

Bull Kelp (*Nereocystis luetkeana*) enhancement plots in the Salish Sea

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Introduction

Data regarding the abundance of bull kelp (*Nereocystis luetkeana*) along the east coast of Vancouver Island in British Columbia is limited, but there is evidence that bull kelp populations have been in steady decline within the central Strait of Georgia within recent

decades (Lamb et al., 2011). In addition, local residents that frequent the coast have reported that *N. luetkeana* has been significantly declining in the Salish Sea over the past 30 years, becoming nonexistent in regions where it was previously abundant (Lindop, 2017). Reasons for significant declines of *N. luet-*

keana forests in the Salish Sea may include coastal development, rising ocean temperatures, local changes in oceanographic conditions (e.g. salinity, turbidity and sedimentation), intensified herbivore grazing or a combination of these factors (Steneck et al., 2002, Heath et al., 2017).

The Mount Arrowsmith Biosphere Region Research Institute (MABRRI) has undertaken a pilot project, attempting to re-establish bull kelp beds that have begun to diminish or have perished in the Salish Sea, specifically the Strait of Georgia. MABRRI's Bull Kelp Monitoring and Enhancement Plot project involved the installation of kelp enhancement plots at two different sites within the Strait of Georgia, including one located in the Winchelsea Islands, near the entrance of Nanoose Bay, and the other northwest of Dodd Narrows, in the Northumberland Channel (Figure No. 1). Located within the UNESCO designated Mount Arrowsmith Biosphere Region, the Winchelsea Islands site was noted

by locals to have a flourishing bull kelp forest; however, no bull kelp is found near the site today. Additionally, the Northumberland Channel historically and presently has bull kelp just south of the enhancement plot site.

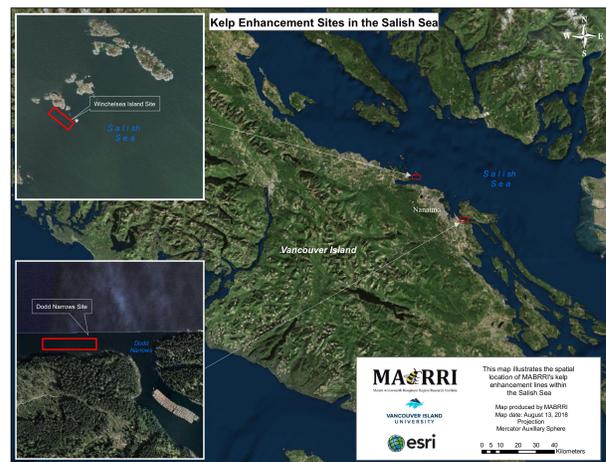


Figure No. 1. Site locations of MABRRI's *Nereocystis luetkeana* enhancement plots in the Strait of Georgia, British Columbia

Site selection for the *N. luetkeana* enhancement plots was based on local historical knowledge that was obtained by speaking with fishermen and divers that have frequented the area for the past 30 years. Through this knowledge sharing, it was noted that bull kelp

has either declined, or is now completely absent in these regions. Additionally, prior to this project, initial surveys were conducted indicating small amounts of *N. luetkeana* near Dodd Narrows. Further, data loggers, measuring temperature and light intensity at the bottom and six metres from the bottom, were deployed at both sites, and initial results indicated favourable characteristics of bull kelp. Both sites were determined to have rocky substrate with suitable depths of approximately 9 meters, and suitable currents that support the growth of *N. luetkeana*.

Methods

Installation of enhancement plots followed Project Watershed's methods, used at their enhancement plots off Hornby Island. The set up included two concrete anchors with a 19mm diameter rope strung between them. Multiple spools of pre-seeded lines, which are strings with *N. luetkeana* growing on them, were wrapped onto the rope as it was lowered

(Heath & Chambers, 2014). Additionally, mature *N. luetkeana* were collected and transplanted onto the rope. One of the transplant methods was adapted and modified from a project in Washington State; the other was developed by MABRRI and Heath (Carney, Waaland, Klinger, & Ewing, 2005).

Two methods were employed during the transplant. The first method ("Method A"), involved a piece of nylon cord looped around the stipe of the *N. luetkeana*, just above the holdfast, with the loop being secured by a cable tie. A second loop, on the open end of the nylon cord, was created with a second cable tie, through which the third cable tie was guided to attach to the nylon cord to the rope (Figure No. 2a) (Carney et al., 2005). The second method ("Method B"), involved fastening the holdfast directly onto the rope by wrapping veterinary tape around them. A single cable tie was then attached on either side of the stipe, over top of the veterinary tape, to

secure the holdfast while minimizing abrasion (Figure No. 2b). A total of 12 individual kelp were evenly distributed along the rope, with an even number of each method used at each site. Each kelp was coded and tagged to easily monitor each kelp's individual progress.

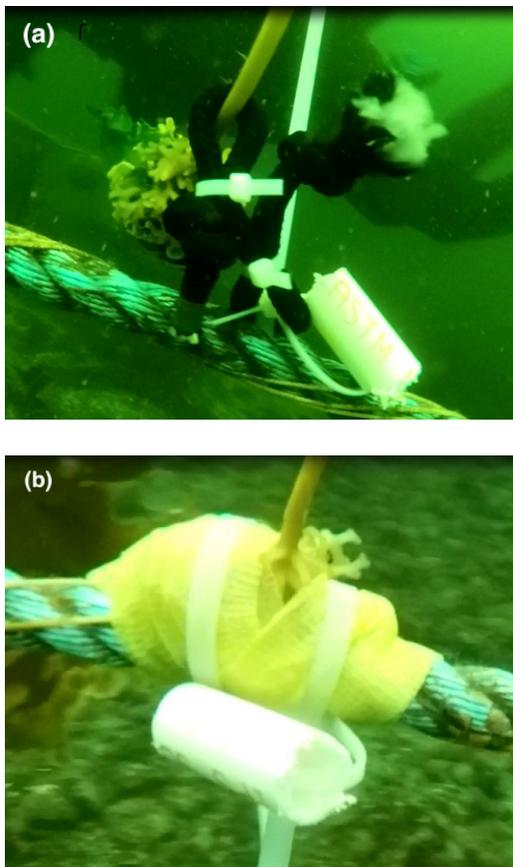


Figure No. 2. The two methods used to attach mature *Nereocystis luetkeana* sporophytes to the enhancement plot rope.

Preliminary Results

The transplant of all mature *N. luetkeana* sporophytes occurred on June 6, 2018. By August 16, 2018, seven individuals remained between both sites; four individuals that were attached via Method A, and three individuals that were attached via Method B. The individuals that did not survive either snapped along their stipe, were grazed, or were completely absent from the site. Five individuals were observed to have sori over the summer, and we will continue to monitor for new sporophyte production occurring at both sites.

Using a time-lapse camera and periodic observations from divers, species that were commonly observed using the *N. luetkeana* as habitat were schools of Pacific herring (*Clupea pallasii*), schools of shiner perch (*Cymatogaster aggregate*), and juvenile copper rockfish (*Sebastes caurinus*). Our dive team is also surveying the benthic species present near the enhancement plots, recording wheth-

er changes are occurring to the composition of benthic flora and fauna over time. This surveying is accomplished by using one-meter by one-meter quadrats in pre-determined locations underneath the kelp lines, at both sites.

Next steps

The goal of the enhancement plots is for the *N. luetkeana* to reproduce and form self-sustaining kelp forests within our study sites, as well as provide habitat for species that would normally use these kelp beds as habitat. In addition to the efforts of restoring *N. luetkeana*, baseline data regarding water parameters and species composition at each site is being collected. This data may then be used to assist future projects in understanding how bull kelp is being impacted over time by changing environmental and climatic conditions.

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