2013-14 Final Report

Salish Sea Nearshore Conservation Project

Prepared for the Living Rivers Fund

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Executive Summary

Land use developments within watersheds have led to a loss of natural estuarine and nearshore marine habitats in British Columbia - the receiving waters of land based activities. Agriculture, forestry, and dredging for commercial and residential development have all contributed to the loss (Durance, 2002). The pressure to modify natural marine features and habitat for the development of commercial facilities and residential units within coastal areas is intensifying. As well, marine activities are directly affecting nearshore habitats. To prepare for the increase in populations on the BC coast and concurrent shoreline developments, it is necessary to identify and quantify nearshore habitats and restore them where possible, and to investigate strategies to restore lost or damaged habitats from historical industrial practices.

This 2013-2014 Final Report is a summary of the first year's accomplishments of a Salish Sea eelgrass project with three components. Inventories, monitoring and restoration of eelgrass (*Zostera marina*) are funded for two years, in part, by the Living Rivers Trust Fund (Pacific Salmon Foundation), Islands Trust Fund, Environment Canada (EcoAction) and the Recreational Fisheries Conservation Partnerships Program (RFCPP).

The eelgrass inventory is part of a nearshore inventory partially funded by the Islands Trust Fund to improve the conservation and protection of marine habitats within the Islands Trust Area. The islands surveyed during the summer and fall of 2013 included Galiano, Gabriola, Executive Islands, Denman, Hornby and Valdes Islands in the southern Salish Sea, and Bowen and Gambier associated islands in Howe Sound (Gambier Island was inventoried in 2012). A description of the eelgrass distribution in these areas is included in this report, as the Living Rivers Fund helped to complete these inventories. All the eelgrass maps can be found on the Islands Trust Fund web site:
http://www.islandstrustfund.bc.ca/initiatives/ecosystem-mapping/ecosystem-maps

Thirty-two potential restoration sites were identified in these eight islands within the Islands Trust Area, seven eelgrass restored habitat sites were monitored and over 775 m^2 of eelgrass habitat was transplanted in the Squamish and Cowichan estuaries, Sechelt and Tod Inlets and the Sunshine Coast. We addressed eelgrass ecology to seven hundred and fifty members of the public through two conferences, 24 school programs, 3 college classes, 3 university classes/tours, 2 conferences and 4 public presentations Twenty-two volunteers were involved in the public outreach component of the eelgrass inventories; 99 were involved with eelgrass restoration. A total of 14 people were paid through this project during the first year and over 80% of the funding funneled back into local coastal community economies.

Seventeen partners contributed cash (total $177,129) or in-kind contributions of labour, boats and materials and supplies ($84,880). A 35 minute video was produced and is included with this report. It will be used for training and community presentations to increase understanding about this critical habitat for recreational and commercial fisheries.

1.0 Eelgrass Inventories

The islands mapped in 2013 included the Bowen Island Municipality, Valdes Island and Cufra Inlet within the Thetis Island Local Trust Area and Local Trust Areas of: Denman, Hornby, Winshelsea - Ballenas, Gabriola, Galiano, and Gambier Associated Islands (excluding the islands off of the Sunshine Coast). The goal of the inventory is to support sound decisions that will affect the natural ecological health of the marine nearshores within the Salish Sea. The following is a description of the methodology used for mapping eelgrass and identifying potential restoration sites.

ShoreZone maps of coastal habitats within the Islands Trust Area were created over the past decade. ShoreZone is a mapping and classification system that produces an inventory of geomorphic and biological features of the intertidal and nearshore zones from low altitude aerial images of the coastal environment (Harper 2011). These maps provided the groundwork for identifying suitable physical components for eelgrass on the islands mapped during 2013.

The presence/absence of *Zostera marina* was determined according to the methodology of Cynthia Durance, R.P. Bio., Precision Identification.

2.0 Mapping Methodology

The identification and monitoring of the distribution of native eelgrass habitats supplies much needed information for regional planning for conservation purposes. Maps and associated outreach activities may also lead to improvements in land use practices from increased knowledge and awareness about the habitat as well as future restoration as funding opportunities become available.

The presence or absence of *Zostera marina* was determined with an underwater towed camera and a boat, except in the Cufra Inlet (Thetis Island), where mapping was done by kayak without a towed camera due to shallow tides. A Trimble Pathfinder ProXR GPS was used, except in the Cufra Inlet where a handheld GPS unit was used.

The methodology is an addendum to *Methods for Mapping and Monitoring Eelgrass Habitat in British Columbia (Methods)* authored by Precision Identification Biological Consultants and peer reviewed by experts in the field. This addendum was created by the Seagrass Conservation Working Group with input and review by Precision Identification. Average accuracy was 0.814m and was the combined result of the built-in accuracy of the GPS unit, lag time between sighting eelgrass and the unit gathering enough satellite data to create a waypoint, in combination with boat drift.

2.1 Linear Mapping

With the exception of the islands in Metro Vancouver, eelgrass mapping was done using a linear method to determine presence of eelgrass along the shoreline. This linear eelgrass mapping is achieved by towing an underwater camera using a boat, except for the mapping done in Cufra Inlet in 2013, where the water was shallow enough to observe eelgrass from kayaks, and by concurrently recording the geographic location of eelgrass beds using a GPS. The resulting representations of eelgrass beds are lines and points (where the eelgrass patch was less than 3m in length).

2.2 Polygon Mapping

With financial assistance from Metro Vancouver, eelgrass beds on Bowen, Bowyer and Passage Islands were mapped using polygons to show their full extent. In addition to the linear mapping described above, underwater camera transects were conducted perpendicular to shore to map shoreward and seaward edges. In some areas, fringing eelgrass and eelgrass patches were too small to map as polygons. In these locations lines and points were used respectively to show eelgrass presence. Fringing eelgrass bands ≤ 5m wide were mapped as lines and patches less than $10m^2$ were mapped as points. Mapping of polygons according to standard methodology was limited due to safe boat operation in wind, current and tidal movements, as well as navigation around boats and swimmers.

For all the islands, general habitat characteristics outlined in *Methods* are also recorded: Form (flat/fringing), Distribution (continuous/patchy), Percent Cover (<25%, 26-75%, >75%), and Substrate type (sand/mud/pebble/cobble). The state of the tide was recorded as "slack" or "running" in order to indicate the level of confidence in the percent cover estimate. A slack tide yields a higher level of confidence than a running tide, which causes the eelgrass to lie across the ocean floor.

ShoreZone eelgrass bioband mapping and marine charts were used to determine potential locations of eelgrass beds. The majority of the eelgrass beds in the Southern Salish Sea are found between 1 and 3m chart datum. This depth contour was followed and eelgrass presence within this depth range was recorded. If eelgrass was not found in this depth range where bathymetry and substrate characteristics were suitable for eelgrass growth, a perpendicular transect was followed ranging from +1m to -6m which is the typical range of eelgrass in the Salish Sea.

GPS waypoints and the following parameters were recorded at roughly 10m intervals with intervals no longer than 20m: depth, eelgrass presence, distribution, form, sediment types, percent cover, tidal state, presence of broad or tuft algae and visibility.

The terms used to map eelgrass habitats are described below:

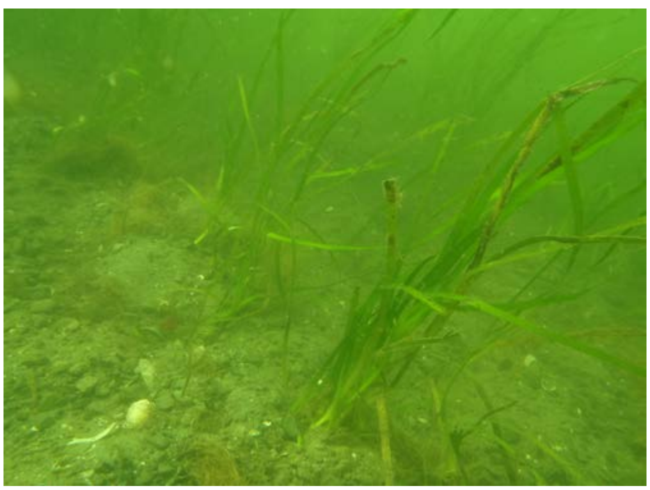
2.3 Distribution

The distribution of eelgrass within the bed is described for this inventory as either patchy or continuous. Patchy beds are those that contain isolated groups or patches of plants. Beds which are not patchy are classified as continuous; a bed that contains bare patches surrounded by eelgrass is classified as continuous. The boundary of a bed is determined by a shoot density of less than 1 shoot per square meter (Durance, 2002).

2.4 Form

There are two basic forms of eelgrass beds in the Pacific Northwest: fringing beds that occur as relatively narrow bands usually on gentle slopes, and more expansive beds that cover large areas such as tidal flats known as “flat” beds (Durance, 2002). Inter-annual variation within a bed is not well known, but appears to be less than ten percent (Dowty et al, 2005). Fringing beds are generally linear. Flat beds are areas of large eelgrass beds in embayments that extend deeper than fringing and more linear beds found along shorelines (Dowty et al. 2005). Distribution is often, but not solely, determined by aspect to dominant winds. Eelgrass distribution across a bathymetric gradient is limited at the upper boundary by the degree of exposure at low tide (desiccation) and by light limitations at the lower boundary.

2.5 Sediment Types



When possible, field observers rated the primary, secondary and tertiary occurrence of substrate types: sand, mud, pebble and cobble. A subtidal environment dominated by cobble might indicate a habitat more suitable for large kelps, which would shade any eelgrass shoots growing between the cobble during the summer months. A predominately sandy muddy bottom would support continuous eelgrass meadows in most cases, unless other factors are present, such as exposure to strong waves or the interruption of habitat by boat mooring buoys. In some cases substrate characteristics change with increasing depth (e.g. cobble to sandy or mud to cobble).

2.6 Percent of Cover

Percent cover was estimated in broad categories to increase accuracy of observation (<25%, 26- 75%, >75%). The coverage of an eelgrass meadow reflects both the substrate and the flow of water through it. A calm environment with a sandy mud substrate generally supports a dense, continuous eelgrass bed with virtually 100% cover. The cover of eelgrass in areas subjected to strong currents is typically patchy. Areas with heterogeneous substrate (mixture of fine and coarse) also tend to be patchy (Durance 2002). The percent of cover data collected from this inventory is based on subjective approximations as observed through the lens of an underwater camera. The approximate percent of cover does give important information on the density and productivity of a bed.

2.7 Tidal Fluctuations

It was important to note whether the tide was running or slack at the time of the inventory. Eelgrass shoots will tend to bend towards the substrate during running tides; the accuracy of percent of cover is then very approximate.

2.8 Presence of Other Vegetation

Other types of algae were documented as broad or tuft. Broad algae, such as kelps, sea lettuce and *Sargassum muticum* can blanket the ocean floor and make it difficult to characterize substrate. They can also shade eelgrass in mixed substrates as they anchor to hard surfaces. Tuft algae, such as brown and red algae do not shade eelgrass but indicate presence of hard surfaces for attachment. The presence of kelps, predominately large brown kelps, was noted, as was the presence of other types of smaller algae and *Sargassum muticum*. *Sargassum* is an exotic species of algae that can overshadow eelgrass if the substrate is a mix of sand and cobble. The presence of *Sargassum* was noted especially off the shores of Thetis and North and South Pender Islands (2012 mapping observations).

2.9 Visibility

Visibility was a subjective observation and was rated low, medium and high. The amount of visibility could impact the accuracy of the observations in some instances, namely characterization of substrate. For example, Gambier Island often had low visibility. This can be caused by winds, sediment flows from the lower reaches of watersheds, inputs from nearby streams and tidal/current movements. Low tide periods make for the best visibility.

3.0 Survey Limitations

During the 2013 survey of islands within Howe Sound, the winds were often a factor in scheduling the inventories. The average horizontal precision for the GPS unit used for the 2013 eelgrass inventory was 0.814 m.

Percent of cover of eelgrass shoots is difficult to assess accurately with an underwater camera but was deemed important to characterize. Areas of particular interest (e.g., impact of shoreline modifications, more detailed assessments for restoration potential) should be surveyed by SCUBA divers. Overall, this inventory is an indication of the presence or absence of eelgrass habitat and does not represent maps of the outer or shoreward edges of each bed, with the exception of Bowen, Passage and Bowyer Islands. Polygons were mapped for these islands where possible in 2013.

4.0 2013 Inventory Results

The islands mapped in 2013 for eelgrass (*Zostera marina*) within the Islands Trust Area Islands include:

- Denman Island Local Trust Area,
- Hornby Island Local Trust Area,
- Winchelsea - Ballenas (Executive Islands) Local Trust Area,
- Gabriola Island Local Trust Area,
- Galiano Island Local Trust Area,
- Valdes Island and Cufra Inlet in the Thetis Island Local Trust Area
- Bowen Island Municipality
- Gambier Island Local Trust Area Associated Island in the Howe Sound (excluding the islands off of the Sunshine Coast)

4.1 Galiano Island Local Trust Area

Galiano Island and its associated islands were inventoried over seven days between June 26th and November 25th, 2013. Approximately 16.66 % of the linear subtidal shoreline of Galiano Island is eelgrass habitat. ShoreZone maps indicate that most of the southwestern and northeastern shorelines of Galiano Island are not suitable substrates (coastal bluffs and low rock/boulder respectively), except where there are sheltered embayments. However there are notable exceptions over the north, south west, south and eastern areas of the entire island.

The eelgrass distribution on Galiano is 88% continuous; 12% patchy. The placement of mooring buoys (at least 14 were noted within eelgrass beds, especially on the southwestern shores of the island), private docks (at least 12) and log storage have damaging effects on the habitat's continuity and function as a wildlife corridor. The construction of retaining walls (rip rap, rock and wooden) and the removal of backshore vegetation (at least 10 sites were observed) are obstacles for eelgrass to flourish in certain sites.

Most of the backshore on Galiano Island remains naturalized, with notable exceptions where trees and understory vegetation surrounding residences are removed and where shores are modified with retaining walls. Exotic invasive plants include English ivy, St John's Wort and gorse. Heavy epiphytic algae growth on eelgrass blades were noted within **Montague Harbour**, a possible indication of a high level of non-point source pollution. Another site for pollution is the public dock in **Whaler Bay** where boats are worked upon. Best management practices are recommended for boat sewage disposal and using tarps for collection of boat paint chips at each location.

There is the potential for eelgrass restoration within Whaler Bay, as the channel in front of the public dock contains a narrow band of eelgrass that could be expanded shoreward if log leases were retired in the future. In November, bufflehead and Barrow's Goldeneye as well as schooling forage fish were observed. Patchy eelgrass beds were noted off the eastern shores of Galiano Island. This area is ShoreZone classified as low rock/boulder. Four mooring buoys were located with these beds.

The eelgrass habitats covering the associated islands of Galiano comprise approximately 19.98% of the islands' linear shorelines. **Parker Island** has extensive eelgrass on its northeastern shores (96% continuous). The construction of docks and the placement of mooring buoys within eelgrass beds, however, may be impacting the habitat. Most of the eelgrass surrounding **Gossip Island** lives on the island's east facing shores is continuous (95%); however docks (7 were noted within the eelgrass beds) interrupt their form and function. Mooring buoys (3 observed) are situated within the existing beds on the south-western facing shores also disrupt the connectivity of eelgrass habitats.

No eelgrass was observed on **Ballingall** and **Lion Islets**, **Wise,** **Charles**, **Sphinx** or **Julia Islands**.

4.2 Gabriola Island Local Trust Area

Gabriola Island and associated islands were surveyed between July 8th and 21st, 2013. Gabriola Island's linear shores are comprised of 24.8 % eelgrass, with 89% continuous distribution. Two potential eelgrass restoration sites were identified on this island. The first is on the southwestern shore facing **Mudge Island** near an active log booming site. When the log lease is retired at this site, a small eelgrass transplant (100-500 shoots) could indicate whether the area is suitable for a larger transplant. The second site is on the northeast tip of Gabriola Island where a small existing bed could be expanded.

Wildlife in some areas abound, including Canada geese, an abundance of fish species, Great Blue Herons (22 at the southern channel entrance between Gabriola and Mudge Islands), sand dollars and Bald Eagles. Beaches that have suitable substrate for sand lance and surf smelt spawning were also noted. Healthy eelgrass beds near the **Malaspina Galleries** in Gabriola Sands Provincial Park are not surrounded by mooring buoys and docks and are thriving in in 4-5 metres water depth, although the area also contains rocky substrates.

Possibly the biggest impacts to marine wildlife habitats on Gabriola and its associated islands are the locations of floats and mooring buoys (in one embayment on the northwestern shore of Gabriola, over 12 floats – moorings and/or crab traps – and 14 buoys were observed in a continuous eelgrass bed); construction of retaining walls (nine riprap or rock walls identified); and, the removal of native backshore vegetation (13 sites). Numerous moorings are located in an otherwise robust eelgrass bed in **Degnen Bay**.

The eelgrass coverage for the Gabriola associated islands' linear shorelines totals 19.98%. Near the eastern shore of **DeCourcey Island** south of a marine park there are many docks and boats. Poor water quality was noted, and there are no washroom facilities at this location. No marine life was observed growing on the seafloor. North of the marine park there is a potential restoration site facing a steep rock ramp foreshore and a steep grassy conifer backshore near a former log booming site.

Snake Island has the potential for eelgrass restoration on its southern tip where there is a protected area with suitable subtidal sandy mud substrate, although this location may be too close to active boating. Seal pups and oyster catchers were cited near a large mussel bed.

There was no eelgrass habitat observed on **Hudson Rocks**. Marine life there included seal pups hauled out, bird habitats, cormorants and oyster catchers. The shell hash substrate off of **Five Finger Island** was noted to be situated too deep for eelgrass growth. **Mudge Island** also has a potential eelgrass restoration site on its southeastern shore. Kelps are mixed with sandy/muddy/ shell substrate. Most of the backshores are naturally vegetated, with exceptions near residential developments where mooring buoys are situated within eelgrass beds (4 observed). The eelgrass habitat observed on Mudge was a mix of patchy/ continuous and flat/fringing beds on the eastern shores of the island. One bed in particular, located mid- island on the eastern side extended 100 metres shoreward beyond the waypoint, but the water depth was too shallow to delineate the bed.

Eelgrass on **Link Island** is characterized as flat continuous beds on its eastern shores. On the south shore of Link Island there are multiple docks (4) and mooring buoys (6). Continuous fringing beds lie next to the northwest shores of **Breakwater Island**. Near **Saturnina Island** there are fringing continuous beds of eelgrass habitat on the western and northern shores.

Bath Island has a wide rock ramp in front of a windblown forest with a patchy bed with two larger patches surrounded by kelp and *Sargassum muticum* on its northwestern shore, while on its western shore there was a flat continuous bed. Eelgrass habitat on **Tugboat Island** is characterized as narrow beds tucked between shore and wharf floats on the eastern side of the island and between the Tugboat Island and **Sear Island** to the south, which has flat continuous beds on its western shores. Continuous flat beds lie at the entrance to a marina on **Vance Island**. A rock/boulder shoreline with a, private dwelling with floating dock and several moorings are near flat continuous eelgrass habitat on **Acorn Island**.

4.3 Denman Island Local Trust Area

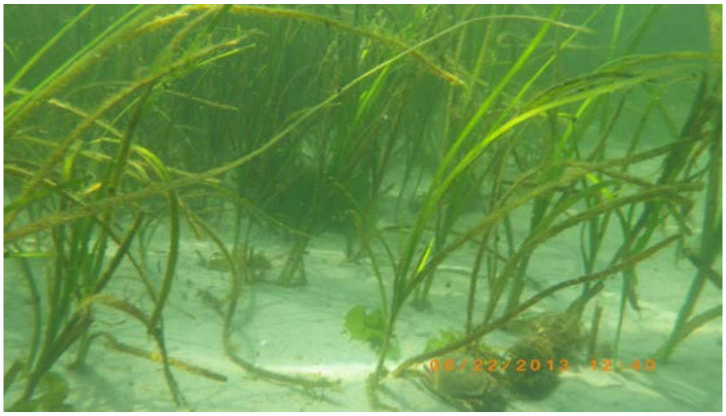
Denman Island and its associated islands were surveyed on several boat expeditions between August 20th and September 15th, 2013. In the Denman Island Local Trust Area 33.24% of the linear shore contains eelgrass. In some areas, especially in eastern subtidal areas, patchy eelgrass was observed amongst broad leaf kelps and *Sargassum muticum*, where the substrate is classified as low rock/boulder. A potential restoration site is located on the southwest area of the island near **Metcalf Bay** and is close to a site that could be used for harvesting transplants. The substrate south of this site gradually changes to cobble and gravel. Most of the beds surrounding the island are fringing, most likely due to coarser substrate changes at depth.

Eelgrass habitat is situated on the north eastern shores, classified by ShoreZone as sand/cobble and where numerous overwater structures are located and associated with industrial aquaculture activities. The eelgrass here was predominately patchy; most likely there are more patchy beds both shoreward and seaward of the mapped area. This area is the second most patchy eelgrass habitat observed, second only to areas in Howe Sound.

The majority of the backshore is not heavily impacted by development; most of the residences had either forested or grassy areas between them, with a minimum of landscaping. Abundant species of birds including black legged kittiwakes, surf scoters, marbled murrelets, grebes, harlequin ducks, surf scoters, herring gulls, and other marine wildlife species such as hooded nudibranchs, sand dollars, sand lance juveniles and abundant schooling fish were observed.

Sandy Island north of Denman Island contains continuous (99%) eelgrass habitats although the southern shores are ShoreZone classified as sand/cobble and the northern areas are classified as altered. Sand dollars were observed on both eastern and western sides of the island. **Seal Islets** were surrounded by fringing continuous (81%) eelgrass habitats. Associated with these beds were observed marbled murrelets and rafts of harlequin ducks and surf scoters, kittiwakes, gulls and seals. The backshore consisted of flat shrub, herbaceous and grassy slopes. . No eelgrass habitat was observed near **Chrome Island** due to unsuitable rocky substrates.

4.4 Hornby Island Local Trust Area



Eelgrass beds on Hornby Island were mapped over several days between August 21st and September 12th, 2013. The linear shoreline of the Hornby Island Local Trust Area is composed 31.70 % of eelgrass habitat. Large areas on both the western and northeastern shores of Hornby have continuous (90%) flat beds, although the classification by ShoreZone of these shorelines is low rock/boulder. The small areas of eelgrass found in these otherwise rocky cobble areas are valuable as critical habitat and corridors for marine life.
Most of the backshore is naturalized, even where residential houses are situated. Suitable substrate for spawning sites for forage fish was identified on the north eastern shores. Three potential restoration sites were also noted; one near this area for potential forage fish spawning, the second within a sandy embayment on the eastern shore (if boat anchoring pressures were decreased), and the third near the Hornby Island ferry terminal on the western side of the island (eelgrass was noted just north of the terminal growing in pebbles). There is also an opportunity for a community clean-up of underwater debris near a breakwater and marina on the southern end of the island. On **Toby Island** dozens of seals were hauled out.

4.5 Winchelsea-Ballenas (Executive Islands) Local Trust Area

The islands within the Winchelsea-Ballenas Local Trust Area were surveyed for eelgrass habitat between November 21st and 23rd, 2013**.** The total linear shoreline coverage of the Local Trust Area is 1.4%.

Mistaken Island west of Parksville has two eelgrass sites, one fringing patchy bed and the second within a cove with a dock, both on the southwestern shore. A flat continuous bed lies between the channel separating the **Ballenas Islands**. A continuous bed also lives on the north shore of the south island, punctuated with rock substrate. A school of forage fish, possibly sand lance was observed at the time of the survey in the shallow subtidal zone.

A small flat continuous bed on the west facing shores of the **Ada Islands** also may serve as suitable habitat for forage fish, prey for ancient murrelets, of which one was cited by field staff (unconfirmed). A second eelgrass bed is situated on the western shore of the west Ada Islands. The substrate at this location is primarily sandy with a secondary substrate of bedrock with associated intermixing rockweed and detritus. A seal haul out with 61 seals was noted near this site.

A small flat continuous eelgrass bed is located on the northeastern side of **Southey Island**. No eelgrass habitats were observed on **Gerald, Yeo, Amelia, Ruth** or **Winchelsea Islands.**

4.6 Bowen Island Municipality

Bowen Island was surveyed between Aug 6th -11th and Oct 4th, 5th and 12th, 2013 using the polygon mapping methodology. The island is characterized by a mix of sandy bays and steep shorelines. Large homes are common, with docks constructed both in the bays and on the steep cliffs. Bays, which are areas in which eelgrass is expected to grow, were also the location of waterfront homes and associated docks (both land-based and floating), moorings and anchored boats.

Eelgrass was estimated to extend along 11.6% of the shoreline of Bowen Island. The area of mapped eelgrass polygons was observed to total 41,917 m^2 and the length of mapped line features was observed to total 958 meters. Percent cover was low, however, and in addition to continuous beds, 84 individual patches of eelgrass were recorded and noted on the map as points. Eelgrass was observed within bays and straight sections of coastline on the southwest, northwest, northeast tip, east (Mannion Bay and north) and southeast coasts.

Around much of the island eelgrass was characterized by frequent individual patches, with each patch often consisting of very few shoots. Patches on the west coast were observed in areas that, from the shoreline or ShoreZone analyses, would not have been predicted, as the plants occurred seemingly opportunistically in patches of soft substrate located amid boulders and other coarser substrate. Percent cover even in continuous beds was consistently far less than 25% and noticeably sparser than other islands within the Islands Trust areas also surveyed during the 2013 mapping season.

Docks in areas such as in **Tunstall Bay** were located in depths suitable for eelgrass growth. Distances between some points on the polygon mapped in Tunstall Bay are longer than 20 meters as the eelgrass field surveyors needed to navigate around swimmers, docks and moored boats. Large clusters of sunflower stars (*Pycnopodia helianthoides*) were observed in the bay on sandy bottoms that did not contain eelgrass. Docks and moorings were also located in eelgrass depth elsewhere on the west coast of Bowen Island (e.g. the relatively straight shoreline north of Bowen Bay, King Edward Bay, the shoreline north of King Edward Bay and Galbraith Bay).

In some sites such as **Galbraith Bay** and **Columbine Bay**, eelgrass was only observed on one side of the bay despite suitable sandy substrate on the other side. For example, the substrate on the north side of Galbraith Bay was bare sand. There were several moorings in that bay. Eelgrass in Columbine Bay was sparse and appeared unhealthy; individual clumps were surrounded by bare sand. One hypothesis for this is that eelgrass may be impacted by boat wakes in the area. Boats were moored throughout eelgrass depth in **Cates Bay**.

Multiple beds of continuous eelgrass were identified throughout **Mannion Bay** between zero and more than 5 meter depth relative to chart datum. These beds, however, were not as dense as would be predicted given the soft substrate and sheltered environment. In the northeast side of the bay bare sandy fringing beds are interrupted by the construction of docks.

Mannion Bay is heavily used for boat anchoring, mooring and docking within depths suitable for eelgrass growth. The construction of docks and floats and their associated chains are impediments for eelgrass productivity in this area. Multiple adjacent docks have been constructed within eelgrass depth Ropes and chains from docks, moorings or anchors had dragged on the sea floor, apparent due to the patterns they had created in the sand. The motion of the chains due to waves and currents can damage or uproot eelgrass.

Eelgrass otherwise appeared healthy in Mannion Bay and there are opportunities to restore lost eelgrass habitat if boat anchoring were restricted to a defined area outside of the depth range for eelgrass growth, i.e. if they were limited to 6 m depth or deeper. Schools of fish were observed within the existing sparse eelgrass; therefore, restoring the eelgrass in the area would serve to enhance fish habitat. Although it was not included in the project deliverables, the research team had been requested to look for evidence of litter on the sea floor in this bay; however, only a few cans and the possible remnants of a shopping cart were observed. Some of the moorings and anchored boats appeared derelict. Many crabs were observed on the south side of the bay, but were not identified to species.

No eelgrass was observed in **Snug Cove** including the head of the cove, near Crippen Park beach. Possible reasons include dredging, ferry wakes, eutrophication and boat traffic associated with the marina, and pollution of the substrate due to chipped wood debris. No flora was observed on the sea floor except for encrusting algae. There are restoration opportunities for the nearshore environment by Crippen Park beach if the historical and present impacts from the marina and former log booming site are addressed.

The inner portion of the eastern cove of **Konishi Bay** on the south coast of the island appeared suitable for eelgrass due to the sandy substrate and sheltered cove with a sandy beach. The substrate was bare sand, however. Eelgrass was observed in deeper locations of that bay. Removal of native plants and retaining wall constructions were noted around residences. In another eelgrass location in the southern portion of Seymour Bay/Seymour Landing where an adjacent coastal lot was for sale, coastal vegetation had been cleared and there is already evidence of slope failure both at the top and foot of the slope, despite installation of riprap. Water flow had also been channeled in the area, which could intensify water and sediment flow into the nearshore environment. Slope failure is a possible threat to eelgrass through smothering by eroding sediments. Shoreline hardening also increases wave energy and wave deflection, which can scour shorelines (Lamont 2013).

The area around **Cape Roger Curtis** has been of concern to local residents due to the construction of large docks and potential for damage to submerged habitats. Eelgrass was not observed around the exposed cape, as the observed substrate was steep and rocky. Kelp was observed in the area, however. Chains from the new construction were observed on the ocean floor. Kelp beds are a major feature along the rocky parts of the Bowen Island shoreline. Several schools of small or juvenile fish were also observed around the island.

4.7 Gambier Island Local Trust Area

Gambier Island was surveyed on August 21st-23rd and September 11th, 2012. This island has rugged shorelines, with steep slopes leading to the subtidal zone. Eelgrass habitat comprises approximately 8.3% of the island's linear subtidal shoreline. The majority of the eelgrass beds are fringing, the significance of which has been described earlier in this report as important to wildlife corridors.

Gambier Island has been highly impacted by historical log storage practices. Eight sites were identified as possible restoration areas starting with small eelgrass test plots (approximately 800 to 1000 shoots). Larger eelgrass restoration might occur if these test plots increase in shoot density and coverage and as funding opportunities arise. In some of these sites, backshore lands have been placed on the real estate market, which may impact future restoration efforts if docks and wharves are permitted as additions to upland development.

Boat mooring buoys and recreational equipment on the water over eelgrass beds as well as derelict log booming cables and booms were observed. There were numerous docks and wharves within eelgrass habitats. Several large shoreline modifications were also noted. These changes to the shore can have long term impacts on nearshore environments, including wave scouring, shading and interruptions to sediment transport. With the presence of active and retired log leases, the island would greatly benefit from an eelgrass restoration strategy plan to increase value for both biological diversity and ecological services.

Bowyer Island was surveyed on October 11-12th, 2013 using the polygon mapping methodology. The west, north and east coasts of Bowyer Island are largely steep and rocky. The south shore is characterized by several coves, varying in substrate. Eelgrass was estimated to extend along 11.35% of the Bowyer Island shoreline, observed only in particular coves along the southern portion of the island. The area of polygons containing eelgrass was observed to total 3690 m^2 and the length of mapped line features was observed to total 70 m. In addition to continuous beds, 4 individual patches of eelgrass were recorded, noted on the map as points. Eelgrass around Bowyer Island was similar in appearance and percent cover to that surrounding Bowen Island, i.e. patchy and sparse. Percent cover within the polygons was less than 25%.

Docks were located in eelgrass depth in the bay on the central southern shore of Bowyer Island, within zone W2/W1a. Eelgrass beds in that bay were observed to extend as far as the docks. Several chains were located on the ocean floor in zone W2 on the southeast shore of the island, and a large dock is within or adjacent to the eelgrass bed.

Large schools of small fish were frequently observed while circumnavigating Bowyer Island, particularly on the west, north and east coasts. Also observed were large numbers of pile perch (*Rhacochilus vacca*) and rockfish. Harbour seals were observed in several locations.

Passage Island was surveyed on October 5th, 2103 using the polygon methodology. One of the most exposed islands of Howe Sound, this island is a good example of how people and eelgrass tend to occur within similar, sheltered environments. Most of the island is characterized by rocky cliffs, with a few beaches. Eelgrass was observed in sections of the east coast of the island, along 15.67% of the total shoreline of the island. The area of polygons containing eelgrass was observed to total 3718 m^2 and the length of mapped line features was observed to total 40 m. Percent cover within the polygons was less than 25%. Ropes were observed on the sea floor in eelgrass depth in an area of the southeast coast of the island in the presence of patchy eelgrass. In this area was also located a floating dock within eelgrass depth and approximately 12 moorings in the eastern part of the area, where the eelgrass was very sparse and patchy. A floating dock and mooring was located at the south end of the more northerly eelgrass polygon on the east coast of the island.

The islands west of Bowen Island were inventoried between August 4th - 6th, 2013. The linear shoreline extent of eelgrass habitat surrounding the associated islands within the Gambier Island Local Trust Area totals approximately 13.27%.

Most of **Keats Island** contains flat or fringing beds of continuous eelgrass habitat on sandy/mud substrates, especially on the north and west facing shores. Patchy eelgrass beds were observed on the southeast shores, most likely due to exposure to predominant winds.

A high preponderance of single eelgrass patches lie on the southern tip of Keats Island, which may be caused by exposure to southerly winds, but also to the multiple locations of docks, especially on the southwestern shore.

There is potential for eelgrass restoration on the northern end of the island at the eastern point of a log booming area if the log lease is retired in the future. This area has a rocky/cobble foreshore, forested backshore and water park with overwater floats. There are also many docks on the southwestern portion of the island, which may cause fragmentation of eelgrass beds. Where there were low rock/cobble substrates, no eelgrass was present.

Anthropogenic Impacts include the construction of docks, presence of moored boats in eelgrass beds, removal of native backshore vegetation and recreational use of the nearshore (water park overwater play structures).

Continuous flat eelgrass habitat was observed in the southeast and western shores of **Shelter Island** directly west of Keats Island. No eelgrass was found near **Home Island** south west of Keats Island. **Preston Island** south of Keats Island contains a small continuous eelgrass bed on the southeast shore. The backshore is forested. **Ragged Islets** contain mostly patchy eelgrass beds throughout most of the subtidal areas, except for the west facing side of the islets. Mooring buoys and docks were observed on the eastern shore and a float on the northern side of the islets. Most of the islets are forested and contain rocky substrate. The small islet to the northeast contains a fringing continuous eelgrass bed.

The majority of eelgrass surrounding **Pasley Island** south of Ragged Islets is flat and continuous in sandy/shell hash substrate. Vegetation along the foreshore has been cleared near many residences. Retaining walls, docks and mooring buoy chains interrupt eelgrass continuity along the south and southeastern facing shores. There is potential for eelgrass restoration on the southeastern facing shore almost at the midpoint of the island where there is a gap in an otherwise flat continuous eelgrass bed. On the northeastern shore of Pasley there is a dense eelgrass bed that could serve as a possible harvesting site for restoration of lost or damaged eelgrass habitat.

No eelgrass was noted off of **Worlcombe Island** southeast of Pasley Island.

Mickey Island northeast of Pasley Island is surrounded on its western, southern and northern shores by mostly fringing patchy beds of eelgrass in sandy/shell substrate. Eelgrass is mostly likely limited on the eastern shores by low rock/boulder substrates. The rocky shores are surrounded by natural forests. Minimal anthropogenic impacts were observed.

To the west lies **Hermit Island.** The majority of eelgrass habitat is flat and continuous in sandy/shell hash substrates. Most of the habitat is located on the east facing shoreline, though the foreshore is cobble or low rock. The majority of the backshore is forested. In some areas, dock construction interrupts eelgrass beds. Harlequin ducks were observed within an eelgrass area on the southwestern side of the island.

Little Popham Island south of Hermit Island has mostly continuous flat beds of eelgrass to the southwest and northeast next to rocky shores and forested backshores. It is very likely eelgrass is limited by the subtidal low rock/boulder substrate surrounding the remaining areas of the island. Most of the eelgrass around **Popham Island** lives on the northeastern portion of the island in sandy/shell substrate and consists mostly of continuous and flat beds along steep rocky shores.

Grace Island southwest of Gambier Island contains mostly fringing continuous eelgrass habitats in shell/sand substrates next to steep rocky foreshores and forested backshores. A large school of fish was observed. **Woolridge Island** to the northwest of Gambier Island contains mostly flat continuous beds of eelgrass on its north facing shores. The beds are very robust, with a possible harvesting site on the east shore if restoration is undertaken in this area. There is woody debris noted near a breakwater on the north western facing shore of the island.

The majority of eelgrass habitat surrounding **Anvil Island** northeast of Gambier Island lives on the southeastern shores and is characterized as fringing. Most of the island is classified as cliff or low rock/boulder which is limiting for eelgrass growth. The presence of numerous mooring buoys and retaining walls impact the habitat. One potential restoration site was identified on the eastern shore.

The islands near the Sunshine Coast within the Gambier Island Local Trust Area were not mapped in 2013 due to poor mapping conditions and scheduling limitations. There are plans to inventory them in 2014, subject to funding and capacity.

5.0 Threats to Eelgrass Habitats

The major observed threats to eelgrass habitats surrounding islands within the southern Salish Sea are docks, moorings and anchoring that occur within eelgrass locations. These can shade out eelgrass beds. In addition, the ropes and chains associated with these activities can move along the ocean floor with tides and currents, damaging or uprooting eelgrass beds.

Human activities within the nearshore environment are likely having a detrimental effect on eelgrass health, possibly contributing to sparseness and patchiness of beds within sandy bays that would otherwise be expected to contain higher eelgrass shoot densities. Further research of additional current or historical activities affecting soft-bottom areas around the islands would help to develop a more complete picture of possible limitations to eelgrass growth. These could include forestry activities, shoreline erosion due to coastal development and exposure to natural waves and boat wakes.

There seems to be an increase in the abundance and distribution range of the invasive seaweed, *Sargassum muticum* within the Islands Trust Area, although there is at present no research to substantiate this. Although the plant settles and grows on cobble, surrounding eelgrass in sandy/muddy sediment can be shaded out by its overarching canopy.

The presence of *Zostera japonica* was noted on Lasqueti and Thetis Islands (2012 inventory) and other areas within the Islands Trust. This non-native species of eelgrass is not known to compete with *Z.*

marina, though it can be found mixed with the native eelgrass in the lower reaches of the intertidal zone.

Though there is some disagreement about the causes of epiphytic algae growth on eelgrass blades, it was noted within Telegraph Harbour on Thetis Island and Montague Harbour on Galiano Island. This could be an indication of excessive nutrients, causing an abundance of algae growth on the blades and blocking light, nutrients and gas exchange (Mumford 2007).

Canada geese are infamous for their grazing on eelgrass shoots. They were noted in large numbers on Lasqueti, Gabriola, and North Pender and South Pender Islands. Overgrazing of shallow eelgrass beds might be a growing concern as the birds are increasing in range and numbers.

As winter storms intensify, there might be an increase in burial of eelgrass shoots by sand over wash. Monitoring eelgrass habitats over time in selected locations vulnerable to storm events might shed light on the effects of climate changes upon the nearshore environment.

6.0 Recommendations

Globally, eelgrass has been used as an indicator of water quality (Neckles 1994). Often, a bed will decrease or increase in width and length dependent on light availability. The lower depth distribution of eelgrass is related to overall water clarity. Water quality, including water clarity, is affected by land practices and water uses. If, for example, a large scale development occurs on shore near an eelgrass bed, the bed may decrease in size because the water quality in the nearshore is consistently compromised by the increased pollution load, known as non-point source pollution, frequently delivered by the storm water system. When the amount of light reaching the plants is limited by shading from increased sediment or plankton blooms associated with increased nutrients from land, eelgrass meadows adapt to the poor light availability through dieback, decreases in density or width and migration to shallower depths.

The Islands Trust Area is home to more than 25,000 people and is located between the highly populated centres of Vancouver, Victoria and Nanaimo. However, only approximately 12.5 % of the marine environment has some type of protection. Most of this protection is in Rockfish Conservation Areas, with Provincial and Federal Marine Protected Areas accounting for only 1.53% (Islands Trust Fund Regional Conservation Plan 2011-2015). Sound decisions by local trustees and an educated public are necessary to protect the functions of the nearshore for all who benefit from their healthy ecology.

A set of recommendations is listed below to contribute to the conservation work of the Islands Trust and Islands Trust Fund.

6.1 Education

1. Educate boaters and coastal residents about the presence and importance of eelgrass beds.

2. Encourage shoreline landowners to replace light-impenetrable docks with materials that allow light penetration.

3. Encourage signage at boat ramps reminding boaters to avoid eelgrass beds in shallow water.

4. Build public awareness about the importance of reducing nutrient inputs in marine riparian areas; encourage protection and restoration of wetlands and the construction of retention ponds to filter land based pollutants; and encourage reduction in the use of fertilizers, pesticides and herbicides.

5. Develop a long term public outreach nearshore marine education strategy that includes new shoreline property owners.

6.2 Regulatory and Enforcement

1. Limit dock development, particularly in established and potential eelgrass areas (i.e. areas where substrate is suitable for eelgrass growth).

2. Encourage creation of “No anchoring/mooring” zones in suitable eelgrass areas (based on substrate, depth and observed presence of eelgrass); encourage movement of moorings to areas too deep for eelgrass.

3. Limit shoreline development; maintain a coastal riparian zone that will enable inland shift of eelgrass beds as sea levels rise.

4. Create and implement appropriate setbacks for built structures from the nearshore.

5. Limit or reduce overwater structures; increase shared community docks and wharves when possible.

6. Require removal of illegal shoreline modifications; require restoration or removal of aged derelict structures where possible.

6.3 Opportunities for collaboration with other agencies

1. Encourage and undertake as resources allow regularly scheduled monitoring of sensitive or vulnerable shorelines; make monitoring results readily accessible to all.

2. Where boat traffic must go through an eelgrass bed, encourage establishment of marked boat channels so that the least damage is done to the habitat.

3. Create protected marine zones and encourage planned siting for mooring buoys for recreational boats around eelgrass beds.

4. Promote management strategies to mitigate conflicting uses in eelgrass habitat, such as oyster and clam harvesting, boating and anchoring in meadows and near-shore development requiring dredging.

5. Promote restoration of natural hydrology when opportunities arise.

6. Promote restoration of eelgrass habitats where possible.

Part 2

Summary of 2013-14 Eelgrass Restoration

Monitoring of past transplant sites was completed in August and September of 2013. Based on the results of these surveys, suitable locations were identified for transplants near or within these transplanted areas for the fall of 2013 and spring of 2014. The transplants installed in the fall of 2013 were monitored in February, 2014.

Based on all monitoring data, additional eelgrass shoots were planted in Cowichan Bay (Genoa Bay and a Channel site within the estuary), Stawamus (Squamish), Halfmoon Bay, and Sechelt Inlet. The monitoring results are included in this report. Tod Inlet within Saanich Inlet received over 400 shoots in March, 2014.

In August and September of 2013 and February and March of 2014, a total of 7,775 eelgrass shoots covering over 775.5 m^2 were transplanted in six sites within the southern Salish Sea. A mapping expedition took place in March of 2014 in the Saanich Inlet and south of Cowichan Bay to find additional restoration sites for the 2014-2015 field work.

1.0 Methodology for Eelgrass Transplants

In the Pacific Northwest, the history of success for *Zostera marina* transplanting projects was dismal prior to 1985. Initially transplant techniques were used that were developed and successful on the Atlantic coast. However, these techniques were not well suited to the Pacific north coast environment and eelgrass. Many of the early transplants were conducted without a thorough understanding of eelgrass physiology and ecology; the donor stock was not always well suited to the area where they were transplanted, and the biophysical conditions of the transplant site were not always appropriate for the species. (pers. comm. Durance)

Since 1985, knowledge and experience from adaptive management practices have resulted in a higher success rate for focused mitigation and enhancement projects along the Pacific coast. (Thom et al 2000) In an assessment of 17 eelgrass transplant projects that were completed between 1985 and 2000 in British Columbia, Cynthia Durance (Precision Identification) rated seven projects as successful, four as failures, and five recently planted projects were deemed most likely successes within several years. Since that time the five recently transplanted sites have been documented as successful. The majority of projects surveyed were motivated by the *No Net Loss* policy of Fisheries and Oceans Canada. The success of one site could not be determined due to an absence of interim monitoring data and the expansion of the surrounding natural eelgrass population. (Durance 2000)

Factors that led to a higher success rate included the correct selection of physical attributes for the compensation area, including elevation, substrate composition and light and current regime. The selection of the most suitable ecotype or genotype increased the likelihood for success and rate of production. (Table 1) The criteria for success included shoot density and area re-vegetated (Durance 2000).

Table 1: Three Ecotypes on the Coast of B.C. Ecotype	**Relative leaf size**	**Leaf width (mm)**	**Depth range (m)**	**Seasonal variation in size**	**Current tolerance**
typica	narrow	2 to 5	primarily intertidal	small variation	low
phillipsi	intermediate	4 to 15	0 to -4	large, plant length reduced in winter	moderate
latifolia	large	12 to 20	-0.5 to -10	minimal variation	strongest

Combined with the selection of the appropriate ecotype for the donor plants, and barring unforeseen stochastic events, the success rate of restoration projects has climbed steadily since 1985. A comprehensive review of thirty- nine eelgrass restoration efforts in the United States by the National Marine Fisheries Service verifies that knowledge about eelgrass ecology has improved. (Hoffman, R. 2000)

The main criteria for successful transplanting is determined by suitable site selection with the appropriate biophysical characteristics (salinity, sediment type, current velocity, light/depth, temperature, and pH), using suitable plant donor stock (ecotype), using an appropriate transplanting technique and handling the donor plants with care. (Durance 2000)

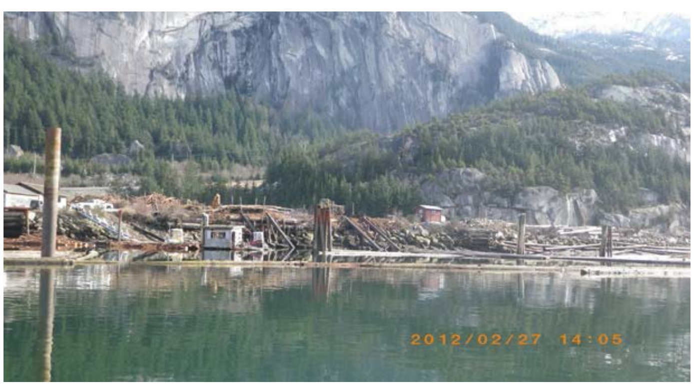
In 2000, Cynthia Durance of Precision Identification created a methodology for mapping eelgrass beds (*Zostera marina*) in British Columbia. Using this protocol, coastal community groups surrounding the Salish Sea (part of the Seagrass Conservation Working Group) started an inventory of these critical habitats for marine wildlife, including all species of juvenile outmigrating salmonid. During the course of these inventories, many communities expressed concern that where there should have been eelgrass, it seemed to be damaged or absent. Ms. Durance had developed a method for transplanting eelgrass that has been used successfully in over 80 sites throughout British Columbia as compensation to achieve No Net Loss. This methodology is used for community based restoration in sites that have been formerly utilized for log storage.

Eelgrass is dependent upon vegetative reproduction; once established, a patch of eelgrass may reclaim a damaged site at a rate of approximately 0.5 metres in all directions annually.

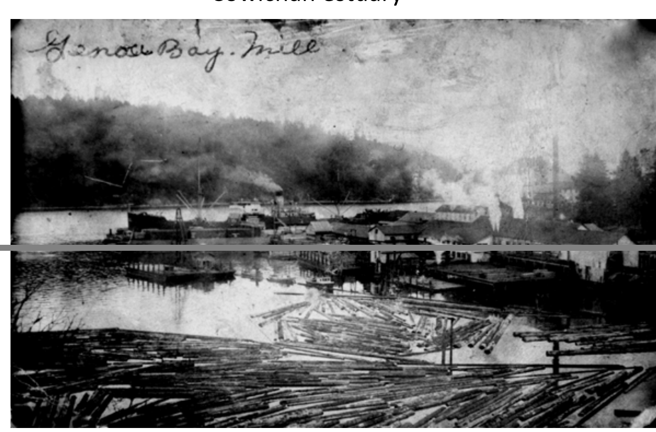
With the support of experienced scientists in estuarine environments and a certified Workers Compensation Board (WCB) SCUBA dive team, community stewardship groups have been trained to accelerate the pace of reclamation for important marine bird, fish, and invertebrate species that utilize these environments for food, protection, and metabolic growth.

Small test plots of 500-800 shoots are transplanted after an initial assessment is completed to evaluate the suitability of the site. The benefit of setting up these smaller plots in estuaries that have been utilized for log storage is that these highly degraded habitats would benefit most from the establishment of eelgrass that would remediate the poor sediment conditions (low oxygen and high concentrations of sulphides).

Logging activity within the Squamish estuary on the opposite shore of the Stawamus restoration site



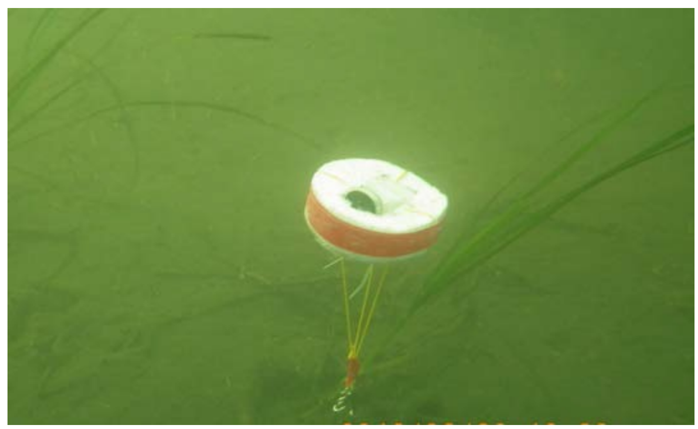
Genoa Bay mill in the past, south of the restoration site within the Cowichan estuary



Log rafts in log storage areas can introduce soluble organic compounds into the water. These leachates increase benthos oxygen uptake, decrease dissolved oxygen, lower pH and increase toxic sulfide compounds (Ascaphus Consulting, 2003). Cynthia Durance has observed over years of monitoring eelgrass transplants that the iron eroding from the ungalvinized steel washers used to anchor eelgrass shoots into the sediment creates favorable conditions for the eelgrass growth (pers. comm.).

Field observations confirm that the rust from the steel anchors (Fe) chelates with sulphides ($SO4$) in the sediment. Oxygen is released that was bound to the sulphur in the sediment. It was surmised that available iron near the roots of the eelgrass rhizome would encourage growth.

HOBO water monitoring units were installed in three sites: Squamish Estuary, Halfmoon Bay and Sechelt Inlet. These units monitor water temperatures and light availability over one year. They were installed within the transplanted beds at the same height as the average eelgrass shoot. Information has been downloaded from each unit after six months in the water; the data has not been analyzed, as there is no baseline yet with which to compare.



2.0 Monitoring Results February 2014

Location	# of samples	Mean Average # shoots/m^2	Shoot Width (mm)	Shoot Length (cm)	Comments	Area Coverage Planted 2013-2014 m^2
Cowichan Bay Site 1 Channel Site Site 2: Genoa Bay Marina Site 3: Genoa Bay (north end)	Site 1: 10 Site 2 : 10 Site 3: 21	5.9 shoots/patch 2.4 shoots/patch 4.8 shoots/patch	4.8 5 5.3	25.8 27.5 32.3	Site 1 appears healthy and growing, although some grazing by geese is evident. No further transplants planned until further monitoring completed. Site 2 does not appear to be healthy – sediment quality may be an issue within the marina near boats, as the area is quite protected from grazing and physical disruption. No further transplants planned. Site 3: Sediment within this site suitable for more shoots. Clean up of underwater and intertidal debris is planned with local community partners.	376.6 m^2
Squamish (Stawamus FN Reserve)	10	8.4 shoots/patch	9.6	68.4	Shoot density and length very similar to those observed during past monitoring surveys. Length of shoots indicates light availability due to high turbidity from snow melt. Area is very stable and protected.	149.7 m^2
Halfmoon Bay	7	10	6.3	61	Sediment is suitable for more transplants. Some disturbance from crabs evident	90 m^2
McLean Bay, Sechelt Inlet	7	9.4	3	52.9	Very productive habitat: Juvenile rockfish, perch, greenlings, flounder, sculpins and other marine life observed during monitoring. Sediment very suitable for	117.5 m^2

					more transplants.	
Tod Inlet, Saanich Inlet	10	3.7/patch	4.7	46.8	Based on this data, an extension of eelgrass was installed east of the monitored site. This site will be monitored regularly, but no new transplants are planned.	41.7 m^2
					Total	**775.5 m^2**

Monitoring results in February indicate only the beginning of spring growth of new shoots, but it was important to monitor changes after 6 months from the transplants to observe any adverse effects on the plants from human or biological activities. The density of the transplants was assessed using a 0.25m^2 quadrat. An average of shoots per patch, width and length of a shoot within a patch was calculated.

Tying anchors onto eelgrass shoots prior to transplant

3.0 Discussion

The objective of this eelgrass restoration initiative is to address issues related to historical log handling practices that limit the amount of critical habitat accessible for out-migrating salmon species and other marine wildlife that use the nearshore for nourishment, shelter and metabolic growth. Tod Inlet is an exception, as eelgrass habitat was lost due to point source pollution from the flow of leachate from the Hartland Landfill until the early 1990's into the estuary, and the cement factory, now Butchart Gardens, that was in operation until the mid-1950's. Because there is a dearth of research data about the limiting factors of these impacted marine subtidal environments, it is necessary to field test adaptive management strategies and monitor their success over time. We have accomplished these goals for the first year of this project and surpassed them because of successful on-going community partnerships.

The benefits of eelgrass mapping in the Gulf Islands have been notable since the beginning of of the inventories in 2012. Our partnership with the Islands Trust Fund has strengthened and created new connections with island organizations and Local Trust Committees (LTC). The Trust Fund reports that as a result of mapping they have responded to data requests from Parks Canada (for Parks management and the National Marine Conservation Area process), three non-profit conservation groups and the Strait of Georgia Data Centre at UBC. Eelgrass maps are publically available on the Islands Trust Fund website and on the Community Mapping Network. The Trust Fund uses the maps internally to inform responses to referrals regarding dock applications and to evaluate the ecological values of conservation covenant proposals. The Local Trust Committees on Pender and Thetis Islands have initiated community outreach (events, brochures) to protect eelgrass and other nearshore ecosystems.

Eelgrass mapping in 2013 has been diverse in the different kinds of conditions we have found eelgrass. This has increased our skill level to collect quality data and find eelgrass in unexpected places. With this confidence we have offered our knowledge and services to the District of Oak Bay and the Tsleil-Waututh First Nations in the Burrard Inlet We are seeking new relationships with other First Nations who wish to conserve eelgrass habitat.

Because the monitoring results of the eelgrass test plots in the Squamish River Estuary, Sechelt Inlet, and on the Sunshine Coast have demonstrated both an increase in density and area coverage since 2007, we decided to fill in the plots already established, join other plots to accelerate the creation of integrated meadows, and install new plots in areas recommended by the Seagrass Conservation Working Group (SCWG) Project Coordinators in Squamish and the Sunshine Coast.

HOBO units were installed in three sites to measure light availability and water temperatures over time. Since we monitored six months after the September 2013 transplants, new growth was just becoming evident in each site. All the sites will continue to be monitored in 2014 and 2015.

Restoration of nature, by definition, is a complex process. Restoration ecology, a term created by William Jordan III and Keith Wendt, is a learning-by-doing approach to understanding ecological principles. Restoration is distinct from mitigation and compensation, as it is the process of bringing back a whole system to a former condition. Jordan defines restoration as "everything we do to a landscape or an ecosystem in an ongoing attempt to compensate for novel influences on an ecosystem in such a way that it can continue to behave or can resume behaving as if they were not present." (Jordan, 2003).

Spatial and temporal extent of the damage from log storage areas is persistent. These impacts include chemical changes in the sediment, smothering by accumulated woody debris and physical alteration and disruption of intertidal and subtidal fish habitat from grounding logs. Such accumulations can physically and chemically alter aquatic systems to the detriment of fish habits, reducing their complexity and often obliterating nearshore vegetation vital for rearing juvenile salmonids. Research has found that site specific factors dictate plant re-colonization rates. There are no consistent eelgrass and algal recovery trends at abandoned sites relative to the amount of time since the last log booming operation. (Pease, 1974)

It is highly recommended that future restoration of degraded habitats, especially those damaged or lost from past log storage practices, be aligned with scientific research that explores the limiting factors adversely affecting shoot density and coverage.

No one data type can stand alone in a monitoring program (Fonseca et al, 1987c, Fonseca 1989a). For some of the small test plots (Squamish), a percentage of the original number of shoots was recorded. In other sites, the actual number of surviving plants was taken and is critical as well. If a planting is small (~500 - 1,000 shoots), all shoots are surveyed for presence or absence (survival survey). The existence of a single shoot indicates its survival because it is associated with a rhizome meristem. Otherwise, subsequent vegetative growth will not occur. This means that if even if a small percentage of the total shoots planted survive, there is likelihood that the transplanted bed will regenerate. An example is the Tod Inlet transplant in 2000. Eighteen hundred shoots were planted, with a 23% survival rate after one growing season. That bed in 2014 is now a narrow fringing eelgrass bed, limited by elevation and substrate and protected by buoys.

Ninety-nine community volunteers from Squamish, the Sunshine Coast, Cowichan Bay and Victoria participated in the transplants (2013-4). Cowichan, Squamish and Tsartlip First Nations have been strong supporters of the increase of eelgrass habitat within their territories. A presentation was made to Squamish First Nations Chief and Council in March 2014. Much enthusiasm was expressed to continue this restoration.

Stewardship of these habitats depends upon community support and awareness. Without the commitment and hard work of the SCWG Area Project Coordinators, Dianne Sanford (Sunshine Coast), Edith Tobe (Squamish River Estuary), Leanna Boyer (Mayne Island), Kai Reitzel of Cowichan Bay and Sarah Verstegen of Brentwood Bay, we would not have achieved success. They supported this work by mapping where eelgrass is and where it should be over large areas, found matching funds, organized community volunteers and helped with logistical issues.

It is hoped that this movement towards recovery of lost marine nearshore habitat is long term, as increasing success depends upon persistence, on-going field observations, applied academic research, community stewardship initiatives and continued funding. We will continue using adaptive management strategies based on results gleaned from monitoring these sites so that we can accelerate the rate of reclamation for destroyed and damaged critical habitat for all species of salmon and the food webs that support them.

Cowichan Bay sign installed at the boat launch of the estuary by the Cowichan Community Land Trust

The restoration site in Genoa Bay is an opportunity for increased community engagement.

Intertidal and subtidal debris is an impediment for further expansion of the transplant. We have approached several potential partners within the community through the Cowichan Valley Stewardship Round Table and through other avenues. Enthusiastic responses thus far indicate the debris will be removed over the spring and summer months of 2014 with in-kind contributions. Planning to increase the size of the existing transplant area can then proceed.

4.0 Recommendations and Conclusion

1. It is extremely beneficial to continue and establish new partnerships with First Nations, local government and non-government organizations and academic institutions so that critical marine habitat conservation and restoration can be sustainably supported.

2. It is recommended that the monitoring schedule for the eelgrass transplant test plots be continued for all six transplant sites for the following year to determine the density and area extent of each installation and whether further transplants are advisable in each location.

A report by Olesen & Sand-Jensen (1994) suggested that new *Z. marina* beds required a minimum of five years to become established and stable. Transplant failure is generally detected within six months. Success is based on natural shoot density and area coverage.

3. Plant new test plots in areas defined by the results of mapping the Sechelt Inlet during the spring and summer of 2014, as the inlet is very productive and water quality is good. Further transplants at the Halfmoon Bay site may be warranted as well, as the sediment and water quality is conducive for success.

4. Combine the results of the Chinook study over the last two years (2010-2012) in the Squamish River Estuary and Howe Sound to identify key areas where out-migrating Chinook could benefit from restored eelgrass habitats.

5. Organize and fundraise for an underwater and intertidal debris removal in the north end of Genoa Bay with community support so that more subtidal habitat is available for future transplants. This project has already begun, with support garnered from the Cowichan Stewardship Round Table in March, 2014.

6. Surveys of Saanich Inlet and northwards will identify future possible transplant sites for 2014-2015. In addition, 32 sites have been identified as potential eelgrass restoration sites within the southern Gulf Islands during mapping expeditions for the Islands Trust Fund during 2012-2013. These sites need to be ground-truthed with SCUBA divers and an underwater camera to determine which are suitable to receive test plots.

7. Continue to establish new partnerships through public eelgrass ecology presentations and maintain positive on-going relationships with the Cowichan, Sechelt, Saanich and Squamish First Nations communities.

Community conservation groups can successfully carry out eelgrass habitat assessments, transplanting and monitoring projects with professional scientific supervision and with authorization from Fisheries and Oceans Canada. The prototype for such activities is the eelgrass mapping project involving 35 community groups. From 2002-2008 well over 1,000 volunteers mapped over 12,000 hectares of eelgrass habitat from Haida Gwaii to Boundary Bay. They are trained in mapping protocols and received stewardship materials beforehand. Some of the mapping data can be viewed on the Community Mapping Network web site: http://www.bc.ca/atlases/atlas.html

This eelgrass network influences the culture of volunteer based environmental conservation organizations by placing them in an active rather than reactive position regarding shoreline development. Many of the thirty-five groups use their maps for locating eelgrass habitat to influence decisions regarding the development and use of the nearshore. Progressing from mapping to restoring damaged or destroyed eelgrass habitats can further strengthen the capacity of grass roots stewardship organizations to affect positive environmental change.

It is proposed that this eelgrass network be utilized to make the next step towards habitat restoration. The groups can assist with restoration by providing labour for shoreline work and assisting with monitoring for restoration projects.

The more work that is accomplished by volunteers, the larger the share of the budget the community would receive for the restoration work. Approximately 80% of all the funding revenue SeaChange has received thus far for this project has funnelled into local coastal community economies.

Volunteers have a double incentive in knowing that their time, skills and/or equipment are contributing both to habitat renewal and financial support of a community conservation organization. Volunteer involvement in restoration also increases a community's investment in making sure the restoration site is well stewarded. By making use of the skills and commitment of stewardship groups, more can be accomplished.

For example, the municipality of White Rock funded a transplant project in 2003 for 100 plants. The Friends of Semiahmoo Bay, a local conservation group, augmented the project. They donated their labour on shore, increased the number of plants transplanted and raised awareness of the importance of the habitat in the community. Another eelgrass restoration occurred more recently in the Comox estuary by Project Watershed. This narrative has been repeated over the years within the Salish Sea – indeed it is one of the only ones that give hope that critical nearshore marine habitat can be conserved and increased when appropriate.

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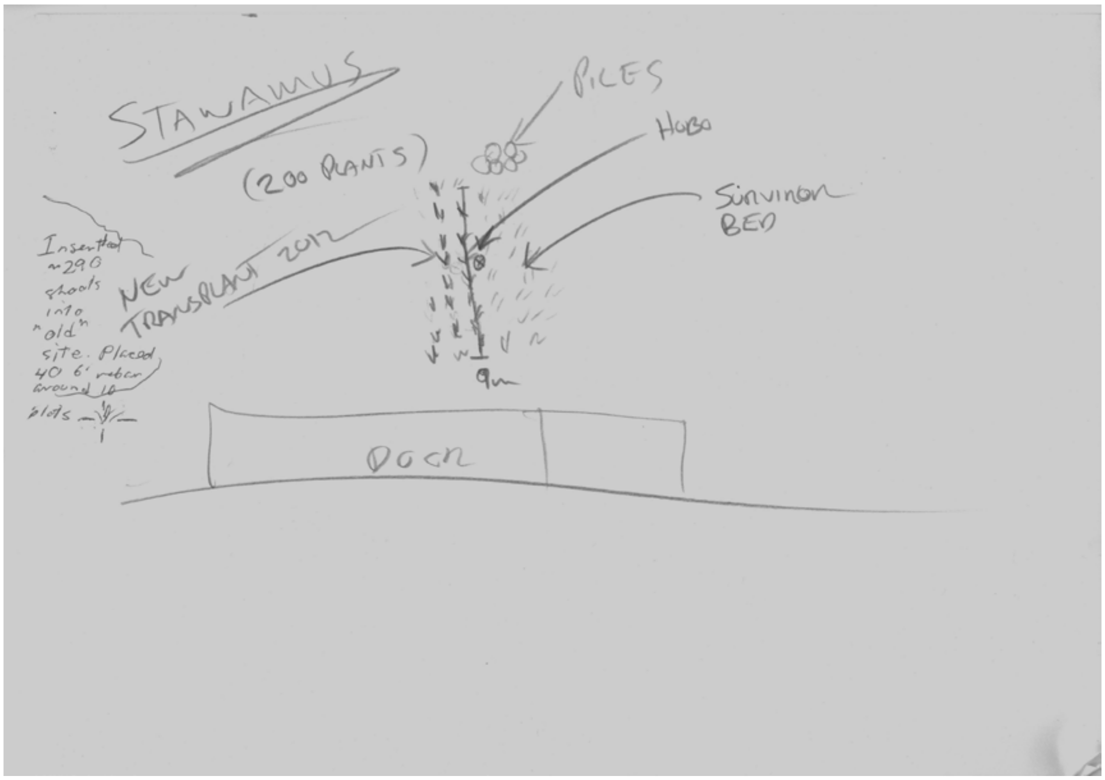
Video footage sequences:

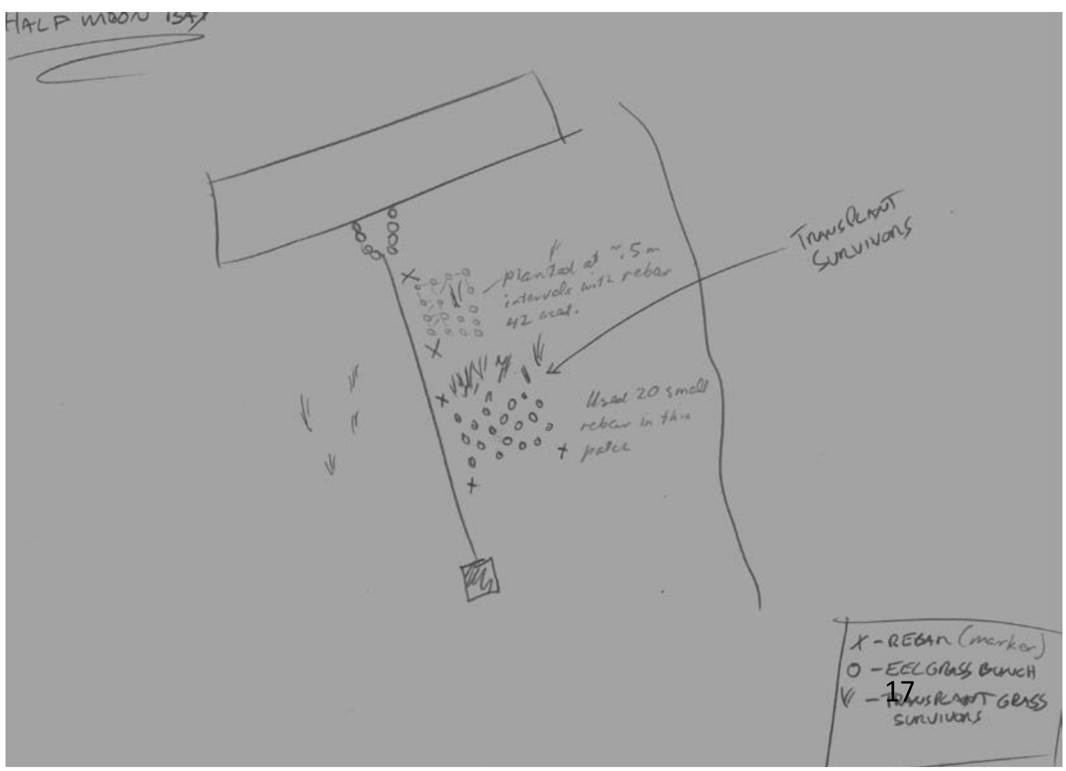
Cowichan Bay sites: 0:33-11:57
Stawamus (Squamish): 11:58-16:57
Halfmoon Bay: 17:07-21:01
Tillicum Bay: 21:02-21:23
McLean Bay: 21:28-27:55
Tod Inlet: 27:56-31:52

Appendix A
Site Sketch Maps
Transplants September 2014

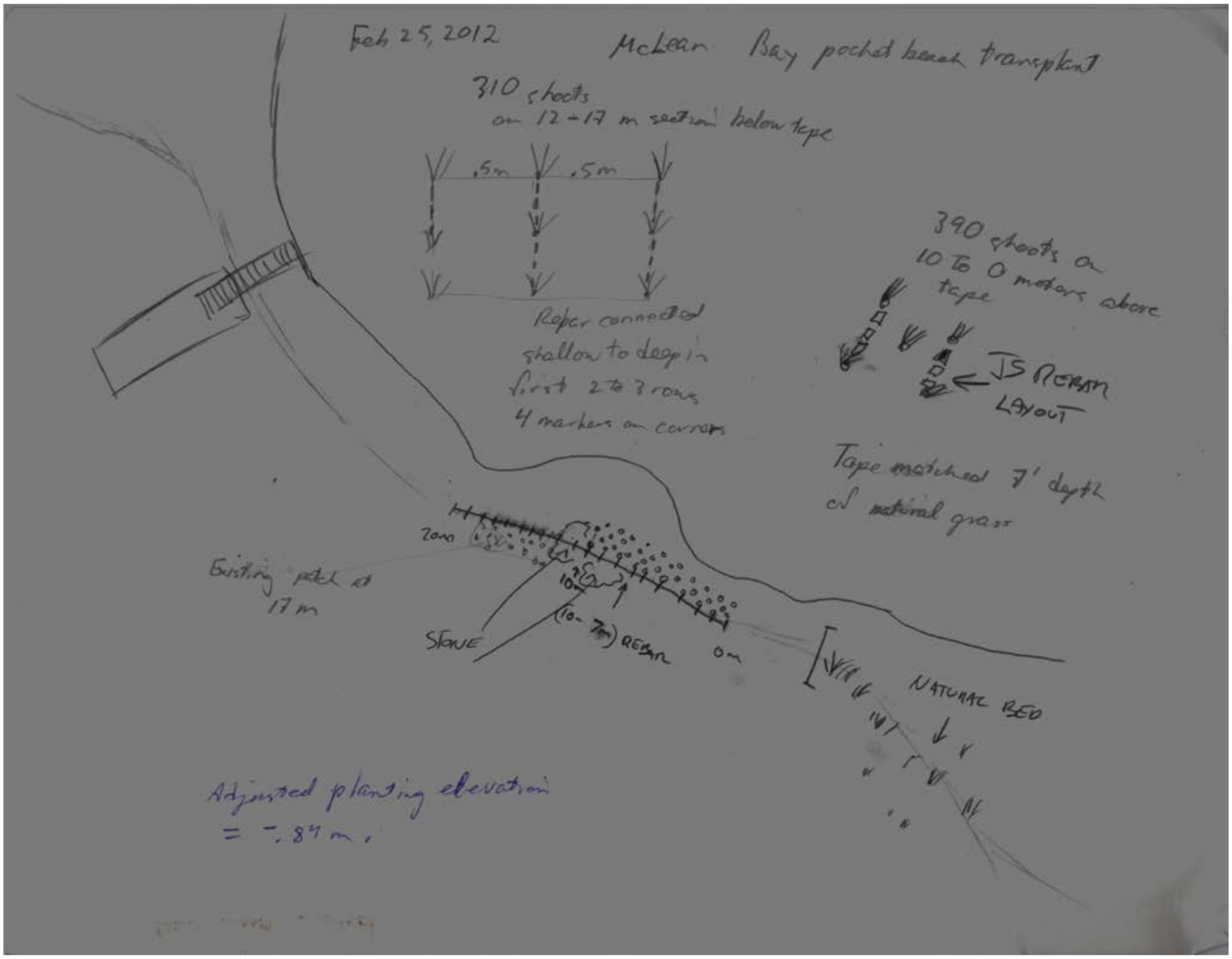
Stawamus (Squamish First Nations Reserve)



Half Moon Bay Sunshine Coast



McLean Bay, Sechelt Inlet



Appendix B

2013-2014 Restoration Sites

Half Moon Bay, Sunshine Coast

McLean Bay, Sechelt Inlet

Stawamus First Nations Reserve
Squamish River Estuary

Genoa Bay

Channel transplant site in Cowichan Bay

Donor site for Genoa Bay transplant

Tod Inlet