Laughlin Lake: Restoration Assessment and Future Projects to Promote a Biodiverse Galiano Island

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Section 1: Summary

Previous restoration at Laughlin Lake on Galiano Island occurred between 2000 – 2003 (Gates, 2003). This report was developed as a monitoring plan to assess the previous restoration conducted at Laughlin Lake and to report on species at risk found at the site: specifically the little brown myotis (*Myotis lucifugus*) and the red-legged frog (*Rana aurora aurora*). Invasive species at the site will be monitored for and removal will be conducted on problem species such as: Scotch broom (*Cytisus scoparius*), Canada thistle (*Cirsium arvense*) and others. Native species will be planted and a tree cover will be established on the North side of the lake to limit invasive grass growth. Trees and shrubs will be placed in wire cages to prevent destruction from the beaver that inhabits the Laughlin Lake area, and to limit deer browsing. The restoration will be monitored through repeat photography, allowing the conservancy to see the change in vegetation growth over time and determine whether the restoration project was a success. Further analysis at the Laughlin Lake site will be conducted to ensure there is a plenty of habitat for the little brown myotis and red-legged frog. Both of these species are threatened, therefore, ensuring their habitat is protected on Galiano Island and at the Laughlin Lake site will be beneficial for the species and will help their survival on the island. This restoration project will remove invasive species, ensure a healthy community of native plants protected from beaver and deer, and protect and establish additional habitat for the threatened species the little brown myotis and the red legged frog.

Section 2: Background

Galiano Island is found in the Gulf Island archipelago between Vancouver Island and mainland British Columbia (‘About Galiano Island,’ n.d.). The island is largely rural and is found in the coastal Douglas-fir ecosystem (Nuszdorfer, Klinka & Demarchi, 1991). Douglas

fir (*Pseudotsuga menziesii*), western redcedar (*Thuja plicata*), bigleaf maple (*Acer macrophyllum*) and arbutus (*Arbutus menziesii*) are common trees found in the coastal Douglas-fir ecosystem on Galiano Island (Nuszdorfer, Klinka & Demarchi, 1991). Shrubs include oceanspray (*Holodiscus discolor*), tall Oregon grape (*Mahonia aquifolium*), salal (*Gaultheria shallon*), salmonberry (*Rubus spectibalis*) and sword fern (*Polystichum munitum*) (Nuszdorfer, Klinka & Demarchi, 1991). During the 20th century most of Galiano Island was logged with small remnant patches of old-growth coastal Douglas-fir remaining on the island (G. Moore, personal communication, May 7, 2016). As a result, the forest on Galiano Island is mainly second growth, with the remaining forest being composed of similarly aged trees. Forests composed of similarly aged trees are not ideal, as they are less resilient and are more susceptible to disease and insect infestations (Merschel, Spies & Heyerdahl, 2014). It is important to create variety in stand age and structure in an ecosystem to ensure the long term survivability of forest environments.

Laughlin Lake is an 11-acre lake found approximately in the middle of Galiano Island (Figure 1) (Gates, 2003).

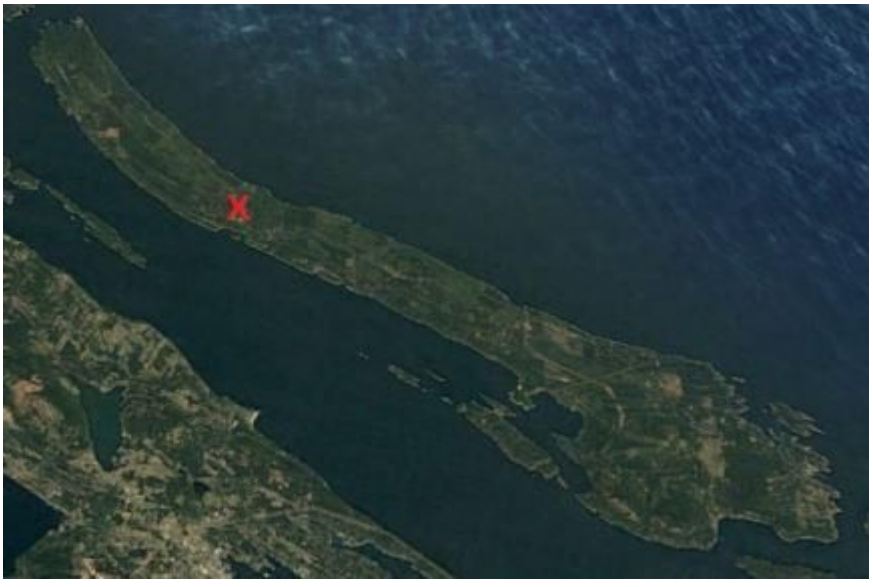

Figure 1: A map showing the location of Laughlin Lake on Galiano Island. The site is located at the red X. The satellite image was obtained from maps.google.ca.

Galiano island is in the coastal-Douglas fir ecosystem, with a distinct wet season during the winter and a dry summer season (Nuszdorfer, Klinka & Demarchi, 1991). The lake and surrounding wetland is classified as a linked basin wetland with a small basin marsh at the northeast end (Adams et al., 1997; Gates, 2003). It is a shallow lake with inflowing and outflowing streams (Adams et al., 1997), and is described as a typical shallow water lake (Gates, 2003). Laughlin Lake is a rare ecosystem on Galiano Island, being composed of a freshwater lake surrounded by wetlands (Gates, 2003). Wetlands are important ecosystems as they provide habitat for a multitude of species, remove pollutants from the ecosystem and create local microclimates (McLaughlin & Cohen, 2013). Because wetlands offer all these services it is important to protect them.

Section 2.1: History of Laughlin Lake

Despite Laughlin`s Lake importance the land was not protected until 2000 when the lot it is situated on was purchased by the Galiano conservancy (Gates, 2003). Previously there was a gravel pit adjacent to the south side of the lake that was active from 1970 until 1994 (Gates, 2003). During this period logging also occurred around Laughlin lake causing a period of active disturbances around the lake (Gates, 2003). In 1994, a road was constructed along the south side of the lake which involved excavation, blasting and flooding of the gravel pit (Gates, 2003). This work created the peninsula jutting out into the lake where restoration was conducted (Figure 2) (Gates, 2003).

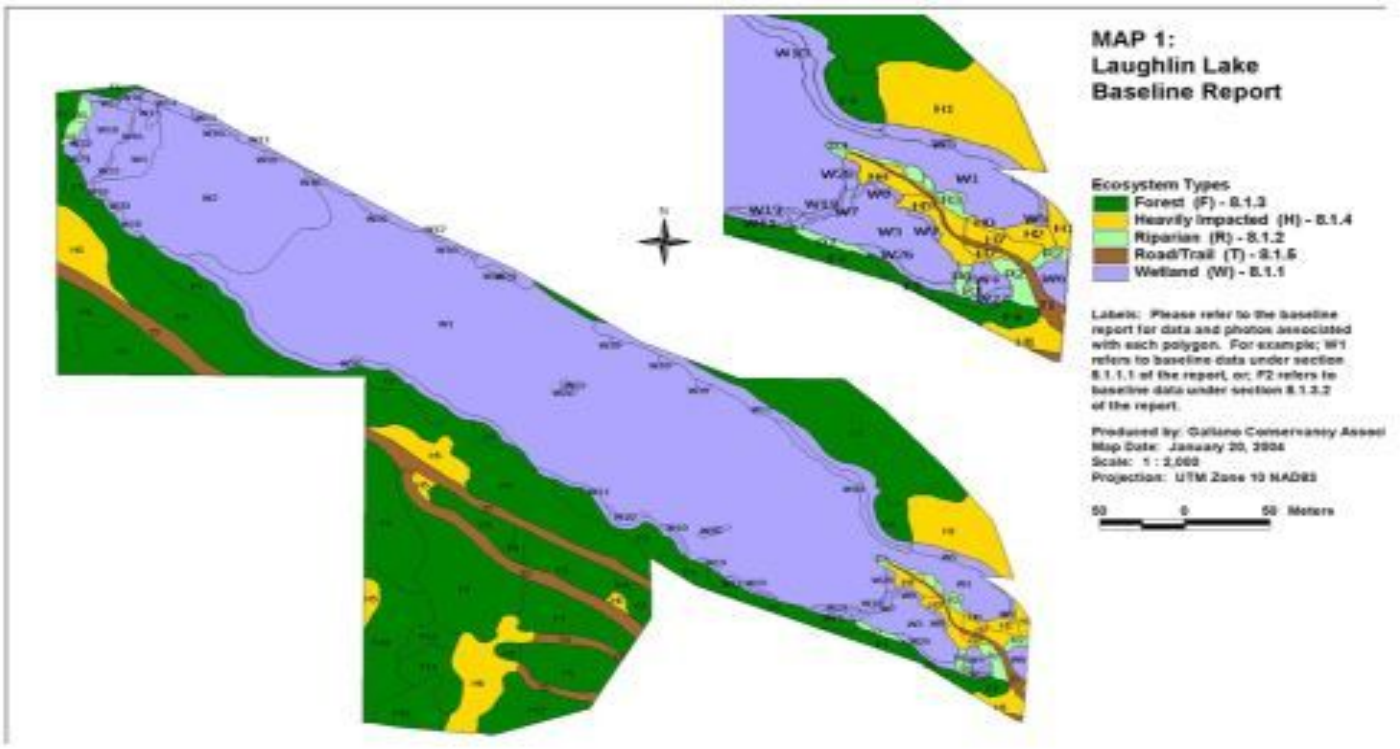

Figure 2: A map of the Laughlin Lake site. Previous restoration was at the southeast side of the lake and contained the most heavily impacted environments. This area is blown up on the top right.

Restoration commenced in 2000 with invasive species removal (Gates, 2003). Scotch broom and thistle were removed from the peninsula. Seedlings (Douglas-fir, red alder and arbutus) were salvaged from roadside ditches and planted by school children (Gates, 2003). The following year, two meter tall Scotch broom covered the entire Southeast area and a six-person crew removed 70% of the broom from the site. In 2002, more flowering Scotch broom was removed in addition to thistle species and exotic grasses (Gates, 2003). Local school groups were brought to the lake and children were taught about invasive species and how to cut broom (Gates, 2003). Pieces of wood were stood up to act as snags, and Douglas-fir, arbutus, alder and salmonberries were planted (Gates, 2003). Then in 2003, further invasive species removal was conducted and coarse woody debris and wood chips were added to the area (Gates, 2003). In addition, soil decompaction was conducted using an

excavator and the peninsula point trail was added through the restoration area (Gates, 2003). Overall, significant work has been conducted at Laughlin Lake since 2000 to restore the ecosystem and establish a community of native plants to support a biodiverse wetland ecosystem.

Section 2.2: Wildlife Assessment

A large diversity of fauna inhabit Laughlin lake, including species of particular concern such as the red legged frog, the little brown myotis, the painted turtle (*Chrysemys Pictta*), beavers (*Castor Canadensis)*, Great Blue Heron (*Ardea herodias fannini*)*,* Blue Dasher (*Botaurus lentiginosus*)*,* Western Pondhawk (*Erythemis collocata*)*,* American Bittern (*Botaurus lentiginosus*), and a large amount of other wildlife species (Islands Trust Fund, N.D.).

The *R. Aurora* is a blue listed frog species, putting it at special concern under COSEWIC because of environmental degradation in its habitat (COSEWIC, 2002). The *R. Aurora* is a small 7-10 inch frog and is a red-brown colour with black freckles, and as their name suggests, they have a distinct red line on their legs. Ideal conditions are complex ecosystems that have cooler temperatures, such as wetland environments (COSEWIC, 2002). They thrive in shallow wetlands for breeding, and occupy terrestrial areas for foraging (COSEWIC, 2002). Large declines in *R. Aurora* populations have been observed. The decline is believed to be due to habitat loss and degradation, as well as threats from other species such as the invasive bullfrog *(Lithobates catesbeianus)* (Ministry of Environment, N.D.). In addition to the *L. catesbeianus,* the *R. Aurora* is also being outcompeted by the green frog (*Lithobates clamitans)(* Ministry of Environment, N.D.). The *L. clamitans* is an invasive species from the east coast of North America, similar to the *L. catesbeianus*, and is one of the most common species of frogs seen today in Canada (Ministry of Environment, N.D.).

Agriculture, forestry, and development are all contributing to the degradation of the wetland ecosystems that the *R. Aurora* inhabits (Ministry of Environment, N.D.).

Laughlin lake provides an extremely well suited habitat for the *R. aurora*, with its diverse ecosystems of vast wetland, dense canopy and overall damp, cool conditions for it to thrive in (Ministry of Environment, N.D.). The large forested areas are important for the *R. aurora* to shelter and feed in, and the wetland area is ideal for breeding conditions (Ministry of Environment, N.D.). Continuous monitoring of this area is important in keeping track of invasive species, such as the *L. clamitans* and the *L. catesbeianus,* and assessing the rate of population growth or decline in the *R. aurora.* Amphibians are excellent indicators for health of the environment, because a frog absorbs moisture through its skin so it is exposed to all the pollutants that are in its habitat (Ministry of Environment, N.D.). As a result they are often not found in polluted or degraded ecosystems. In addition, the *R. aurora* plays an important part in food webs consuming many different insects as well as being an important food source for some birds of prey, decomposition processes, as well as transferring nutrients between land and marine environments in their migration routes (Ministry of Environment, N.D.).

In addition to the *R. Aurora,* Laughlin Lake is an ideal location for bat habitat, including the *M. lucifugus.* The area has large Douglas fir trees, as well as rock crevices for the bats to inhabit. A diversity of insects that the bats feed on inhabit the lake as well, providing idyllic feeding conditions. On the north side of the lake, where previous restoration efforts are being continued, one of our objectives is to increase the hospitality for bats, in particular the *M. lucifugus*. Bats are an extremely good indicator of environmental health since they inhabit such a wide range of environments (Government of Canada, 2015). If bats don't inhabit or are reduced in an area, the environment can be tremendously altered

(Government of Canada, 2015).

M. lucifugus is a species of particular interest, due to its recent endangerment due to white nose syndrome (WNS) across eastern Canada and the majority of the United States (Forbes, 2012). The fungus is travelling at a rate of approximately 250km per year and in eastern North America, about 94% of the bat population has been wiped out (Forbes, 2012). This has left remnant populations of *M. lucifugus* throughout western North America. Therefore, ensuring populations of *M. lucifugus* survival on Galiano Island is necessary in the survival of this ecosystem.

Section 3: Project Statement

To restore Laughlin Lake by removing invasive species to allow a healthy, self-sustaining wetland-lake-forest ecosystem that will support populations of bats and amphibians. This project will place an emphasis on removing invasive species and restoring suitable sites for the endangered bat, the little brown myotis (*Myotis lucifugus)* and the species of special concern the red-legged frog (*Rana aurora aurora*).

Section 3.1: Goals & Objectives

- **Goal 1**

  Monitor the Laughlin Lake site for invasive species

Objective 1

Prevention is the best way to limit invasive species spread, therefore monitoring for invasive species at Laughlin Lake should be conducted yearly ('What we do to stop invasive species', n.d.). Monitoring Laughlin Lake for invasive species will allow for quick action if a high-priority invasive species is found. To ensure this, consistent, effective and comprehensive monitoring should be conducted at the Laughlin Lake site. The 2017 invasive species monitoring update follows:

Peninsula

The restoration of the peninsula was quite successful. Figure 3 shows a map of the restoration site on the peninsula.

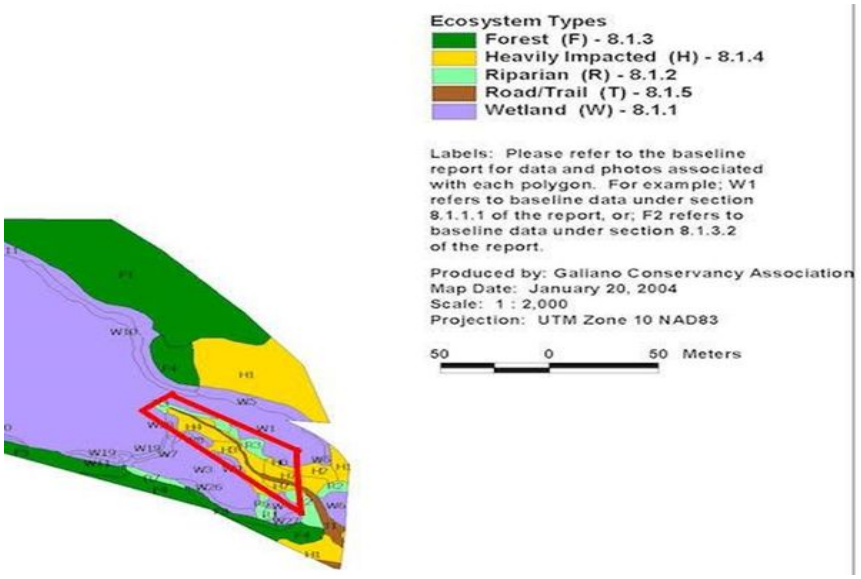

Figure 3: A map of the peninsula at the southeastern end of Laughlin Lake. The peninsula is inside the red square.

Observations were made of some invasive species that have begun to re-establish including: Himalayan blackberry (*Rubus armeniacus*), Canada thistle, common daisy (*Bellis perennis*) and dandelions (*Taraxacum* sp.). However, several healthy native species were also observed including: salmonberries (*Rubus spectabilis*), stinging nettle (*Urtica dioica*), horsetail (*Equisetum* sp.), bracken fern (*Pteridium aquilinum*), salal (*Gaultheria shallon*), and yellow pond lily (*Nuphar lutea*), as well as a garter snake (*Thamnophis sirtalis*).

North side of lake

The north side of the lake (Figure 4), underwent intensive restoration in the early 2000's , and needs some extra work to remove the remaining invasive species. Invasive grasses have moved in and small individuals of scotch broom are present. Currently rare, but also present were species of Canada thistle which produce abundant seeds so can easily become dominant ('Canada thistle', 2014). It appears as invasive species are still dominant

on the North side of the lake so further invasive species pulls will need to be conducted.

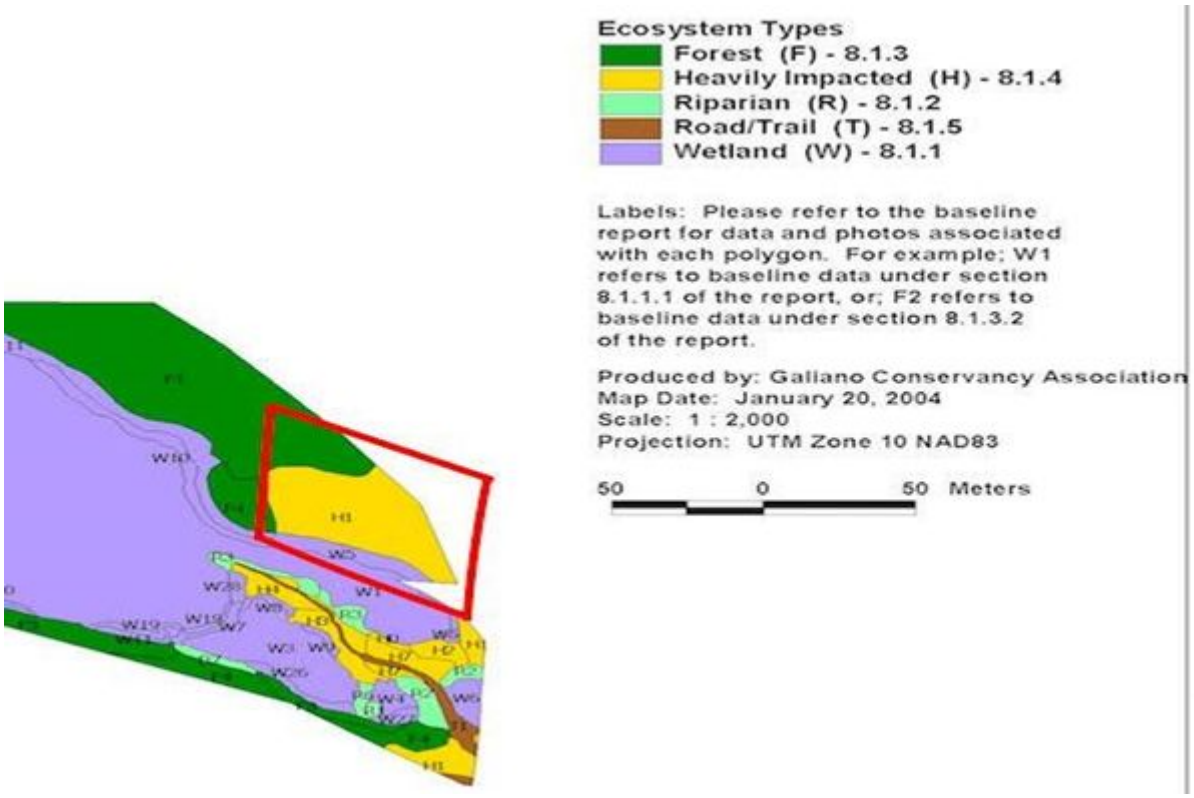

Figure 4: A map of the north side of the lake with the red square encircling it.

Future areas

Unfortunately, due to the limited field time the entire lake area was not explored so invasive species may be more widespread than this report suggests. However, there was enough time to explore about halfway up the North side of Laughlin Lake and many individuals of flowering scotch broom were found. Figure 5 is a map of the area to fully explore and areas for future explorations. As a result of the Scotch broom found in the limited search of the area, future analysis will need to be performed along the North side and South side of the lake.

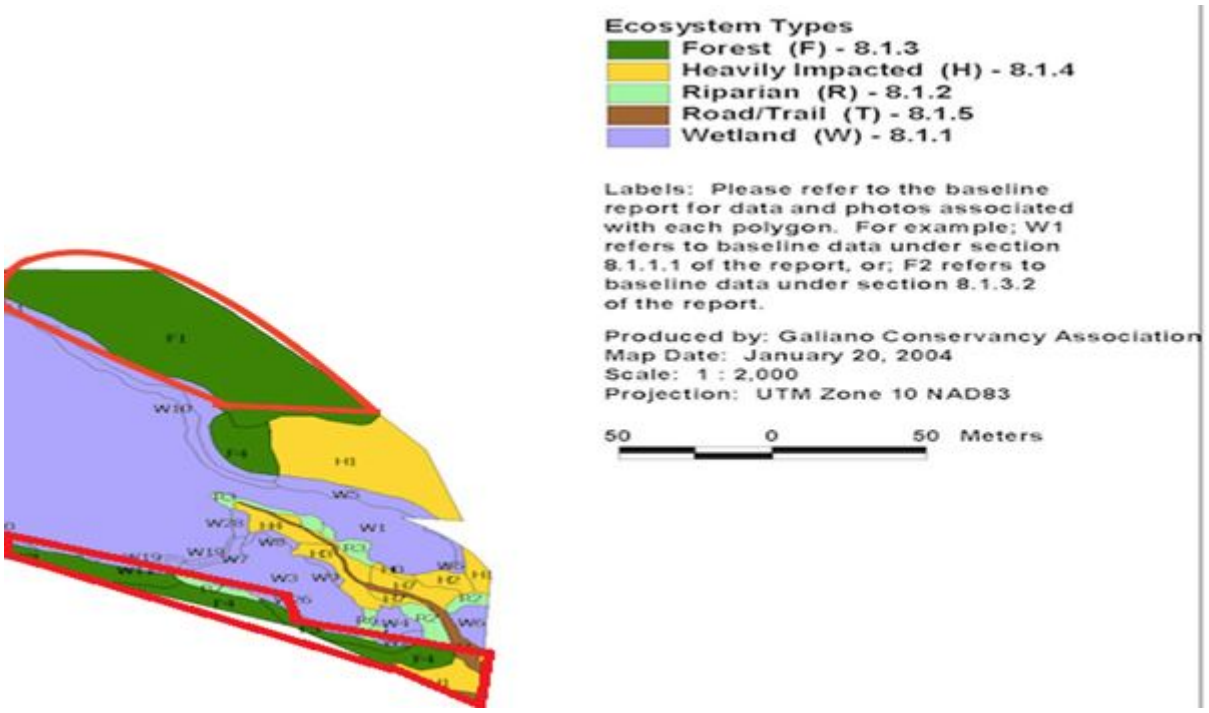

Figure 5: A map of the future areas to search for invasive species around Laughlin Lake.

- **Goal 2**

Restore the site to remove invasive species and establish a community of native plants.

Objective 2

The removal of the most problematic invasive species, particularly scotch broom should be conducted at the Laughlin Lake site. Broom plants shoot out hundreds of seeds annually which can remain viable for years to come (‘Scotch broom,’ 2014). However, the seeds need to penetrate ground cover and make it into the first few inches of soil in order to germinate, therefore, minimizing soil disturbance when removing invasives and planting native species is key. Ripping up large broom plants is difficult, requires special tools and creates a large amount of soil disturbance, leading to erosion and increased invasive species seed access. Therefore, the first step for restoration at Laughlin Lake is to eliminate large,

flowering broom plants by cutting them below the first lateral roots, before they go to seed and doing so without disturbing the soil is a key first step for restoration. The red rectangle, labeled R1 in Fig. 6, is a steep, sunny strip of land that has many well established, flowering scotch broom plants, making it a high priority location for restoration; it is highly recommended that these plants are cut down this year, before they go to seed. The scotch broom plants in the high meadow north of the peninsula (O1 in Fig. 6) and in the clearing at the beginning of the southern lake path (O2 in Fig. 6), were mostly small but some were starting to flower. Eliminating these immature plants before they go to seed would help prevent the reintroduction of broom following soil disturbance, potentially saving a great deal of time and effort in years to come. There was also invasive thistle present that could be removed at the same time as the small broom plants. Due to our limited time at the site, we were not able to fully investigate all the areas around the lake. We recommend sweeping the yellow sections Y1 and Y2 to check for invasives; it is quite likely that there is more large scotch broom present around the lake edge that should be removed immediately if possible. The peninsula, labelled G1 in Fig. 6, had a variety of different invasive species present, some more of a concern than others but all should be removed.

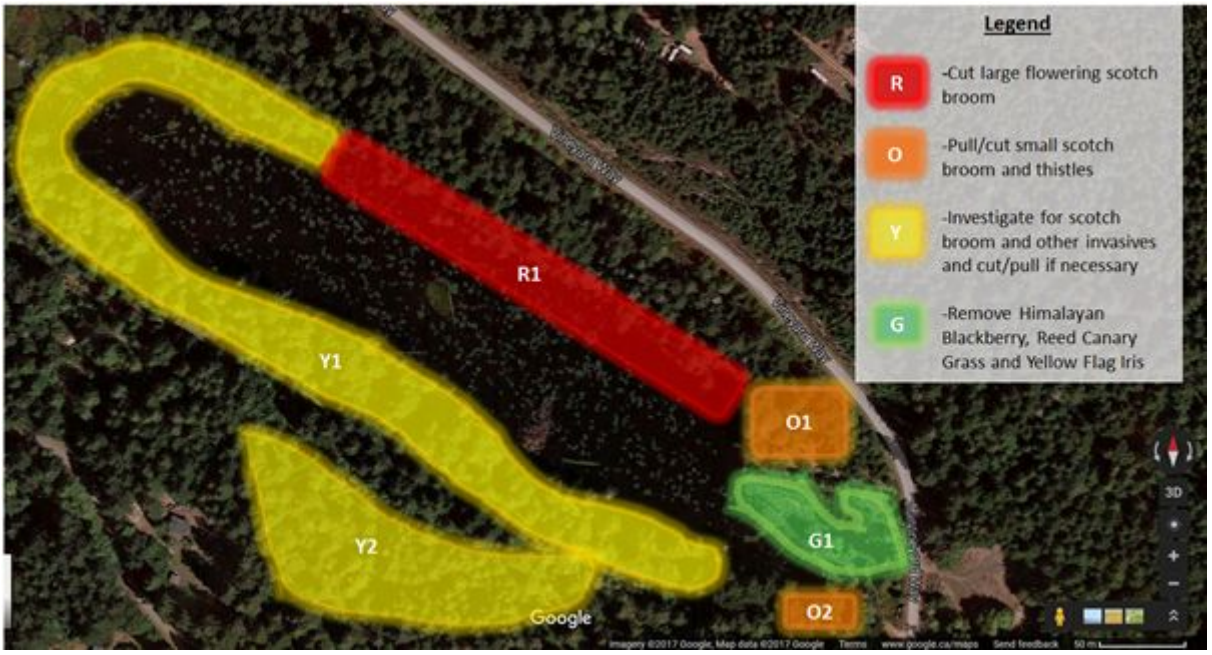

Figure 6: This map combines our onsite observations with the baseline report map (see Fig. 2.1) and describes invasive species removal recommendations for Laughlin Lake. Red indicates areas with many large, flowering scotch broom plants orange indicates areas with young scotch broom and thistle species, yellow indicates areas that may have invasives, and blue indicates areas with Himalayan Blackberry, Reed Canary Grass and Yellow Flag Iris.

Objective 2.1

Laughlin Lake has an active beaver and it has shown to be very effective and notorious at felling trees. Wire cages will be placed around trees to prevent the beaver from destroying further trees in the sensitive restoration area. These trees are a necessary component of a healthy ecosystem, and shading out the understory is an effective means of preventing invasive grasses from growing, as they prefer sun (Schramm & Ehrenfeld, 2010). Figure 7 shows the area below the understory and the area exposed to the sun. As can be observed in Figure 7, providing a shaded understory reduces the growth of invasive species by blocking their access to sunlight. Establishing a healthy understory population will help create a healthier native ecosystem at Laughlin Lake. Currently grasses are dominant, therefore further plantings of shrubs will be necessary. This will increase competition with the grassses and scotch broom and will hopefully shade them out (Schramm & Ehrenfeld,

2010). Creating more competition from native species will help increase native species success and allow further establishment of native species (`Controlling invasive plants, n.d.).Thus protecting trees from the beaver will be a necessary component of this project.

Figure 7: An image from the north side of Laughlin Lake where previous restoration was conducted showing the effectiveness of establishing a canopy at preventing non-native grasses and plants from growing. Therefore, establishing a canopy will be a key part of this restoration plan as it is an effective and relatively easy way of removing invasive species.

Objective 2.2

Replanting native species at Laughlin should be conducted in the sites of restoration. Replanting helps to reduce the spread of invasive species as the natives species compete with them and gradually shift the environmental conditions (sunlight availability, PH, available nutrients, water, space) so they favour historical native ecosystems and not hybrid/novel ecosystems that favour invasive species. We recommend planting a mixture of native tree species, each placed in their appropriate microclimate when available, in order to achieve successful restoration. The species to plant in the O1 site shown in figure 6 are Douglas-fir in

sunnier, drier spots, red alder in moist locations, western redcedar in cooler, wetter locations, and arbutus in drier rockier places. The arbutus planted in the sight previously did not fare well, with most of them either dead or dying. We recommend planting a few more and monitoring them as an experiment to gather more information about arbutus transplant survival on Galiano. We noticed many arbutus on the Island looking sickly and diseased, the success or failure of the second planting of arbutus can help to determine if the first batch of plants were sick and/or not watered enough when initially planted, or if it was disease that did them in. The replanted trees should be placed in wire cages to ensure no browsing by deer or felling by the beaver, as monitoring in May of 2017 showed these cages prevent the beaver from felling the trees. In addition to planting trees, shrubs should also be planted. Salmonberry and oceanspray are two common shrubs found on Galiano Island, but these also need to be placed in cages to prevent browsing by deer. Smaller shrubs should be planted as well, such as: bracken fern, sword fern and stinging nettle. Stinging nettle is a native species that is abundant on Galiano Island and has great potential for restoration work. It is a nutritious, edible, perennial plant that can be spread via seed, transplants, and via rhizomes. We recommend collecting mature seeds from well established nettle patches, there is a small patch in the orange square labelled O2 in Fig. 6, and spreading them around a variety of locations onsite. Before planting occurs site analysis should be conducted to verify plants are being placed in correct moisture regime, soil type and canopy cover. Trees and shrubs will be planted in the O1 site shown in figure 6, but further analysis around the lake may show other sites needing replanted as well.

Objective 2.3

Several trees at the Laughlin Lake site are enclosed in wire cages but these cages need to be adjusted. The trees have outgrown the cages and are being constrained by them. On-site

analysis should be conducted to change the cages around the trees. Also, some shrubs have cages that have been knocked down or are just too short to prevent browsing by the deer. Every caged plant should be checked and have their cages adjusted if necessary to allow a healthy, sustainable native plant population.

- **Goal 3**

  Develop a monitoring plan for Laughlin Lake using repeat photography.

Objective 3

Further historical monitoring of Laughlin Lake will be completed using repeat photography and historical satellite analysis. Repeat photography is conducted by taking a photo at the same site and in the same direction that was taken sometime in the past (Hendrick & Copenheaver, 2008). This allows a historical analysis that will show the change of a place over time (Hendrick & Copenheaver, 2008). Having these images taken periodically is an excellent way to assess the success of restoration and change in vegetation cover of the landscape (Hendrick & Copenheaver, 2008). Repeat photography sites have already been created at the Laughlin Lake site, so this project will continue and expand on the already developed repeat photography sites. Examples of repeat photography are shown in figures 8 - 10, while figure 11 uses historical satellite imagery to show the change in vegetation cover. In figures 8 and 9, it is clearly evident that the landscape in 2001 was overtaken by scotch broom. In 2003 the broom has been removed and other species are beginning to establish. In 2013-2017 trees are getting large and an understory has developed. Figure 10 shows the planting and growing of trees along the peninsula of the lake. It is interesting to note, however, that between 2013 and 2017 there is actually a decrease in trees. This decrease in tree cover is due to the tree's not having a cage around them, so they were

felled and taken by the beaver. Further analysis was performed using historical satellite imagery obtained from Google Earth (Figure 11). Shown in figure 11 is the growth in vegetation from 2004 until 2016. A large overstory appears to be forming on the North side of the lake. Using repeat photography and historical satellite imagery is an effective means of assessing the success of a restoration program.

Figure 8: Repeat photography from pin B facing 336° at Laughlin Lake. Top left: 2001, top right: 2003, bottom left: 2013, bottom right: 2017.

Figure 9: Repeat photography from pin B facing 19° at Laughlin Lake. Top left: 2001, top right: 2003, bottom left: 2013, bottom right: 2017.

Figure 10: Repeat photography from pin B facing 279° at Laughlin Lake. Top left: 2001, top right: 2003, bottom left: 2013, bottom right: 2017.

Figure 11: Historical satellite imagery extracted from Google Earth. Left: June 7, 2004 Right: August 18, 2016.

- **Goal 4**

Protect the Laughlin Lake site from future disturbance and ensure a high abundance habitat for the little brown myotis and the red-legged frog.

Objective 4

Laughlin Lake harbours a population of the blue-listed red-legged frog (COSEWIC, 2002). In assisting *R. aurora* recovery, the following steps are suggested in order to maintain and control populations. Firstly, ensure protection of remaining *R. Aurora* habitat and restore possible sites that the *R. Aurora* could inhabit including terrestrial and marine areas. Secondly, monitor levels of invasive species such as the *L. clamitans* and the *L. catesbeianus,* and control their populations. Thirdly, increase education about species at risk in BC, particularly the *R. Aurora,* increase awareness about invasive species and implement control measures to prevent their spread. Lastly, implement monitoring on possible diseases and the effects of climate change on the *R. aurora* populations in order to mitigate increased harm to the species. Through effective monitoring and restoration at the Laughlin Lake site *R. aurora* populations may thrive.

Frieda Weinart, has heard the call of the SARA listed little brown myotis at Laughlin

Lake (Freida Weinart, personal communication, May 11). Goals in protecting the *M. lucifugus* are firstly: to address the population inhabiting Laughlin Lake and to monitor any possible signs of WNS in the area. Monitoring WNS is crucial for populations because it spreads rapidly and poses such a large threat to the entire population of *M. lucifugus (*Forbes, 2012). Collaboration between other NGO's and BC Bats program will help monitor for WNS in BC and hopefully prevent the spread of the disease to Galiano Island and BC. Protecting habitat and preventing the spread of WNS is crucial to the recovery of *M. Lucifugus* populations. In doing so, Laughlin Lake should be monitored for current and possible future bat roosting sites. Implementing future sites includes ensuring protection of the current vegetation and wetland, as well as planting additional trees for bat roosts. In addition, limiting the amount of human disturbance in the area would be beneficial for the survivability of *M. Lucifugus.* During early monitoring of the site several red-legged frog individuals were discovered. Because both of these species are threatened in Canada (Forbes, 2013; Maxcy, 2004), it is important to protect their habitat. Despite Laughlin Lake being a small site on Galiano Island, it harbours high biodiversity with two threatened species having an established population. Protecting the Laughlin Lake site is an important component of this restoration plan.

Section 4: Experimental Possibilities

The concept of introducing an alien species to control an invasive can be a controversial one and there are many historical records of this process going spectacularly wrong as the introduced species becomes an even more noxious pest (i.e Cane Toad). Therefore any suggested biological control species must have undergone rigorous testing to ensure it can be used safely. The Integrated Weed Control Project, run by Washington State University, strictly tests and monitors any biological control method for many years before

allowing said species onto the market. We used information and species recommendations from their website in order to inform our biological control suggestions.

Biological control using the Scotch broom bruchid and Scotch broom seed weevil could be part of an integrated management strategy for controlling the invasive plant. As it takes a several (4-6) years to build the beetle populations and they are dependent on the flowering and seed producing parts of scotch broom to survive, they would not be useful as a tool to immediately eradicate broom at the lake site. Instead they could be introduced to the thriving populations of Scotch broom on the surrounding roadsides (potentially even island wide), in order to weaken those populations and reduce future spread of the invasive species. In addition, the weevils, which can spread up to 2 km per year from the release site, may help to control satellite scotch broom populations that the conservancy is unable to attend to.

Section 5: Conclusion

Laughlin Lake is an ecologically important habitat, and monitoring previous restoration work and continuing it in the future is vital. Previous restoration was overall successful with a high density of invasive species removed, and new vegetation growing in. Future restoration will help progress the ecological integrity of Laughlin Lake. Monitoring previous work included repeat photography, research on the history of Laughlin Lake, and a brief analysis on the current conditions in contrast to previous conditions. Ongoing monitoring is required in order for the success of the restoration process of returning Laughlin Lake to an ecologically stable environment. Current objectives for Laughlin Lake are to improve the habitat for and to monitor endangered species, particularly the *R. Aurora* and the *M. Lucifugus,* take repeat photographs to compare historic photographs and for future use in restoration, remove invasive species and return ecological integrity to the area. Protecting flora and fauna from invasive or intruding species is also vital, such as caging the

immature trees, and some mature trees in order to protect them from the beaver and overpopulation of deer. Wetland environments such as Laughlin Lake are declining at a rapid pace due to development and agriculture, making the restoration of Laughlin Lake increase in importance with the ongoing future.

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