Joint Innovation Project - 2024/25

Building capacity for gametophyte generation and direct seeding techniques for the commercial kelp species Saccharina latissima (Sugar kelp) in Alaska

Lead Entity: Alutiiq Pride Marine Institute (Subsidiary of Chugach Regional Resources Commission)

Category: Innovations in seaweed farming
Project Location: Seward Alaska
Project Start Date: 9/30/24
Expected End Date: 3/30/2026
Award Amount: $99,473

PROJECT OVERVIEW

Please provide an updated description of your project here using the following guidelines:

- Seeding kelp farms with meiospores results in variable sporophyte density, is limited in genetic traceability, and may result in reduced growth performance compared to gametophyte seeding; a method which Alaska currently lacks in capacity, while there is a concerted effort from other regions world-wide in implementing this technology in kelp farm seeding.
- Three things need to come together in order for gametophyte propagation to be an effective and advantageous resource for seeding kelp farms in Alaska: 1) optimized protocols in culturing and seeding gametophytes specific to Alaskan kelp strains and species, 2) equipment, knowledge and capacity for research and commercial seed production, and 3) knowledge of population genetic processes and policy change in permitting. This project aims to prioritize the first two points through 1) assessing growth parameters for efficient gametophyte cultivation and seeding, and 2) establishing Alaska specific protocols for *Saccharina latissima* which combined with dedicated culture space and incubation equipment will allow further gametophyte generation to continue beyond this study, while simultaneously cataloging genetic samples for the Alaska Department of Fish and Game to use in assessing genetics.
- We have established a gametophyte laboratory equipped with two incubation systems which currently house cultures from two parental groups, a mixed gametophyte stock from sporophytes collected in Jakalof Bay in Oct. 2024, several dozen clonal cultures of males and females, and a mixed sex culture from sporophytes collected in Jakalof Bay in May 2025. Much time has spent growing cultures to desired biomass levels needed for experiments, controlling biological contamination from phytoplankton, and assessing methods for measuring biomass which has proved difficult to achieve in the small quantities used in our replicates (eg. 0.057 mg dry weight/ml, 1 ml volume). Our solution was to use volumetric measurements using packed cell volume tubes (PCV) and a centrifuge which were correlated against known wet-weight concentrations using linear regression to estimate biomass (Adjusted $R^2 = 0.7778$), while dry weight calculations were achieved based on a conversion factor specific to the experimental batch. Besides the practical lessons and observational information collected from culturing, we have completed an experiment which assessed how starting gametophyte density effects growth and reproduction of mixed sex cultures under white light, which resulted in a significantly higher

specific growth rate in our low density treatments, while no sporophytes were observed in any culture over the 20 day experiment. This experiment was chosen as a result of two things learned after the inception of this project, 1) isolated sex cultures take a long time to grow to desired biomass and are likely not relevant to commercial application in Alaska in the near future, and 2) published evidence suggests repression of sexual reproduction in gametophytes through irradiance is a function of usable photosynthetic radiation meeting a threshold, rather than the spectrum of light used, thus using density as a control for reproduction may allow for photosynthetic saturation and subsequently higher growth rates. Unfortunately, due to technical failures we were not able to include temperature as a predictor variable, or compare growth under red light with the same batch of gametophytes due to the depletion of this stock.

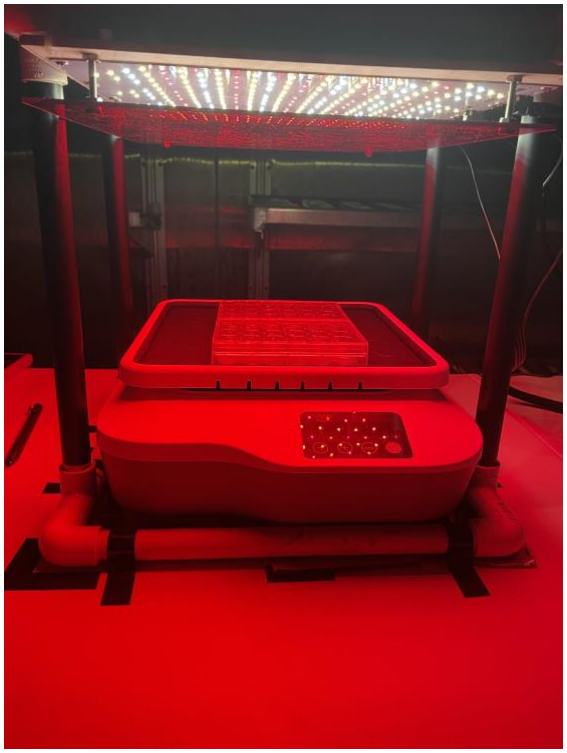
- Our next steps are to conduct several experiments on the basis of our second objective which deals with reproductive success and seeding optimization. We are currently building a laboratory wave tank to test our hypotheses. Additionally, once an incubator has been secured, we will continue our density – growth experiments with comparisons at different temperatures and light regimes.

ADDITIONAL INFORMATION

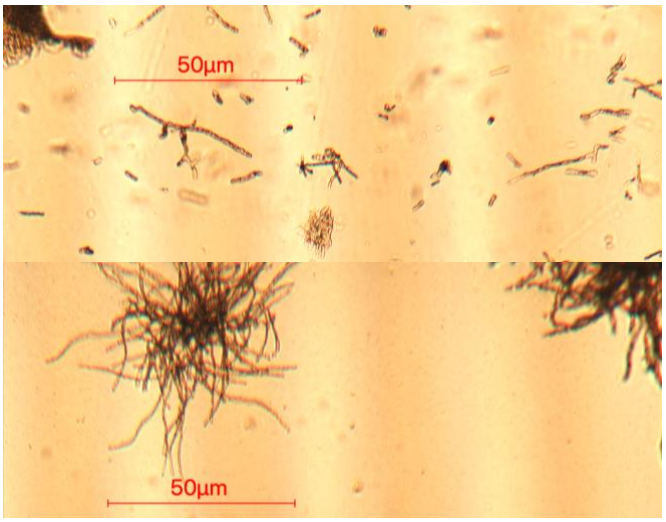
- Limitations: The biggest limitation is suitable incubator space. We are working to secure funding to receive a research grade incubator.
- Awards spending: All award money will be spent by the end of the project timeline.
- Additional info: this project feeds into our next project funded by the Seed Quality Improvement Grant supplied by the Southeast Conference, where we now have additional funds to continue lab experimentation past the end date of the JIP grant, along with funding for an outplant experiment to assess direct seeding practices.

PHOTOS

Please upload 2-4 photos of the project here, or as attachments.

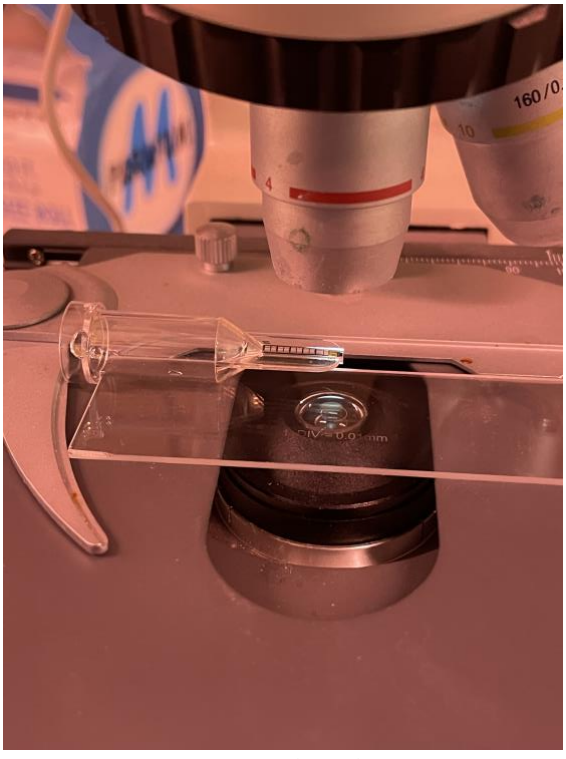


Irradiance and water motion system used for density – growth experiment.



Gametophytes after (top) and before (bottom) manual fragmentation.

Industrial Plankton Seaweed Bioreactor.



Packed Cell Volume (PCV) tube under microscope to measure volume density.