PACIFIC SALMON FOUNDATION

NEARSHORE AND ESTUARY PROGRAM

MARINE SCIENCE PROGRAM NEWSLETTER

VOL. 1 | January 2022

PSF.ca

Photo by Liam Coleman. Cover photos by Eiko Jones, Sam Starko, Silven Read and Liam Coleman.

IDENTIFYING AND PRESERVING THERMOTOLERANT KELPS FOR RESTORATION

Kelp forests have many important roles in the nearshore environment. They maintain marine food webs, buffer shorelines against erosion, and contribte to carbon and nitrogen cycling. They also provide refuge from predators, habitat, and food resources for Pacific salmon and their forage fish prey. Coastal First Nations food fisheries and commercial fisheries rely on healthy and intact kelp forests to be productive.

Today, the cumulative effects of a warming climate, coastal development and sedimentation threaten kelps. Already, many populations of kelp forests along the west coast of North America have disappeared or are in steep decline. With the entire nearshore marine food web bolstered by kelp, the repercussions of losing kelp forests would be far-reaching and could result in large-scale ecological shifts and the loss of a way of life for many coastal communities.

To address kelp forest declines, the Pacific Salmon Foundation is working with researchers to investigate what contributes to kelp resiliency, how kelp genetic diversity can be protected for the future, and novel ways of restoring kelp forests. We want to ensure that kelp habitats can support the next generation — us and salmon!

SAVING FOR THE FUTURE: BIOBANKING KELP

The Pacific Salmon Foundation is collaborating with Dr. Sherryl Bisgrove's team, including Dr. Liam Coleman and Silven Read, at Simon Fraser University. They are focusing on ways to protect and preserve the genetic diversity of kelp species that are found in the Salish Sea and beyond. One strategy they are working on is the development of a kelp biobank. Similar to seed banks that have been set up around the world to preserve genetic diversity of terrestrial plants, the aim of a kelp biobank is long-term storage of kelp spores or gametophytes — an alternate stage of kelp that is microscopic and can remain dormant for years — from different areas. It is like an insurance policy for the future. If a local area of kelp disappears due to warming or is wiped out by a localized disaster, such as an oil spill, there will be a repository of regionally adapted and genetically diverse kelp that can be tapped into for restoration.

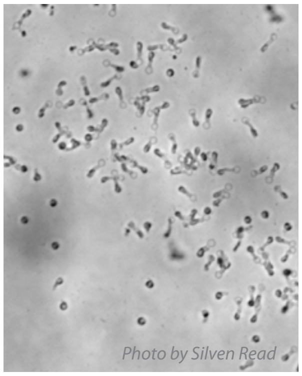

Photo by Silven Read

Germinated spores seen through a microscope.

Bull kelp produce spores from patches on their blades called sori. Researchers collect these patches and induce them to release their spores to culture the microscopic stages of the bull kelp life cycle in a lab. Here, many sori can be seen releasing their spores in a beaker.

Co-op student Jasmine Ibasco tends to bull kelp sori that are releasing spores, which were used in experiments.

Photos by Liam Coleman

DID YOU KNOW?

Bull kelp (*Nereocystis luetkeana*), the most prevalent canopy-forming kelp in the Strait of Georgia, completes its lifecycle in a year. It rapidly grows from its microscopic stage each spring through summer to form dense forests that reach from the sea floor to the water's surface. During peak growth, the bull kelp stipe extends at a rate of 10 – 17 cm per day and can reach lengths of 40 m! As the characteristic float or 'pneumatocyst' reaches the surface, blades of foliage extend along the surface to soak up the sun, fix carbon and create habitat. Most of this forest will be ripped up by autumn and winter storms and washed onto the shore, where it continues to contribute to the food web by feeding invertebrates and microbes as it decomposes.

Photo by Nicole Christiansen

With aquatic species such as kelps and seagrasses — another focus of the group — there are unique challenges for preservation that the team must work through. The tactics commonly employed for terrestrial plant species may not work with aquatic species. For example, kelp produce spores that are never meant to leave the water and so, unlike plants, they lack any sort of protection from drying out. Therefore, simply drying and keeping kelp spores at low temperatures will not work. Freezing in a solution may be possible, but again the methods will need to be optimized specifically for kelp spores so as to not damage them through the freeze and thaw process. Another potential strategy is to store kelp gametophytes at low temperatures with reduced light levels. While long-term storage has been accomplished using this method, it requires considerable space and labour to maintain. Work is still needed to assess whether the stored gametophytes accumulate genetic damage over time. The team will continue to test and tweak potential methods to come up with the most practical and effective solutions.

Another objective of the SFU team is to identify genetically thermotolerant stocks of kelp. In an initial experiment, they compared the survival rates of spores from distinct populations that were exposed to varying temperatures in their lab. One set of spores was obtained from a population of bull kelp within the Strait of Georgia, near Stanley Park, which experiences warmer waters. The other set was collected from a population near Victoria that grows in cooler waters. The results of this experiment suggest that the Stanley Park population was adapted to withstand warmer temperatures. While neither set of spores could survive water temperatures above 20° C, most of the spores from Stanley Park survived at 17° C, whereas very few of the spores from the Victoria population did. More experiments are planned to further explore the local adaptations of different kelp populations.

Photo by Silven Read

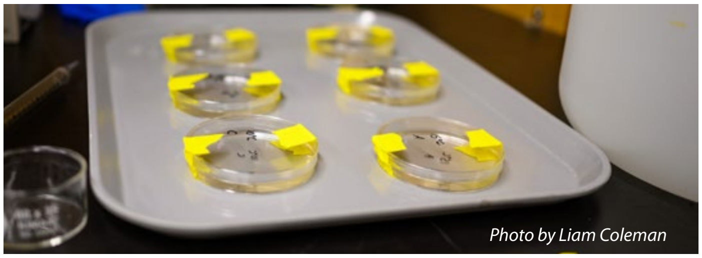

Photo by Liam Coleman

Postdoctoral researcher Liam Coleman and co-op student Jasmine Ibasco are working together to collect bull kelp samples from their field sites.

Petri dishes full of bull kelp spores are awaiting experimental heat treatments. The team tested the maximum temperatures that bull kelp spores can withstand before they die. Information like this will be important for making predictions about how local bull kelp populations might continue to be affected by warming oceans.


Photo by Liam Coleman

STRATEGIC RESTORATION

With kelp forests experiencing broad scale declines, restoration will be vital to maintaining this highly ecologically valuable habitat. However, restoration projects are often hampered by the considerable time, effort, and expense that they require. Unfortunately, most restoration efforts also fall short of achieving the goal of establishing a self-sustaining population. To address these plaguing issues, postdoctoral researcher Dr. Samuel Starko from the University of Victoria's Baum Lab and the Kelp Rescue Initiative are teaming up to investigate ways to restore our kelp forests with less effort and greater success.

Traditional methods for restoring kelp forests usually involve time and skill intensive SCUBA diving, but researchers around the world have come up with a new solution. The method, called 'Green Gravel', involves culturing young kelp on pebbles and rocks that can be dispersed right off the side of a boat. The young kelp simply overgrow the pebbles to attach directly to the substrate. The Green Gravel method has been trialed abroad, but not yet in the Pacific Northwest. Based out of the Bamfield Marine Sciences Centre, Dr. Starko will test this method with our local kelp species and work out how best to apply the technique along the coast of BC. If it is effective, this method could vastly increase the scope of a restoration project with less time and effort.

Still, the ultimate success of a restoration project rests upon the kelp stocks that are used for reseeding an area. Creating a self-sustaining population requires that the kelp must be suitably adapted for the local conditions and be robust to future climatic changes. In seeking out how best to restore kelp forests, Dr. Starko will examine the populations along our complex coast looking for populations which may harbour genetic traits that will be beneficial for future conditions. This work will also identify genetic diversity hotspots as well as areas of low diversity that must be prioritized for urgent conservation efforts.


Photo by Lianna Gendall

Postdoctoral researcher Sam Starko examining fronds of kelp in the field.

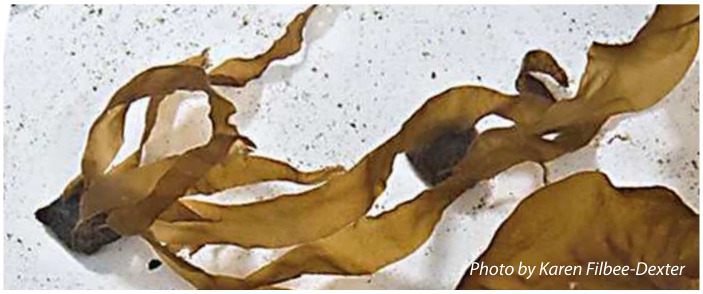
Photo by Karen Filbee-Dexter

The Green Gravel method of growing kelp on small stones for transplanting into restoration plots.

This research will focus on the two locally dominant canopy-forming kelp species, *Macrocystis pyrifera* (giant kelp) and *Nereocystis luetkeana* (bull kelp). Using genomic techniques, he will characterize the genetic diversity of various populations and make connections with traits. Once these are better under-stood, he will be able to apply this knowledge to test different strategies for out-planting. He will assess if it is better to plant a low diversity of stress-tolerant genotypes of kelp or a random but diverse set of genotypes. If one strategy yields greater success, it can be implemented more broadly.

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