EELGRASS RESTORATION IN UPPER HOWE SOUND
Final Report

Prepared by:
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Organization: Squamish River Watershed Society

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Precision Identification: Cynthia Durance, (604) 734-5048

Project Location: (provide civic address, river km, or identify nearby landmarks)
IR 24, Stawamus Reserve, just upstream of where the Stawamus River enters into Howe Sound

Is this project a result of a previous CN Project: YES **NO**

Amount Awarded: $7,021 **Total Project Value:** $13,080

Project Start Date: August 2008 **Project End Date:** June 2009

Background Project Description:

Pacific salmon (especially Chinook, coho, and chum) rely on nearshore waters and estuaries for survival during a part of their life cycle. As well, salmon use estuaries and nearshore areas for migration, juvenile rearing, refuge, and feeding. The nearshore region of Howe Sound includes shallow saltwater, nearby wetlands, estuaries, and bluffs. These areas are important zones for young salmon as they migrate from rivers to the sea. Salmon travel through estuaries twice, first as juveniles on their way to the sea and then migrating back to spawn. The juvenile salmon move to estuaries for weeks or months as they grow and adapt to the salt water before moving out to sea. Here is where salmon make a critical transformation from a freshwater to a saltwater fish, a process called smoltification. The foreshore regions and the estuary of Upper Howe Sound has been significantly reduced over the past 100 years through industry, channel dredging, and urban expansion. The foreshore currently lacks many of the native aquatic species that existed in the past. One of the most important of these species is eelgrass (*Zostera marina*). Eelgrass beds provide, in essence, "salmon highways" for Chinook, coho, pink, chum, and steelhead salmonid stocks, which use these critical marine environments for food, shelter and metabolic growth, some from their juvenile stages to migrating adult lives.

The complex and intricate food webs of an eelgrass meadow rival the world's richest farmlands and tropical rainforests. From an unstructured muddy/sandy bottom grows a myriad pattern of leaves that supply nutrients to fish, shellfish, waterfowl and about 124 species of faunal invertebrates. The plants offer surface area for over 350 species of macroalgae and 91 species of epiphytic microalgae. A study in Padilla Bay, Washington showed that the biomass of macroalgae attached to leaves or shells or loosely floating beneath the leaves in seagrass habitats was greater than the native eelgrass shoot biomass. This macroalgae begin the complex food chain from plant to animal as the algae supplies food for insects and copepods, the major protein for young salmonids.

Native eelgrass (*Z. marina*) plants retain their leaves year-round. Because the plants are rarely exposed to air, the leafy habitat is available to marine animals almost continuously. Living in the web of blades, animals, including juvenile salmon, young herring, plume hydroids, nudibranchs, anemones, jellyfish, clams, scallops, cockles, shrimp, spider, red rock and dungeness crabs, sea stars, moon snails and sand dollars find protection and food. The mat of underground rhizomes prevents the easy movement of predators into and through the sediment, and the thick canopy of blades makes quick movements by larger predators (fish and birds) more difficult.

Only about 5% of eelgrass is consumed by direct grazing. Only a few species eat the leaves. Among the consumers are snails and amphipods, important prey for fish and birds. Great Blue Herons, dabbling ducks, widgeon, pintail and mallard ducks and Black Brant geese are among the millions of shorebirds that use eelgrass beds for foraging. Central to the marine food web is the Pacific herring; contributing 30% to 70% to the summer diets of Chinook salmon, Pacific cod, lingcod, and harbour seals in southern BC marine waters. Herring roe constitutes an important component of the diets of migrating seabirds, grey whales, and invertebrates. About 500 linear km of B. C. coastline turn milky-white every March and April as a result of the herring's release of sperm around the eggs (roe) spawned directly on eelgrass and also on algae which is often epiphytic on eelgrass.

Eelgrass detritus provides the basis for a chain of consumers in the open ocean living as far as 10,000 meters in depth. The extensive root system of the plants helps stabilize sediments and prevent erosion along the BC coastline. Damage to eelgrass can affect an entire ecosystem as well as the stability of our shorelines.[1]

[1] *Eelgrass Conservation for the BC Coast – A Discussion Paper.* Prepared by Nikki Wright, SeaChange Marine Conservation Society, June 1, 2002. This paper may be found on the Seagrass Conservation Working Group website at www.stewardshipbc.ca/eelgrass/index.html .

In 1973 Colin Levings (then working for Fisheries and Oceans Canada) put together a study paper "Intertidal Benthos of the Squamish Estuary"[2] studying the importance of benthic invertebrates on feeding salmon. Some of the findings noted within the report include identifying the primary habitat for amphipods appearing to be that of intermediate intertidal zones where aquatic species provide cover at low tide.[3] Eelgrass beds provide important habitat for intertidal benthos on which salmonids feed. The loss of this habitat in the Mamquam Blind Channel has resulted in less than 10% of the original productive habitat being available. Re-introducing eelgrass beds should help to provide the necessary shelter and food source for migratory salmonids as well as establishing permanent benthic biomass along the foreshore.

Re-establishing eelgrass habitat is an ongoing effort to adapt to differing conditions and environmental impacts. The substrate in the Mamquam Blind Channel has already been tested and determined to be suitable for eelgrass growth. The harvesting of the eelgrass from the native bed (such as at Roberts Bank) is undertaken with permits from DFO and is performed very carefully. The eelgrass plant is not removed – only a portion of the plant, one of the shoots, so as to minimize disturbance. Once harvested, the eelgrass is prepared for planting and transplanted into the new environment within a 24 hour period to reduce any stress to the vegetation. Certified WCB SCUBA divers do the actually plantings to ensure proper transplant techniques are followed. Guidelines for the transplanting of eelgrass are followed (as detailed in the Project Description section). Ideally the transplanting occurs following freshet but prior to the summer so that the eelgrass shoots can adapt to the new habitat. As well, this provides an opportunity for the plants to become fully established for smolt outmigration and smoltification in the spring.

The transplant method that we would use was developed in the mid 1990's specifically for eelgrass beds within British Columbia and has proven highly successful. The method considers genetic variation between populations of eelgrass, seasonality, and the hydrodynamic regime of transplant area. The method has been employed at over 30 sites since 1994, and is recommended by DFO. The transplanted areas typically achieve natural density and cover within 3 years.

The eelgrass shoots traditionally are harvested in a period of 1.5 hr. Shoots are gathered randomly, as the harvesters spread out radially from a central location in the *Z. Marina* zone marked by large plastic storage containers. Harvesting occurs at approximately 0 m MLLW. The containers are filled with ambient water for short-term storage of the harvested shoots. The shoots are gathered every 3 steps by removing the plants from the substrate, along with a 1 – 5 cm portion of the rhizome. In order to remove the plant from the substrate, the basal area of the shoot is secured by hand, and the rhizome is pulled from the sandy-mud sediment in the direction opposite to its forward growth. If the rhizome does not break free from the substrate naturally, it is snapped off by hand at approximately 5 cm in length. Up to five shoots are collected at a time, within an arms reach of the harvester. These will b e carefully bundled and put into a mesh tote bag carried by the harvester until it contained 50 shoots, at which time its contents will be emptied into the larger storage container. This is repeated until all the shoots are harvested.

[2] Fisheries Research Board of Canada, Manuscript Report Series No. 1218: *Intertidal Benthos of the Squamish Estuary* by Colin Levings, Pacific Environmental Institute, West Vancouver, BC, January 1973.
[3] *ibid*. page 17

Once the storage containers contain the requisite shoots for transplanting, they will be transported to shore using a plastic sled, which slides over the eelgrass bed without damaging the substrate. At shore, the plants are meticulously counted and separated into six water coolers one for each transplant site. Steel anchors (no zinc galvanization, 2 cm diameter hole) are also secured to the eelgrass at this time by fastening the washer to the base of the eelgrass shoot using a metal twist tie wrapped around the anchor and loosely attached to the eelgrass blade (see figure to the right). The anchor is necessary to provide stability and prevent movement of the transplanted eelgrass as it re-establishes itself. The coolers will then be transported to Squamish and additional ocean water will be added to them to prevent over-heating. A sub-sample of measurements of shoot length will be taken in order to: (i) determine the distribution of plant dimensions in the community; (ii) characterize the general length of the transplanted shoots; and (iii) provide future monitoring of eelgrass health, growth and colonization

Eelgrass anchor
(MHL photo)

Transplanting consists of digging a small hole (i.e., approximately 5 cm deep) by hand into the substrate. The anchor and rhizome are then deposited in this depression and subsequently covered with sediment. All of the rhizomes for a given sub-site are buried facing the same direction, so that all the blades flow in the direction of the tidal current and won't pull back on the rhizome when they are first buried. In the past, one person untangles the eelgrass shoots from the cooler, located on the shore adjacent to the transplant site and carefully places the plants (tied to washers) into mesh bags. A second person in SCUBA gear then transports the mesh bag of shoots to the planting site. The diver makes a depression in the substrate with their hand and covers the rhizomes/anchors. A second SCUBA diver is on hand to assist with the measurements of the transect lines and to determine the plot spacing as well as being present for safety purposes. As per WCB regulations a third person (separate from the team preparing the eelgrass shoots) is present with emergency safety gear to spot the divers. Initially a dive flag will be placed at the selected site.[4]

The eelgrass shoots are planted in a 20m transect in groups of 10 one metre apart.

Planting design example:

o o o o o o o o o o

o o o o o o o o o o

____________________20 m transect____________________

o o o o o o o o o o

o o o o o o o o o o

The method selects an eelgrass population that is genetically adapted for the site that is to be restored. Plants are harvested with a length of rhizome that enables the plant to survive while setting roots in the new substrate. The eelgrass is buoyant and must be attached to anchors, the type and weight of the

[4] Excerpts of methodology taken from "Assessing the Potential for Eelgrass Restoration in the Squamish Estuary, British Columbia" by Margot Hessing-Lewis. 2005.

anchor depends on the local current regime and varies with location. The anchored eelgrass is planted in bunches to further protect them from currents and tides while new roots develop.

The project is monitored from start to finish and monitoring continues over the course of the year to ensure survival. All monitoring results will be provided in a report within the year.

Monitoring Plan

The eelgrass plots were monitored by two qualified SCUBA divers immediately (the following day) after transplanting to ensure a) that the plants are secured to the substrate material lining the Mamquam Blind Channel and b) to photo document any marine life that has migrated to the newly planted site. After a years time the site will be monitored again, this time to measure blade lengths, as well as to check for dislodged rhizomes and unhealthy blades. Health will be determined by analyzing the colour of the blades. A green blade will qualify as healthy compared to a black blade, which indicated that it is dead or dying. Only green blades will be counted and measured.

Monitoring consists primarily of counts of the number of eelgrass shoots per plot, as well as measurement of leaf length. Leaf lengths will be recorded with a measuring tape, and the longest blade of the bundle is always measured. It has been suggested that monitoring of eelgrass plants post-transplant continue for 2 years to determine whether or not eelgrass can grow in the transplanted environment (Thom, 1990). In all likelihood, depending upon funding being available, the monitoring undertaken in the first year will be duplicated after year 2. This has occurred on the previous pilot plots.

Planting Results

The eelgrass transplant took place from May 22 – 24, 2009. On Friday, May 22 the eelgrass was harvested from Roberts Bank in Delta, BC. As per the project description, the eelgrass shoots were carefully harvested by hand and stored in large plastic bins for transport. In the late afternoon of the same date, the eelgrass was stored in the waters of the Mamquam Blind Channel just off a pier on the Nexen Beach. The original project was to transplant 3000 shoots to two locations, one being the Nexen Beach site and the other being the Stawamus Reserve. In the interest of time and recognizing the difficulty in planting this many shoots at one planting, only half the intended amount were harvested at this date with the remainder to be planted in late August. At this time over 1800 shoots were harvested at Roberts Banks.

On May 23, 2009 over 12 volunteers arrived in the mid-morning to assist with preparing the eelgrass shoots for planting. As noted in the Project Description each shoot was secured to a washer by a twist tie. The volunteers were trained in this procedure and the WCB trained SCUBA divers then planted the shoots below the low-low tide along the east beach of the Nexen Lands site (UTM N49 41.103 W123 09.744). The weather and temperature were ideal for the transplant with a clear day with temperatures in the high 20's. From 10:00 – 2:00 the volunteers continued to prepare the eelgrass shoots for transplant and the SCUBA dive team worked until 5:00 pm and then resumed planting from 9:00 – 1:00 pm the following day.

Prior to the planting the SCUBA team investigated the previous years test plots located at the Nexen Beach and at Stawamus Reserve. The previously planted eelgrass was healthy and had grown substantially both in height of each blade as well as in density. An estimate in eelgrass shoot counts per plot revealed over 90% survival, indicating that the eelgrass is healthy and productive.

Photo 1: Training how to tie the washers to the shoots

Photo 2: Volunteers hard at work

Photo 3: Each tied shoot is placed into a plastic bin filled with ocean water

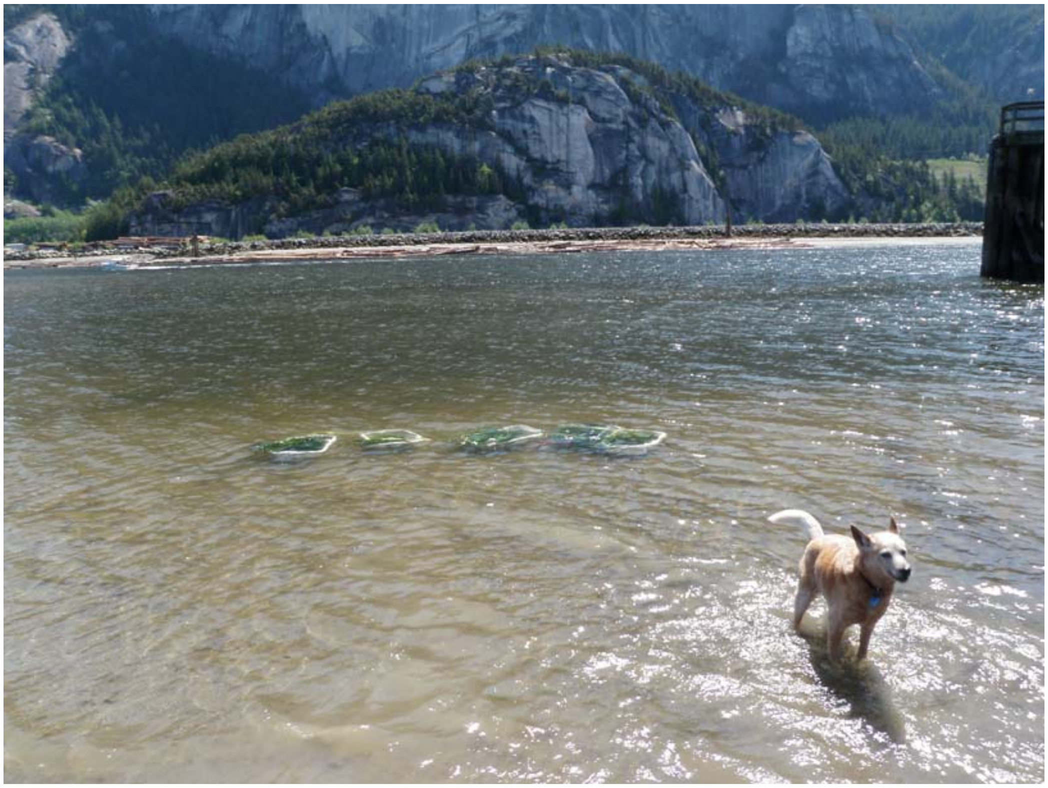

Photo 4: Each bin is stored in the Mamquam Blind Channel and then taken by the SCUBA team for planting


Photos 5 & 6: Eelgrass in bins and eelgrass shoots planted into substrate (notice measuring tape along planting transect in the second photo)

Photo 7: Facing east over the planting site.

Key Personnel:

Project Coordinator: Nikki Wright, SeaChange Marine Conservation Society

Ms. Wright has had experience with community organizing for over thirty- five years, marine education for the last eighteen years, and has acted as the Executive Director of a non-profit marine conservation society since 1998. In 2000, she coordinated the first eelgrass transplant in Tod Inlet. Subsequent restoration eelgrass projects motivated her to "transplant" her knowledge and experience to other coastal community groups. She has organized community eelgrass mapping for twenty-eight coastal conservation groups on the BC coast and has served as Chair for the *Seagrass Conservation Working Group (SCWG)* since 2002*.* The SCWG is a consortium of provincial and federal agencies, First Nations representatives, coastal conservation groups and consultants working together since 2001 for the conservation of seagrasses in B.C. Presently she is helping to compile a catalogue of potential eelgrass restoration sites for the coast of B.C.

Professional Biologist: Cynthia Durance, R.P.Bio. Principal of Precision Identification specializes in the ecology, restoration, and distribution of seagrasses in the North Pacific.

Ms. Durance studied eelgrass ecology and developed restoration methods while working at UBC from 1981 to 1989. Since that time she has remained an active member of the seagrass research community, developing successful eelgrass transplant methodologies, teaching eelgrass ecology, and participating in international conferences and workshops. She travels extensively throughout the Pacific Northwest lecturing to both scientific and community stewardship audiences. She has written many publications including Field Methods for Mapping and Monitoring Eelgrass (*Zostera marina*) in British Columbia. Current research interests include monitoring eelgrass distribution as an indicator of nearshore health. She serves as scientific advisor to the Seagrass Conservation Working Group, and is the Canadian Editor and Member at Large for the Pacific Estuarine Research Society. Ms. Durance has presented scientific papers relating to eelgrass restoration and ecology at international conferences in the United States, Mexico, and Australia.

Project Manager: Edith B. Tobe, RPBio. Executive Director, Squamish River Watershed Society.

Ms. Tobe has been actively working with local volunteers, restoration projects, public awareness, and scientific monitoring within and around Squamish for over 15 years. She is trained as a Professional Biologist and Engineering Technologist. She has been with the Squamish River Watershed Society (and former Watershed Committee) since 1993 and brings a wealth of information, community contacts and partnerships, and longevity to the project.

Dive & Shore Crew:
Sarah Verstegen, Cynthia Durance, and Jamie