Environmental Impact Statement
for the implementation of a
Sponge Aquaculture System in Trevor Channel, B.C.

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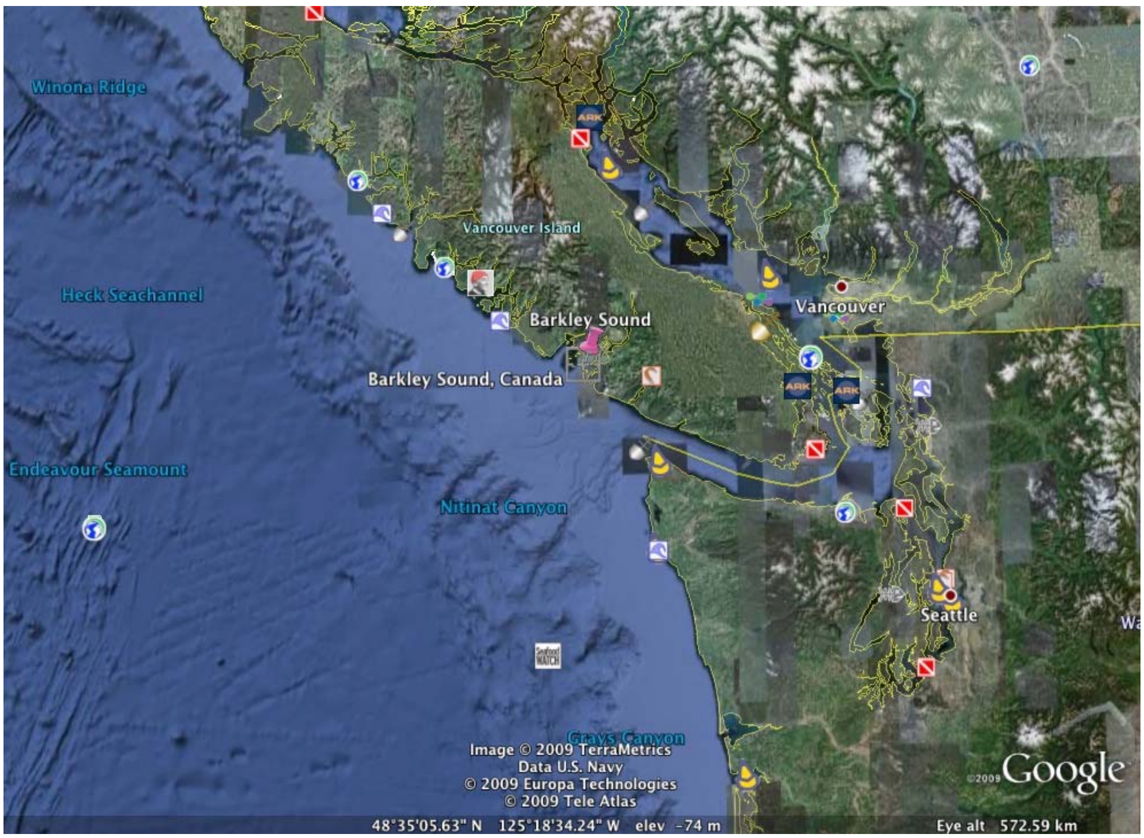


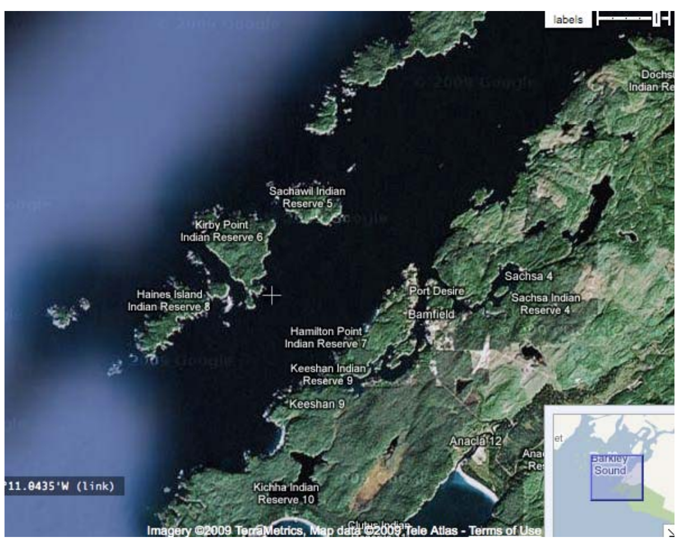
Barkley Sound, B.C. 1

48°52'18.37"N, 125°13'05.94"W

(Google Earth, 2009)

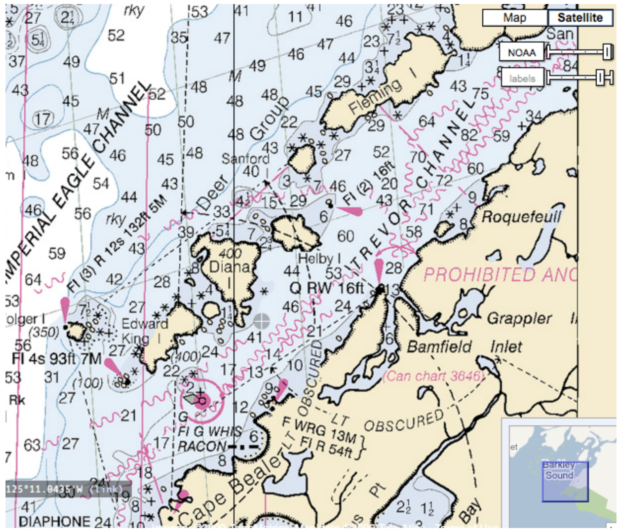
Marine sponges are known as one of the richest sources of biologically active metabolites. Bioactive metabolites, chemicals developed by many marine organisms to repel predators, are often found to have significant pharmacudical potential. Use of these chemicals, however, requires a larger supply than could be sustainably supported by natural sponge populations. One supply option is the implementation of sponge aquaculture systems, where sponges are grown from cuttings in offshore farms (Duckworth *et al.* 2004; Duckworth 1997; Lambert, 2008; Lays & Lauzon, 1998).

A potential location for sponge aquaculture is in Barkley Sound, an inlet on the west coast of Vancouver Island, British Columbia. Offshore British Columbia is known to support over 300 different sponge species, many supporting bioactive compounds. In a survey of 40 sponge species near British Columbia, 28 species contained bioactive compounds (Austin, 2008; Lambert, 2008; BMSC, 2009).



Trevor Channel, B.C.

(Google Earth, 2009)

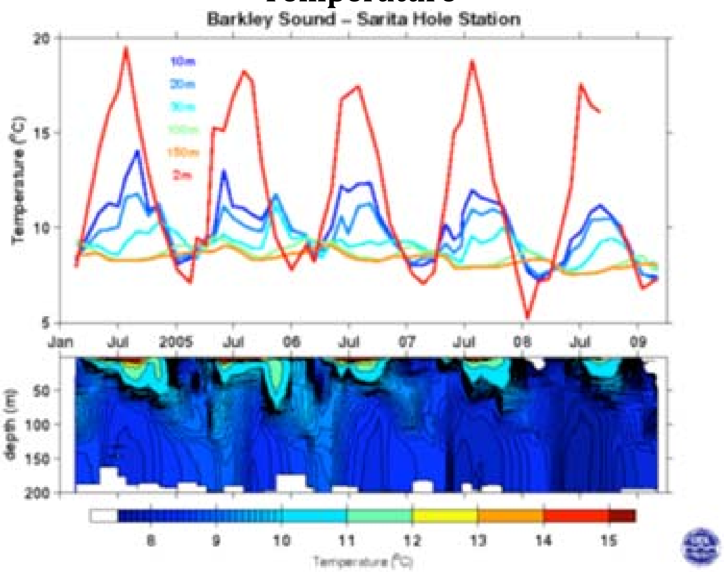


Trevor Channel

(Google Earth, 2009)

The environmental impacts are examined for the implementation of a sponge aquaculture system located in Trevor Channel. Trevor Channel is located in Barkley Sound, off British Columbia (Yahel, 2004). The mild water temperatures and high nutrient content of Barkley Sound make it an ideal location for sponge populations (Lambert, 2008). Tides in this location are mixed semi-diurnal with two unequal tide cycles per day. The channel is characterized by strong tidal currents with a tidal range of ~4m. Although high turbidity and high concentrations of bacteria are characteristic of channel, the channel exhibits "deep sea – like" conditions, such as: a stable temperature of 7.5-10degC; low DO concentration; high concentrations of Silica (>55 μM), Nitrate (>20 μM), and Phosphate (>2 μM). Summer upwelling brings nutrient rich waters to the surface, supporting phytoplankton populations, thus increasing the food source available to sponges (Lambert, 2008). Channel salinity ranges from 0-35 (Yahel, 2004; Lays & Lauzon, 1998).

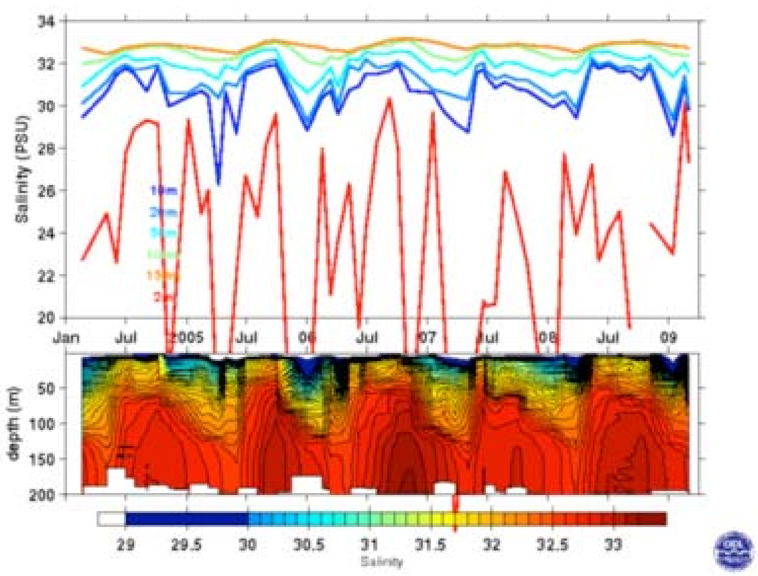
Temperature



Temperature Plot for Trevor Sound

(Barkley Sound Time Series, 2009)

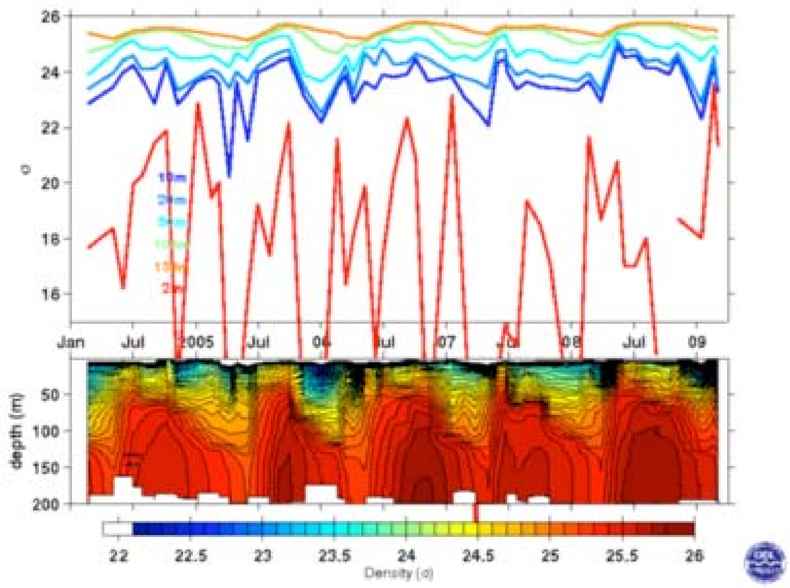
Salininity



Salinity Plot for Trevor Sound

(Barkley Sound Time Series, 2009)

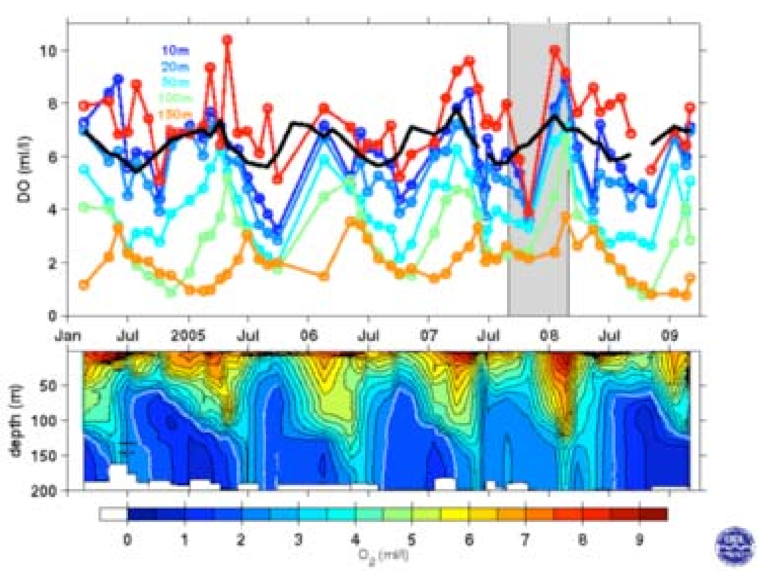
Density



Density Plot for Trevor Sound

(Barkley Sound Time Series, 2009)

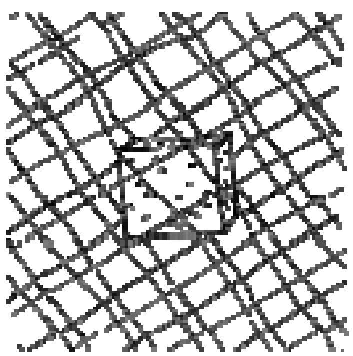
Dissolved Oxygen



Dissolved Oxygen Plot for Trevor Sound

(Barkley Sound Time Series, 2009)

The environmental conditions of Trevor Sound must be considered when selecting sponge species for cultivation. Once selected, an initial harvest of wild sponges is required as seedstock for cultivating sponges. Wild sponges are collected by cutting a small portion (~1/3) off of the original sponge. Sponge explants are then placed in individual mesh bags located on a mesh matrix that is hung up in the water column (Duckworth & Battershill, 2003). The mesh matrix will be located in close proximity (~20cm) to a fjord wall within the channel so sponges are not exposed to the severe mid-channel flow. Anchors will be used to hold the matrix at a depth of ~500m, and floats at the sea surface will be used to hold the matrix up (Duckworth, 2003).



Mesh enclosure with individual mesh bags

(Duckworth & Battershill, 2003)

After regenerative growth occurs in sponge explants, sponges are harvested by removing new biomass from original explants. Bioactive compounds will be extracted from the removed biomass offsite (Duckworth & Battershill, 2003).

The introduction of a high density sponge farm can have significant environmental impacts on Trevor Channel. Because sponges are filter feeders, they can control local aspects of the water column through inhaling and exhaling water. Sponges remove significant quantities of nutrients from the water in the form of plankton or other small organisms. Bacteria and Eukaryotic Algae are selected as food sources from inhaled water. Sponges also exhibit differential selection of food size. In a study of high density sponge area, 99% of small bacteria were removed from the water column (with only 30% removal of large bacteria. Eukaryotic algae is also a food source, capable of being removed from the water column up to 94%. One environmental concern of aquaculture implementation is food depletion for other filter feeders, and competition with native sponge populations. The possibility of sponge populations spreading outside the aquaculture system also threatens the natural channels biodiversity, and is capable of altering the natural gene pool. Sponges can also alter the dissolved oxygen content of their surrounding water. Studies on sponge impacts on DO content have shown a generall decrease in DO content in water surrounded sponge populations (Duckworth, 1997; Duckworth & Battershill, 2003; Yahel, 2004)

The potential for changes in nutrient cycling is great at the local scale. Nutrients are removed from water as sponges injest organisms as food. Particulate organic carbon and nitrogen are also potential food sources for sponges. Waste products, on the other hand, include ammonia, NOx, and soluble phosphorus. Ammonia, NOx, and phosphorus are excreted from sponges as waste (Yahel, 2004; Leys & Laurzon, 1998).

In a study on glass sponges, water column changes were seen up to 0.75 m away from the wall on which they were located. All water conditions shifted toward exhaled water concentrations with proximity to the sponge population.

The aquaculture infrastructure may have important environmental consequences as well. The mesh matrix can reduce water flow due to drag forces, and pose as a possible danger to other organisms that could get tangled in the matrix (GBRMP, 2009).

Filter Feeder Inhale-Exhale

(Yahel, 2004)

Some environmental impacts of sponge aquaculture have potential for remediation. For example, if unnatural chemicals are present in the mesh, this can present the introduction of toxic chemicals to certain marine species. This can be avoided by using materials with no unnatural chemicals present, in addition to a "weathering" period in which the rope is submerged in water for a period of time. Changes to the natural sponge population at an aquaculture site can be reduced by only cultivating sponge species that are native to the area. This is reduces the some of the unnatural environmental effects of population introduction (Duckworth & Battershill, 2003; GBRMP, 2009; Leys & Laurzon, 1998; Yahel, 2004).

There are also many positive aspects of sponge aquaculture to be considered. Sponge cultivation provides a source of bioactive compounds for human medicine, while reducing the harvest of wild sponge populations at the same time. Additionally, sponge aquaculture farms increase employment while boosting the economy of local towns (Duckworth *et al*;. Leys & Laurzon, 1998; Yahel, 2004).

Overall, sponge aquaculture is a viable means of obtaining bioactive compounds for medical use, as well as protecting natural sponge populations. (Duckworth *et al.* 1997) The benefits of the proposed aquaculture system in Trevor Channel are great, and with the remediation of negative impacts if possible, the value derived from the system is greater than the sum of possible environmental risks.

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