Kelp Ark QUARTERLY REPORT 2
Seed Quality Improvement Project, Q2 2025
Title: Population genetics and gametophyte seed banking of Alaska kelps
Date Submitted: 10/23/2025

Report Narrative:

Our project has been advancing at a striding pace. Since the Kelp Ark team visited Juneau from August 21 – 24th, 2025, we started our field collections with Southeast Alaska Region by going out and wading in Point Louisa, Juneau to collect both *Saccharina latissima*, and *Alaria marginata*. Then we al so went out by boat and collected *Nereocystis luetkeana* over by South Shelter, Juneau. During these intensive 4-days we released spores from we released meiospores from 178 individual kelps. After this first push, the UAF team has kept on working closely with Nick Mangini, to increase the meiospore releases up to 374 in total. From all these individuals the team has now successfully isolated up to 186 individual gametophytes (See detailed tables below). As a measure of redundancy, we are also keeping additional "mixed" tube containing a mixture of gametophytes.

This Quarter represented most of the work being done thus far this Grant, and a lot of learning was done while successfully harvesting two species of kelp from 4 of the 6 farms participating in this project. Starting with the Juneau farm (Sea Quester), we were able to support the collection and subsequent spore release of both Alaria and Bull Kelp form the Juneau region. Next, we were able to obtain both Alaria and Sugar Kelp tissue from Noble Ocean farms in Cordova over a two-week period. Next, we moved to Kodiak Island where there are two subregions with differing availability dependent on the timing of collection. Our first collection of Alaria was done with Alaska Ocean Farms on the West side of Kodiak Island. Lastly, to cap off September we were able to assist in the collection of Alaria by Spinnaker Sea farms in Homer. These collections were hours spent on logistics, using the various creative sources of both friends and family to assist in the harder to reach areas Kelp for shipment to the Juneau Hatchery. We will continue the collections of Alaria and move into the final collections of sugar as the fall and winter progress.

Task summary:

Task 1: Establish a collection of commercially relevant Alaska kelp

1.1(Q1) 64% Kelp Ark will work with a group of Alaska farmers to gather sugar, bull, and ribbon kelp sori. Sori will be collected from each Alaska kelp-growing region (Prince William Sound, Kenai Peninsula, Southeast, and Kodiak)

Communication was established with 8 different farmers from the planned regions to collect kelps from all the species later in September. This date has been chosen as it is the most appropriate time window for sorus, and weather conditions.

Our team met with ADF&G's Michelle Morris to coordinate what will be the best course of action for a collection permit for this project and decided to apply for a commercial kelp harvesting permit to collect reproductive sorus from all four regions.

Worked with farmers to obtain and share information for starting permitting applications. Began to plan travels to start collections, considering capacity at the UAF laboratory to uptake and process the kelps. Our team spent time working out details and plans for kelp collections, as well as meeting as a team to understand how to best handle the influx of kelp from different sources.

Our team obtained 17 seaweed collection permits from ADF&G for the project, involving 6 different farmers spread across Prince William Sound, Kenai Peninsula, Southeast, and Kodiak regions.

The Kelp Ark Team traveled to UAF to start the gametophyte strain collection as well as standardize protocols on handling of spore releases. We received 69 Alaria marginata sporophytes from Prince William Sound, as well as collected 48 Nereocystis luetkeana, 29 Saccharina latissima, and 41 Alaria marginata sporophytes from Southeast, and released meiospores to prepare for gametophyte isolations. (fig. 1)

Figure 1. Different approaches used for field collection used for this project. From left to right, boatside pulling kelps onto a boat, intertidal wading, snorkeling from paddleboard.

We have established a calendar to receive the remaining samples at a rate that is feasible for our UAF laboratory team to work with.

Currently we have received 374 individual kelps with the following breakdown:

	Specimens Collected & Released
Totals	**374**
total A. marginata	**242**
Juneau (SE)	41
Cordova (PWS)	69
Homer (Kenai)	70
Kodiak	62
total S. latissima	**84**
Juneau	29
Cordova	55
total N. luetkeana	**48**
Juneau	48

1.2 (Q1-2) 100% Kelp Ark will communicate with the Gene Conservation Lab at the Alaska Department of Fish and Game before sori collection in order to communicate their sampling plan and ask for feedback. Kelp Ark will consider adapting protocols, when possible, to increase the project's ability to inform the Alaska kelp farm permitting process.

Kelp Ark's Sergey Nuzhdin, Michael Marty-Rivera and UAF's Michael Stekoll met with ADF&G Gene lab's Chase Jalbert, and Kristen Gruenthal about our project and how to contribute to their efforts. We shared our project overview, including collection and sequencing plans. They shared a paper by Trevor Bringloe on long-read annotated genomes for Alaria esculenta. After communications the ADF&G Gene lab seemed in agreement with our targets and approach for this project.

1.3 (Q1-4) 16% UAF will culture at least 50 individual kelp gametophyte strains per species per region. In total, this will be at least 600 strains, with cultures for sugar, bull, and ribbon kelp from each of the 4 regions. This collection will be housed in Juneau, AK at the UAF's Lena Point facility.

Following Q1-1, gametophytes are now growing in the UAF Lab, to be isolated in September. By now we have started our gametophyte isolation from these strains. Our current count is up to 186 individuals. Additionally, as a redundancy, we are also keeping a

tube with a mixture of several gametophytes; to be accessed in case something goes wrong with our isolations, we have 95 tubes for this case (fig. 2).

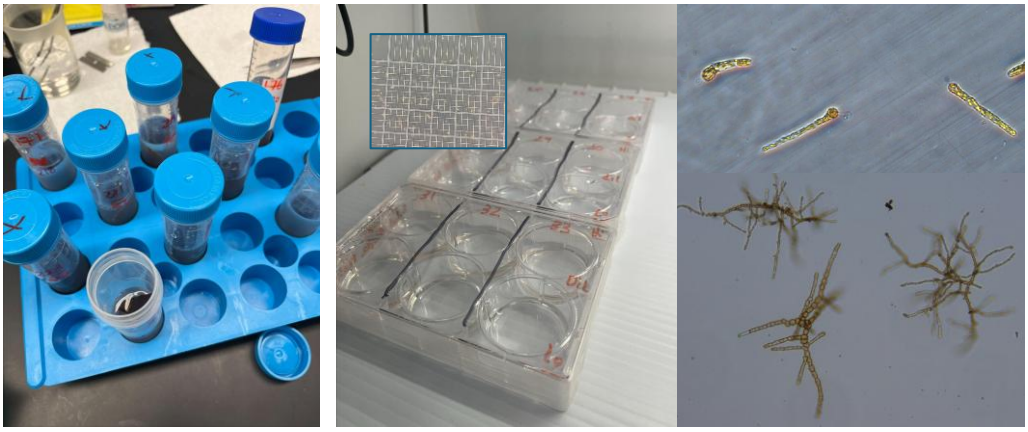

Figure 2. Gametophyte working stages. From left to right, spore releases in 50mL tubes, 6-welled dishes for serially diluted spore settling (inset of hemocytometer for cell counts), gametophytes culture at a size-class ready for isolation.

Individual Gametophytes Isolated	**Female**	**Male**
Totals	**94**	**92**
total A. marginata	***47***	***46***
Juneau (SE)	39	38
Cordova (PWS)	8	8
Homer (Kenai)	0	0
Kodiak	0	0
total S. latissima	***27***	***26***
Juneau	27	26
Cordova	0	0
total N. luetkeana	***20***	***20***
Juneau	20	20

1.4 (Q4) 0% Kelp Ark will replicate the Alaska kelp seedbank in California.

• Deliverable: Alaska kelp seedbanks in California and in Alaska, which will be in the public domain. 45% Completed.

Task 2: Assemble and annotate genomic and transcriptomic biodiversity resources

2.1 (Q3-4) Kelp Ark will use available genomes from S. latissima, N. luetkeana, and Undaria pinnatifida to align resequenced genomes of Alaskan kelps.

Biomass is now growing for all isolated gametophytes to be used for sequencing.

2.2 (Q3-4) Kelp Ark will use Illumina sequencing technology, utilizing a minimum of 5x coverage per genotype and a median read length of approximately 200 bp. Data will be filtered for sequencing adapters and quality via Illumina prior to starting the snp calling. They will filter out potential bacterial contamination using PathoScope 2.0.

2.3 (Q4-5) Kelp Ark will use principal component analysis to understand the geographical boundaries of population clusters to delineate population structure.

2.4 (Q4-5) Kelp Ark will communicate with the Gene Conservation Lab at ADF&G to share findings and maximize the utility of their research to ADF&G as they work to better understand population structure, local adaptation, and regulatory strategies for Alaska kelps.

We are in conversations with ADF&G to acquire some additional funding for sequencing. We have asked for a quote from Novogene for sequencing samples. Gene lab has mentioned a funding pool of $45K that could be made available for our sequencing.

Task 3: Communication with stakeholders and AMC

- *Kelp Ark will engage with other AMC Kelp Seed Quality Improvement projects as appropriate, as well as the broader AMC coalition and scientific community, to share findings and participate in related efforts.*

We have established communications with other folks who have been engaging with AMC funded projects, such as Markos Scheer of Seagrove kelp, and John Smet from Pacific Kelp Co. about how to continue collaborations into the future in terms of upcoming grants of interest and seedbanking strains from other collections in Alaska.

- *Kelp Ark will lead accounting and invoicing.*

Invoices have been submitted for the months of June, July, August, and September.

Task 4: Quarterly progress reports, final report, and project presentation

- Quarterly progress reports detailing updates will be submitted to AMC during the project period.
- Copy of all data generated during the project, in clean and usable formats.

- Final report outlining key findings, successful techniques, and recommendations for future commercial production.
- Presentation at a virtual venue sponsored by SEC to share results of AMC projects. Presentation to include Power Point or similar slides.

Budget Overview

- Budget allocated: $199,396
- Amount spent this quarter: $30,817
- Remaining balance: $166,499

Next Steps

We will continue to isolate gametophytes at the UAF Lab, before continuing collections, as the number of plates is too high for the available capacity. Once we have cleared up space we will resume the field collections.

We have also acquired a general quote from Novogene to sequence samples and will discuss with ADF&G Genelab during the upcoming quarter about how we can work with them and the expected $45K that we have been in communications about.

Challenges

- Challenges arose in the deliveries of both the West side of Kodiak and Homer regions. In Kodiak, the Kelp is collected by divers, followed by pickup from a mailing floatplane that comes once a week. The consultant then collects the sporophyll tissues and sets aside a portion for delivery by Alaska Air- gold streak to Juneau (UAF Lab). In the case of Homer, we had to find a passenger of a commuter plane traveling to Anchorage, the passenger then met with a third party who delivered the sorus tissue to Alaska Air cargo for shipment to Juneau (UAF Lab). This shows the needed collaboration and communication needed to make projects like this successful.