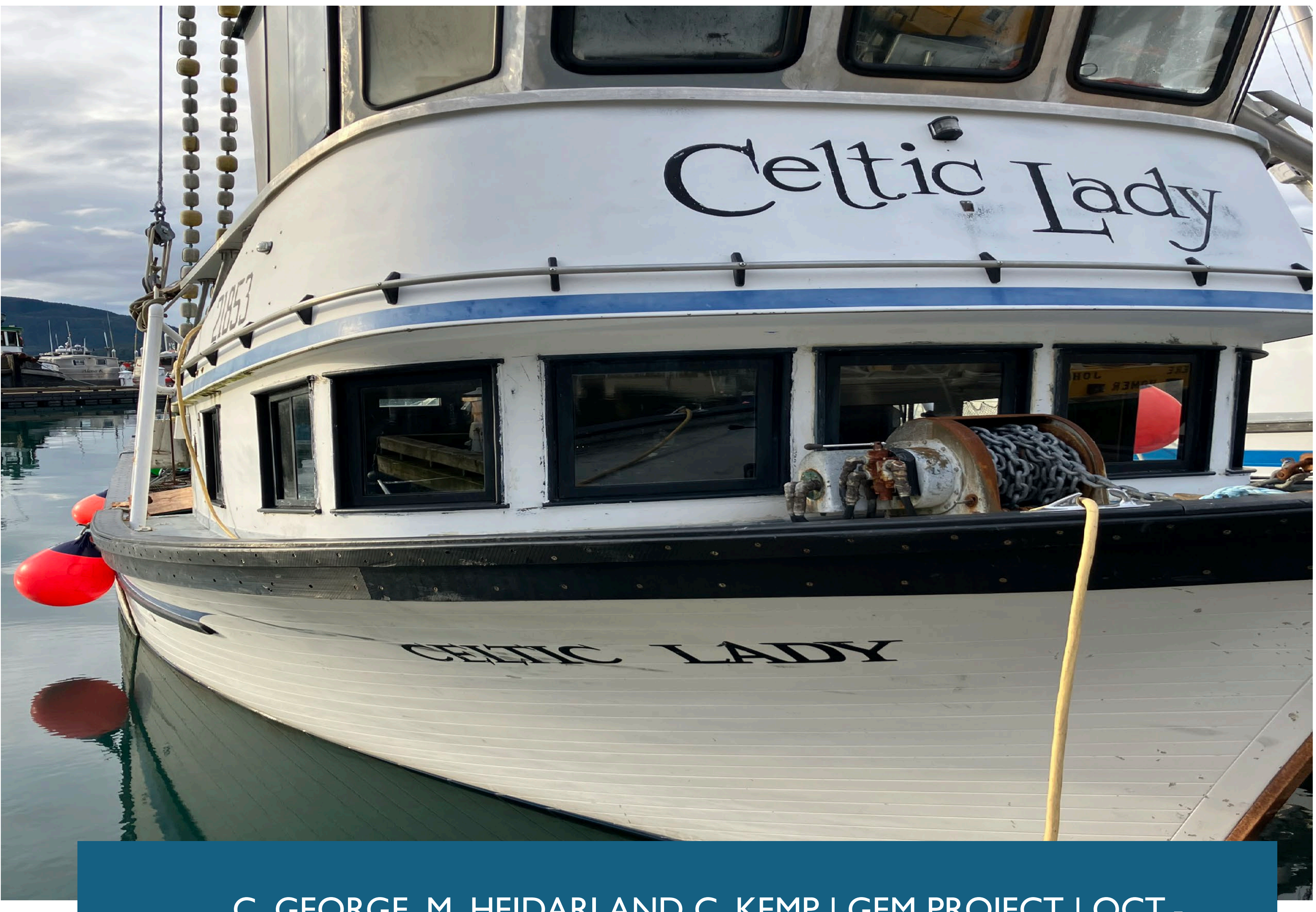
GREEN ENERGY IN MARICULTURE

RESEARCH IN CORDOVA AND SEWARD



C. GEORGE, M. HEIDARI AND C. KEMP | GEM PROJECT | OCT.-NOV. 2024

The fishing vessel Celtic Lady owned by Cale Herschleb and used for kelp farming in Cordova, Alaska

PURPOSE

The Green Energy in Mariculture (GEM) project aims to establish how energy is used in shellfish and seaweed farming and processing in Alaska, develop a plan for the industry to expand while minimizing energy use and emissions, and distribute best practice guidance for farmers that want to minimize energy costs. Our field work allows us to collect primary information about current energy use and will form the foundation for all subsequent work.

- Our goal is to understand energy use in mariculture by collaborating with farmers and processors
- We use interviews to give a voice to participants and receive information directly from farmers
- We record data like fuel consumption and building characteristics to quantify energy use

TRIP 1

During trip one we collected data on current energy use at kelp and oyster farming operations. The goal was to understand the range of energy costs that farmers experience and opportunities to reduce costs through efficiency improvements. During the trip, we worked with farmers cultivating bull kelp, sugar kelp, ribbon kelp, split kelp and Pacific oysters.

In our first interview, we met with a kelp farmer and fisherman. He explained that he and his business partner use consumer class dehydrators and freezers to dehydrate and process kelp. The equipment and vessels they use for kelp harvesting and processing are also used for commercial fishing and personal needs outside of kelp farming. This farmer explained the time it took to process each batch of kelp, estimated annual vessel use, and petrol consumption per trip. With some simple review of electricity and fuel prices, we used this information to quantify annual costs of planting, harvest and processing. In total, the farmer harvested approximately 10,000 lbs wet weight of kelp from a 3 acre farm. The harvest took approximately 9 hours of labor over three days. There was no market for most of the kelp, but several processing methods were trialed. The trials included using a 5-10 lb. capacity dehydrator to dry kelp and a 5 lb. capacity electric smoker to produce smoked kelp. Smoking one batch of kelp required approximately 4 hours. The processed kelp was used to distribute samples and experiment with products for consumer sales. While sales were low this year, the trials set a foundation for future expansion.

In addition to commercial farm sites, we studied one research site. Multiple species of kelp are studied at the site, as well as oysters. Several experiments are underway, including studying the impact of depth on kelp growth and oyster growth rates in new locations. While working with the farmer-researchers, we measured fuel consumption rates at various operating speeds in a controlled sea trial and observed operations at the research sites. The farmer-researchers noted that their fuel consumption per trip to the site was highly dependent on weather: colder weather and rougher seas led to additional fuel consumption. The farmer-researchers make approximately 15 trips to the site per year, and transit approximately 16 nautical miles each way. While at the site, farmer-researchers measure kelp growth, remove unwanted species from the lines, and turn oyster cages. Turning the oyster cages allows the sun to dry out unwanted growth on the cage itself. Since the farmer-researchers are not producing at scale, they only maintain two oyster cages and have a labor-intensive process for flipping them that can take 10-20 minutes for each cage while working in a pair. By growing multiple species of kelp at the same site, the farmer-researchers are able to learn about the species quickly, but maintaining the site is more labor intensive than a typical commercial site. As a result, the labor times observed for both kelp and oyster farming at this site are not representative of the commercial industry.

Figure 1 A mariculture vessel throws a wake while in transit to the farm site.

Figure 2 Farmer-researchers turn an oyster cage at the research site so that the sun will clean off unwanted growth.

In the third interview we explored a repurposed trailer for intake, packaging and cold storage of live oysters, shown in Figure 3. The set up was cost efficient. The cold storage space was maintained with an air conditioning unit modified by a “cool-bot” so that it maintained the temperature below 38°F. Cold storage spaces like these can be an asset for the mariculture industry, especially in rural locations that can have shipping delays.

Figure 3 Images from the oyster cold storage unit, including shelving and “cool-bot” controlled air conditioning.

In the fourth interview we met with business partners that use a bow picker with water jet propulsion to plant, maintain and harvest their kelp. During the summer, the vessel is used for commercial fishing. In addition to the standard survey information describing their transit distances and operating practices, these farmers conducted a sea trail with us. Similar to the sea trial at the research site, we recorded fuel consumption rates, engine RPM and percent engine load under a range of vessel speeds.

Our final interview was with a farmer, advocate for farmers and an innovative researcher that shares the kelp farming business with his wife. This farmer uses an older vessel that he retrofitted specifically for kelp farming. The vessel was affordable, but also has many challenges including fuel efficiency, maintenance costs, part availability for replacements and slow transit speed. However, the vessel retrofits included efficient designs for kelp harvesting, including a novel method for spreading the kelp seedline.

TRIP 2

In our second trip we visited a research facility owned by the Chugach Regional Resource Commission (CRRC). CRRC assists the Chugach region through education, resource development and management. In the 1990s, a facility was built in Seward to research shellfish farming and other methods for enhancing the local marine ecosystem. Initially, the facility was used for farming crab for commercial and tribal uses. CRRC later began to develop methods of farming local species of subsistence and traditional harvests.

Today, the facility has been repurposed to study many species simultaneously and provide office space for natural resource management, and new buildings have been added to the property. In recent years, CRRC invested in retrofitting one building for energy efficiency and laboratory use, including increasing wall insulation and installation of a solar power system on the roof. CRRC plans to expand the facility in the future, which may further expand energy demands.

Specifically of interest to the GEM project, the facility is used for studying macro and micro algae at various life stages and early life stage shellfish growth rates. The experiments require independent climate control for various rooms, heated water and chilled water for different grow tanks 24 hours per day. Maintaining these temperature differences is one of the primary energy demands for the building. Heating for the building is primarily provided by an oil boiler, and heat pumps are used for some room-specific temperature control. While on site, our team recorded the temperature and dimensions of each temperature-controlled room in order to model energy demand and quantify the value of potential energy efficiency measures. The researchers also maintain independent temperatures in a shellfish nursery, algae culture, dry lab and guest research experiment area. While on site, we recorded water flow rates, pump power ratings and temperatures. Those data are now being used for an energy audit to identify the best energy efficiency opportunities, and extract useful information like the amount of electricity required to maintain flow through a shellfish nursery.

Figure 3 Water pump systems at the CRRC research facility

Trip Conclusions

The data collected through these studies will be used to provide reports to study participants. Additionally, the data will be compiled with energy use data collected through a broadly distributed online survey and further ground-truthing field work with mariculture professionals. These data will establish a baseline of energy use in the Alaska mariculture industry that we can use to identify energy efficiency and renewable energy opportunities in the future.

In future field campaigns, we will continue to conduct interviews to receive first-hand accounts of mariculture practices. We will also expand our data logging. The first two trips revealed that installation of long-term data logging devices requires a preliminary visit to understand the equipment that is in use and identify the people qualified to install data loggers. The relationships build during these trips identified partners that are interested in participating in future data logging campaigns. Now that we have documented the equipment in use, we aim to provide data logging devices to several partners to record operating patterns over the course of a season.


Figure 4 Colleagues