaten. Pit cooked.
Aquilega formosa	Red Columbine	Medicinal and pollinator.
Brodiaea coronaria	Harvest Brodiaea	Roots eaten
Epilobium angustifolium	Fireweed	Used for Cords. Pollinator
Heuchera micrantha	Small flowered Alumroot	Medicinal
Lilium columbianum	Tiger Lily	Bulbs eaten. Medicinal uses.
Lupinus bicolor	Two coloured Lupine	Nitrogen fixation. Pollinator
Summer and Later Bloomers		
Anaphalis margaritacea	Pearly everlasting	Medicinal
Sedum spathulifolium	Broad-leaved Stonecrop	Edible leaves. Medicinal.
Sedum lanceolatum	Lance-leaved Sedum	Edible leaves. Medicinal.
Sedum oreganum	Oregon stonecrop	Edible leaves. Medicinal.
Solidago canadensis	Canada goldenrod	Used as a tea. Medicinal.
Trees and Shrubs		
Arbutus menziesii	Arbutus	Cooked with camas to turn it pink. Medicinal.
Quercus garryana	Garry Oak	Acorns eaten. Medicinal
Holodiscus discolor	Oceanspray	hardwood used for digging sticks, Spears, arrowheads. Medicinal.

Plant and Ethnobotanical use information from: Dunster, Katherine J. 2009; Pojar, J., and MacKinnon, A., 1994; Turner, N. J., 1995

Table 2. Rocky Outcrop/seaside associated Coastal Douglas-Fir ecosystem - Suggested species and uses

Species Name	Common Name	Traditional Uses
Canopy		
Bromus carinatus	Douglas Fir	Pitch was also used as a medicinal salve for wounds
Danthonica californica	Arbutus	Bark boiled and used for tanning paddles, fish hooks and hides, contains tannin
Pinus contorta	Lodgepole Pine	Decoction of new shoots taken for stomach pain
Quercus garryana	Garry Oak	Acorns steamed, roasted or boiled and used for food
Shrub Layer		
Holodiscus discolor	ocean-spray	Infusion of seeds taken for smallpox, black measles and chicken pox
Mahonia nervosa	dull Oregon-grape	Berries eaten raw
Rosa gymnocarpa	Wild rose	Leaves placed under food while pitit cooking to add flavor and prevent burning.
Mahonia aquifolium	tall Oregon-grape	Berries eaten raw
Amelanchier alnifolia	saskatoon	Berries eaten raw
Symphoricarpos	snowberry	Berries rubbed on skin for burns. Can also be used for rashes and sores.
Herb Layer		
Columbia brome	Bromus vulgaris	Tied bunches of stems used to make brooms and brushes.
Lathyrus japonicus	beach pea	Immature seeds eaten as peas
Lonicera ciliosa	Orange honeysuckle	Tubes formerly sucked by children for sweet nectar
Trientalis latifolia	broad-leaved starflower	Infusion of plant juice used as an eyewash
Rubus ursinus	Pacific blackberry	Berries eaten raw
Galium aparine	cleavers	Compound infusion of plants used as wash for poison ivy and itch
Predominant Mosses		
Rhytidiadelphus	rough goose neck moss	Used for padding and bedding

Nuszdorfer, F. C., Klinka, K. and Demarchi, D.A.. (1991). Ecosystems of British Columbia: Coastal Douglas Fir Ecosystem, 81-92. Victoria, B.C.; Ministry of Forestry.

Table 3. Densely forested Coastal Douglas-Fir associated ecosystem - Suggested species and uses

Species Name	Common Name	Traditional Uses
Canopy		
Bromus carinatus	Douglas Fir	Pitch was also used as a medicinal salve for wounds
Abies grandis	grand fir	Needles dried, powdered, and used to scent the hair and keep from going bald.
Acer macrophyllum	bigleaf maple	Leaves used in steaming pits to flavor deer, seal or porpoise meat.
Cornus nuttallii	Western flowering dogwood	Inner bark is a pain killer, contains analgesic
Thuja plicata	Western Red Cedar	Bark made into soft warm clothing
Shrub Layer		
Gaultheria shallon	salal	Berries eaten raw
Mahonia nervosa	dull Oregon-grape	Berries eaten raw
Taxus brevifolia	western yew	The native people used the strong, stiff wood for making items such as bows, tools, and paddles.
Herb Layer		
Achlys triphylla	vanilla-leaf	Decoction of plant used as a furniture and floor wash for lice, bedbugs and other household pests.
Galium triflorum	sweet-scented bedstraw	Plant rubbed on the skin for chest pains.
Polystichum munitum	sword fern	Leaves used as temporary mats and mattresses, floor cover, wipe slime from fish
Rubus ursinus	Pacific blackberry	Eaten raw
Tiarella trifoliata	three- leaved foamflower	Raw leaves chewed as a cough medicine
Trillium ovatum	Pacific trillium	Infusion of roots used as a wash for sore eyes
Rubus spectabilis	Salmonberry	Eaten raw

Nuszdorfer, F. C., Klinka, K. and Demarchi, D.A.. (1991). Ecosystems of British Columbia: Coastal Douglas-Fir Ecosystem, 81-92. Victoria, B.C.; Ministry of Forestry.

Table 5. Edible Shrub and Berry Nursery - Suggested species/uses

Species Name	Common Name	Traditional Uses
Shrub layer		
Amelanchier florida	Saskatoon berry	Eaten raw, made into jams or cooked
Berberis aquifolium	Tall Oregon Grape	Used in cooking, can be made into a jam and wine. Used traditionally for aiding digestion (Pojar & Mackinnon 1994; Hunn 1990)
Mahonia nervosa	Dull Oregon Grape	Used in cooking, as a dye and for basket-weaving (Native American Ethnobotany Database)http://naeb.brit.org/uses/search/?string=Mahonia+nervosa
Rosa nutkana	Nootka Rose	Wide variety of indigenous medicinal uses as well as a food source (Native American Ethnobotany Database)http://naeb.brit.org/uses/species/3427/)
Ribes sanguinuum	Red-flowering Currant	Eaten raw, made into jams or cooked
Sambucus racemosa	Red Elderberry	Used medicinally and eaten once cooked, by indigenous peoples (Native American Ethnobotany Database)http://naeb.brit.org/uses/search/?string=Sambucus+racemosa
Symphoricarpos albus	Common Snowberry	Wide variety of indigenous medicinal uses (Native American Ethnobotany Database)http://naeb.brit.org/uses/search/?string=Symphoricarpos+albus
Vaccinium ovatum	Evergreen Huckleberry	Eaten raw, made into jams or cooked
Vaccinium parvifolium	Red Huckleberry	Eaten raw, made into jams or cooked
Low Shrub/Trailing Layer		
Rubus ursinus	Trailing Blackberry	Eaten raw, made into jams or cooked
Fragaria vesca	Woodland Strawberry	Eaten raw, made into jams or cooked
Rubus leucodermis	Blackcap Raspberry	Eaten raw, made into jams or cooked
Gaultheria shallon	Salal	Eaten raw, made into jams or cooked
Rubus spectabilis	Salmonberry	Eaten raw, made into jams or cooked