

Seaweed Aquaculture in RI

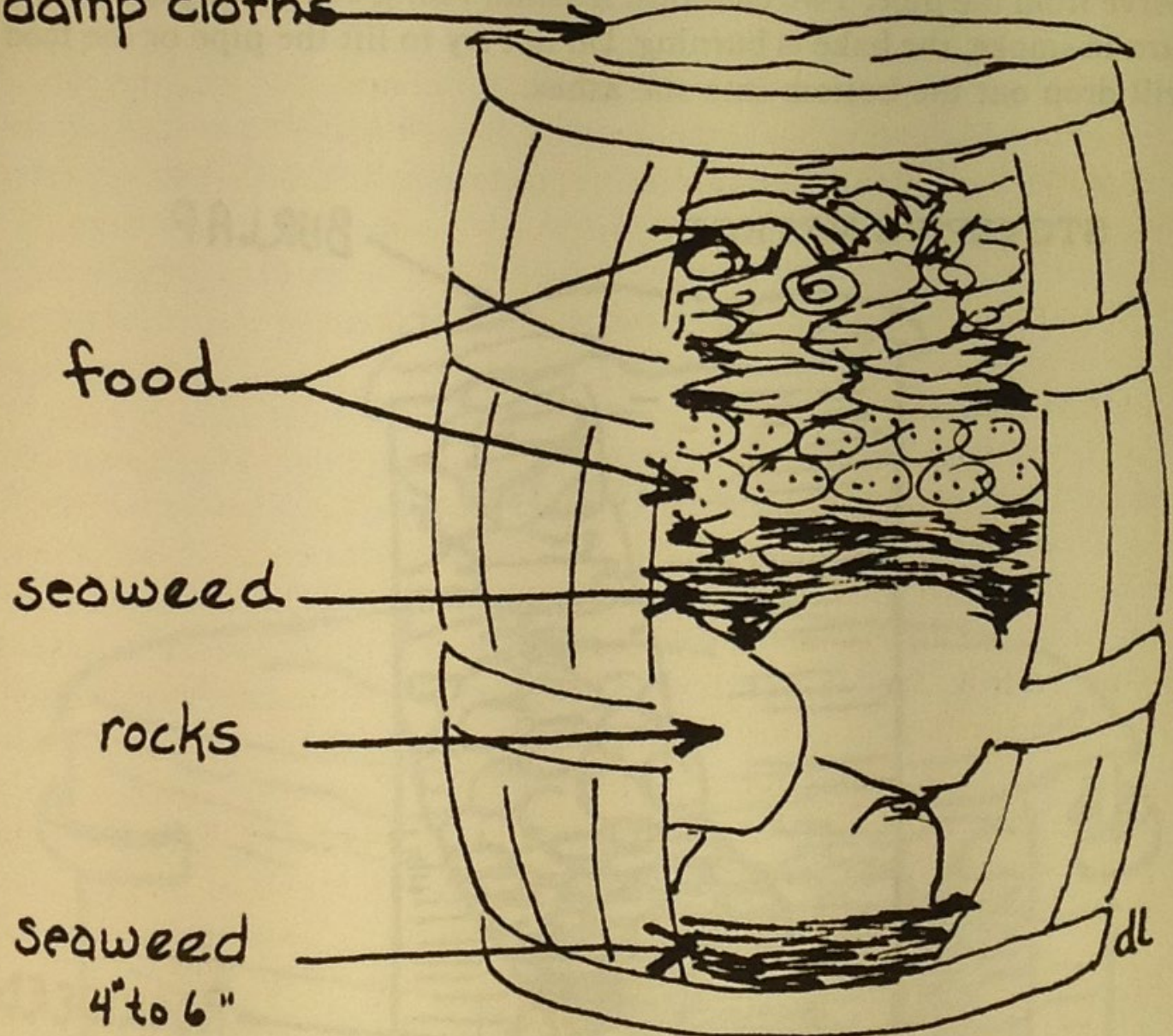
Rob Hudson

RI Sea Grant / URI's GSO Coastal Resources Center

December 4th, 2023



burlap bags or damp cloths



food

seaweed

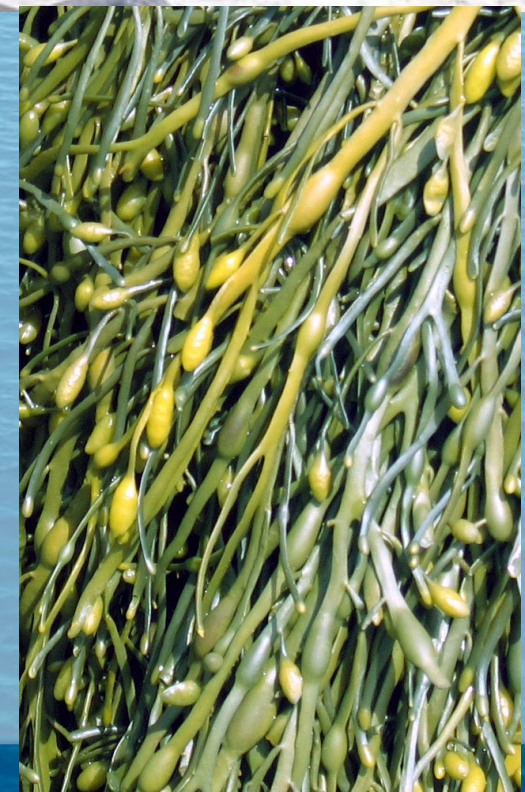
rocks

seaweed
4" to 6"

dl



Taste history at Ponaganset clambake | News | valleybreeze.com



RI Sea Vegetable (aka. Kelp) Aquaculture

10 Permitted Farms (3 actively producing)

2 new permits currently under review

14,500 lbs - Sugar kelp landings for 2022

Official landings are not reported (farmer reported)

Primary species under cultivation:

Sugar Kelp (*Saccharina latissima*)

Season: November to May 1st

Seed source: self-propagated and/or private supplier

Seaweed is sold: freshly harvested / raw to processors, chefs,
and consumers



Photo Credit: Rob Hudson

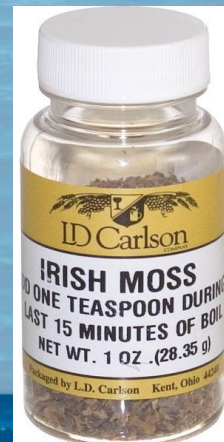
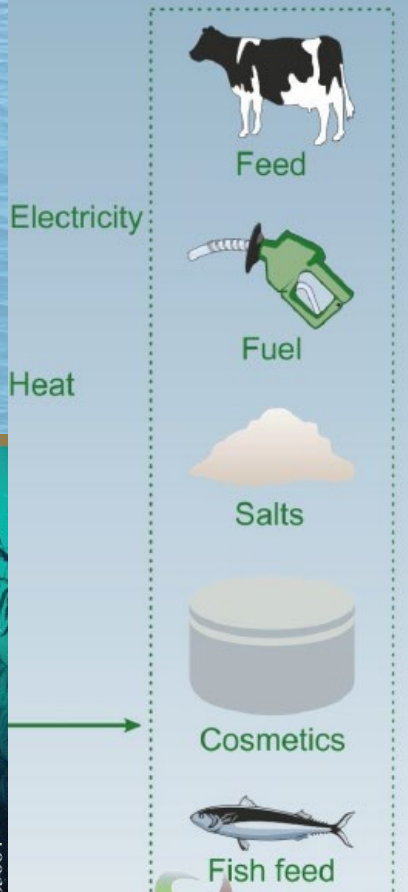


Photo Credit: Rob Hudson

Why Grow It?



Example of end products



+563069

This is most likely why grown



fresh, frozen
Slaw Cut Kelp
sold in 1 lb. packs/10 per carton

Kelp Is the New Kale

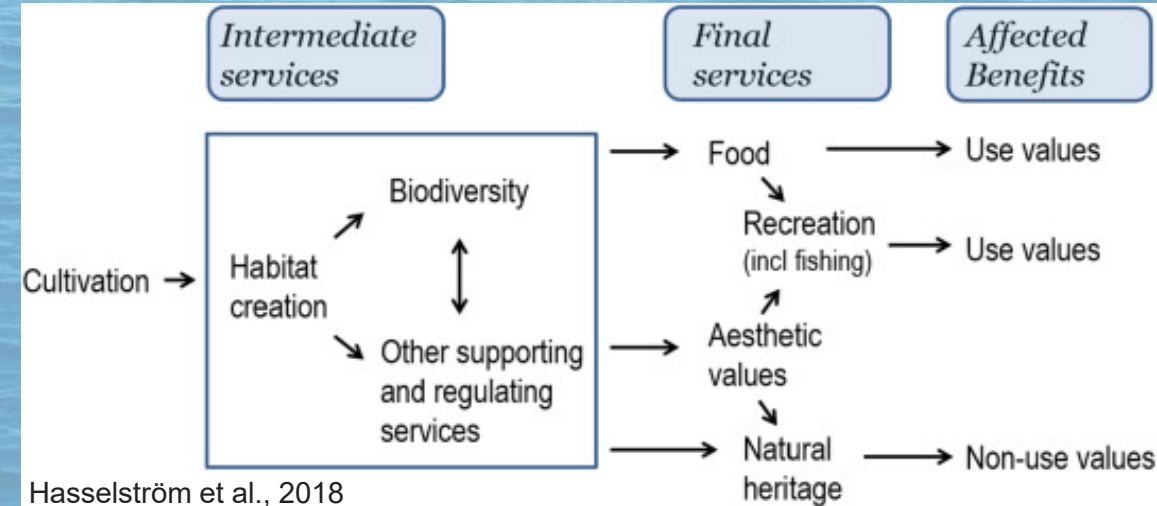
The global seaweed harvest is worth more than all the world's lemons and limes.

NICOLA TWILLEY AND CYNTHIA GRABER | SEP 13, 2016 | SCIENCE

Kelp Benefits

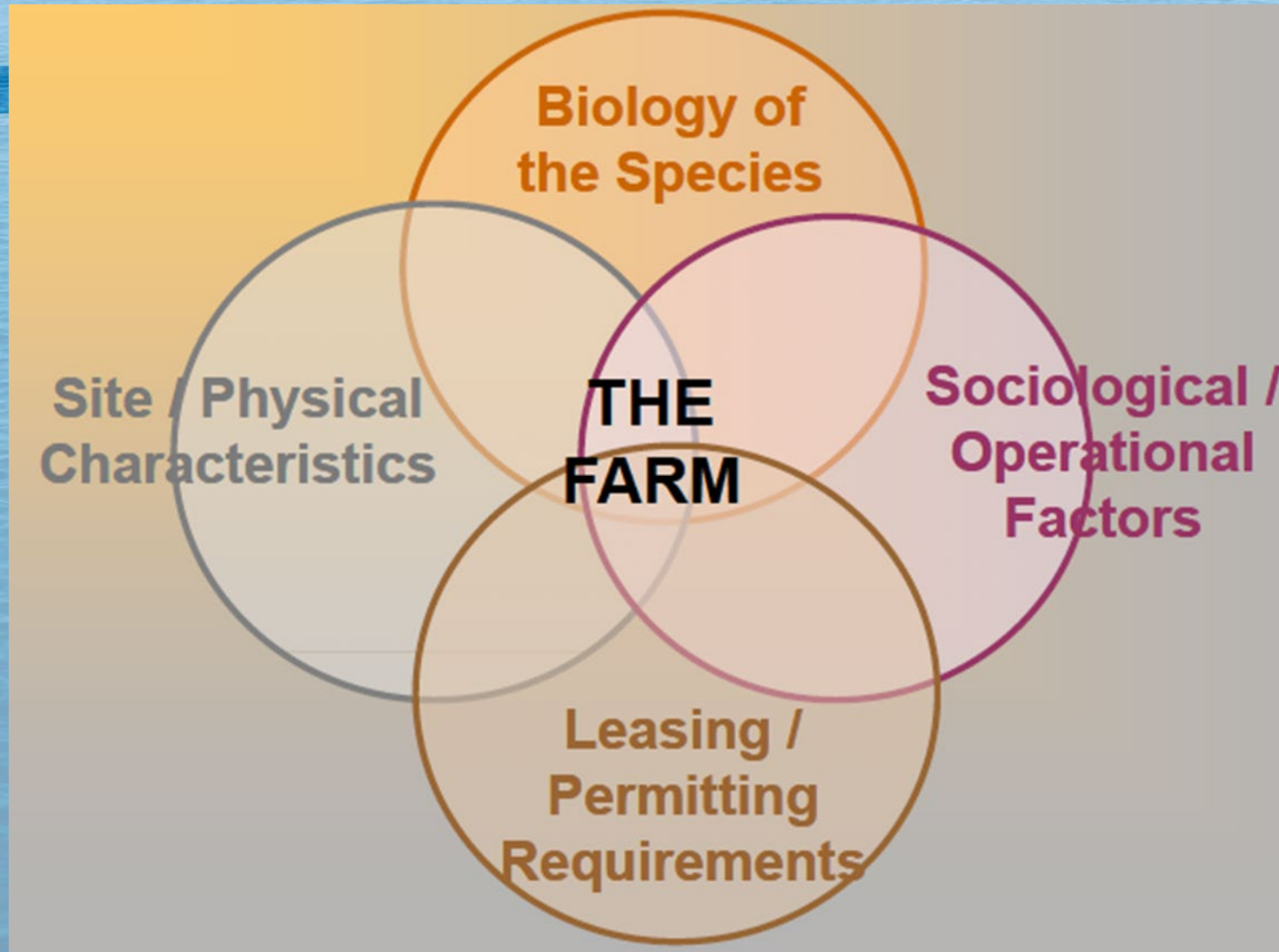


Ecosystem Services

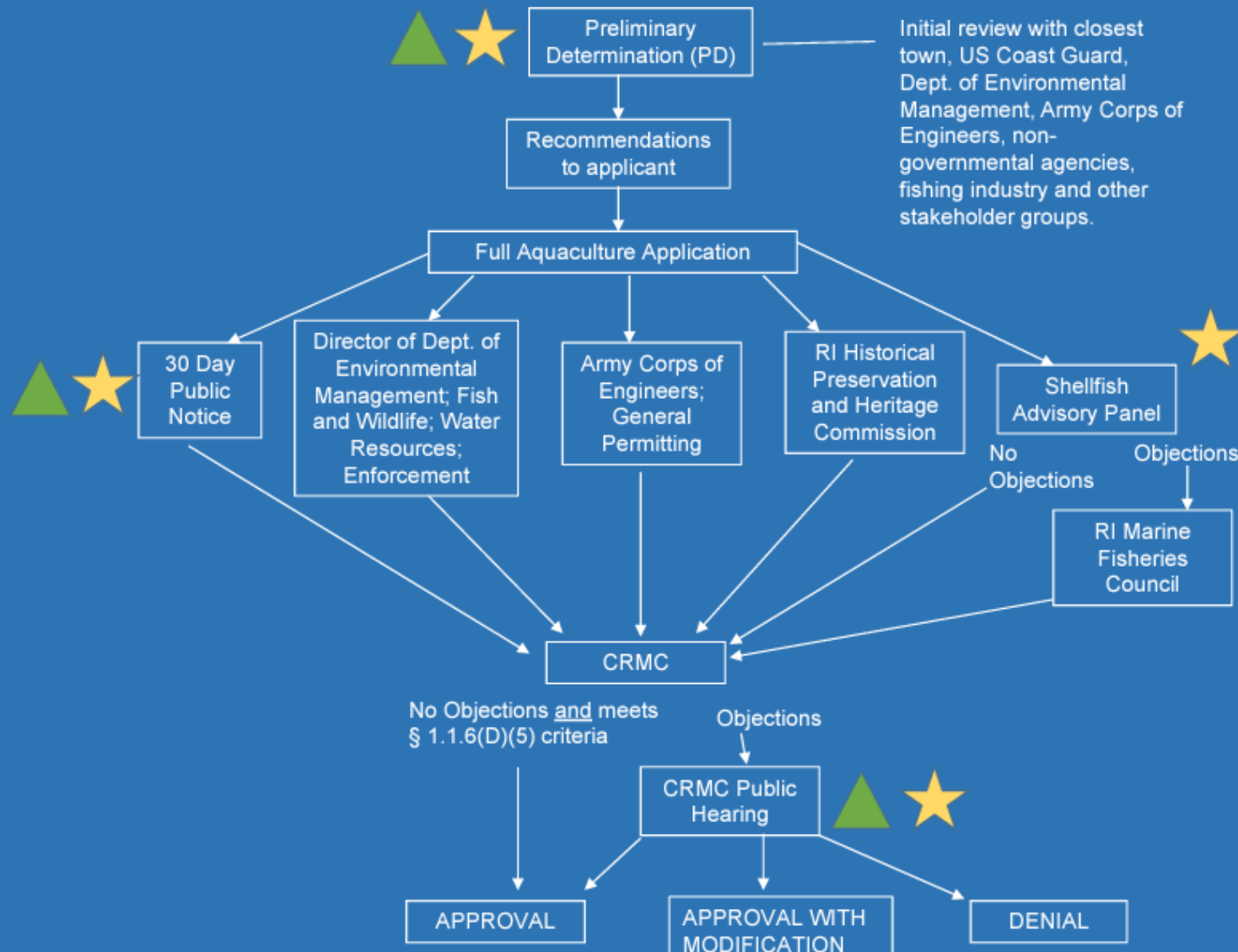


- Superior Nutritional Value
- Detoxification
- Improved Digestive Health
- Contains Rare Antioxidants
- Important for Thyroid Health
- Good Source of Vitamin K
- Anti-Inflammatory Properties
- Stress Relief
- High in Iron
- Lowers Cholesterol

Prior To Site Selection



Prior To Site Approval



▲ All events marked with triangle include notification to property owners within 1000' of the application.

★ All events marked with star include notification through the new CRMC Aquaculture Listserve.



Seaweed Culture

- There are four commercially important seaweed species in the region
 - Sugar kelp (*Saccharina latissima*)
 - Winged kelp (*Alaria esculenta*)
 - Skinny kelp (*Saccharina angustissima*)
 - Gracilaria (*Gracilaria tikvahiae*)



Sugar Kelp

- Depth: 5-30ft (can be found at 100ft)
- Optimal temperature range: 50-59°F (10-15°C)
- Sorus tissue formation: <60°F (15.5°C)
- Tolerated temperature range: 75°F (24°C)

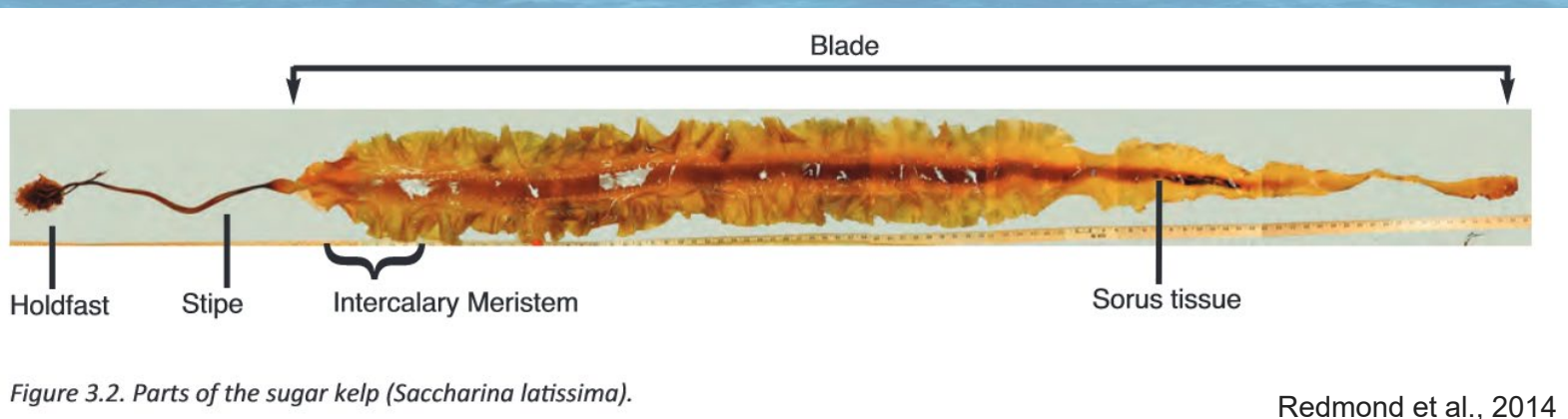


Figure 3.2. Parts of the sugar kelp (*Saccharina latissima*).

Redmond et al., 2014



Saccharina latissima
Redmond et al., 2014

Heteromorphic life cycle

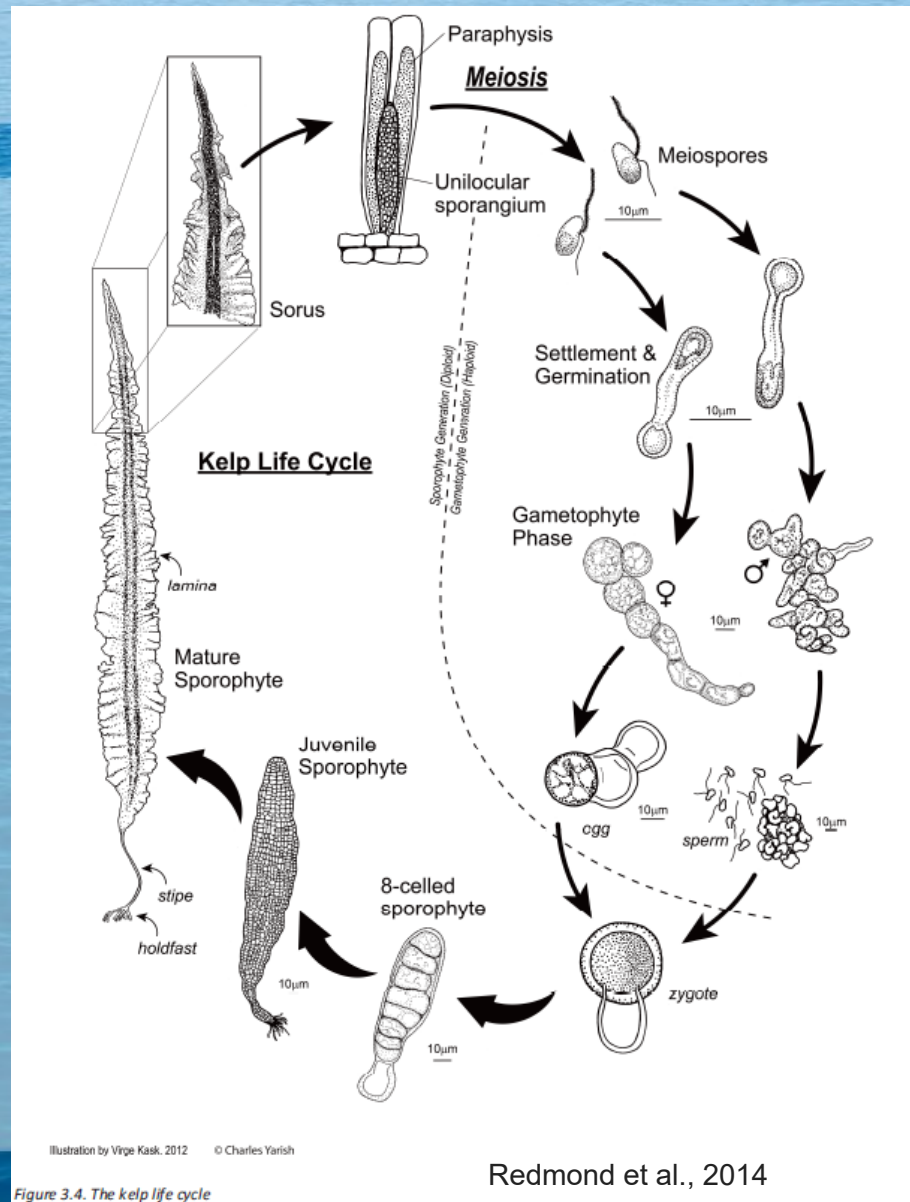


Figure 3.4. The kelp life cycle

Seaweed Aquaculture

Photo Credit: Jordyn K.

Nursery

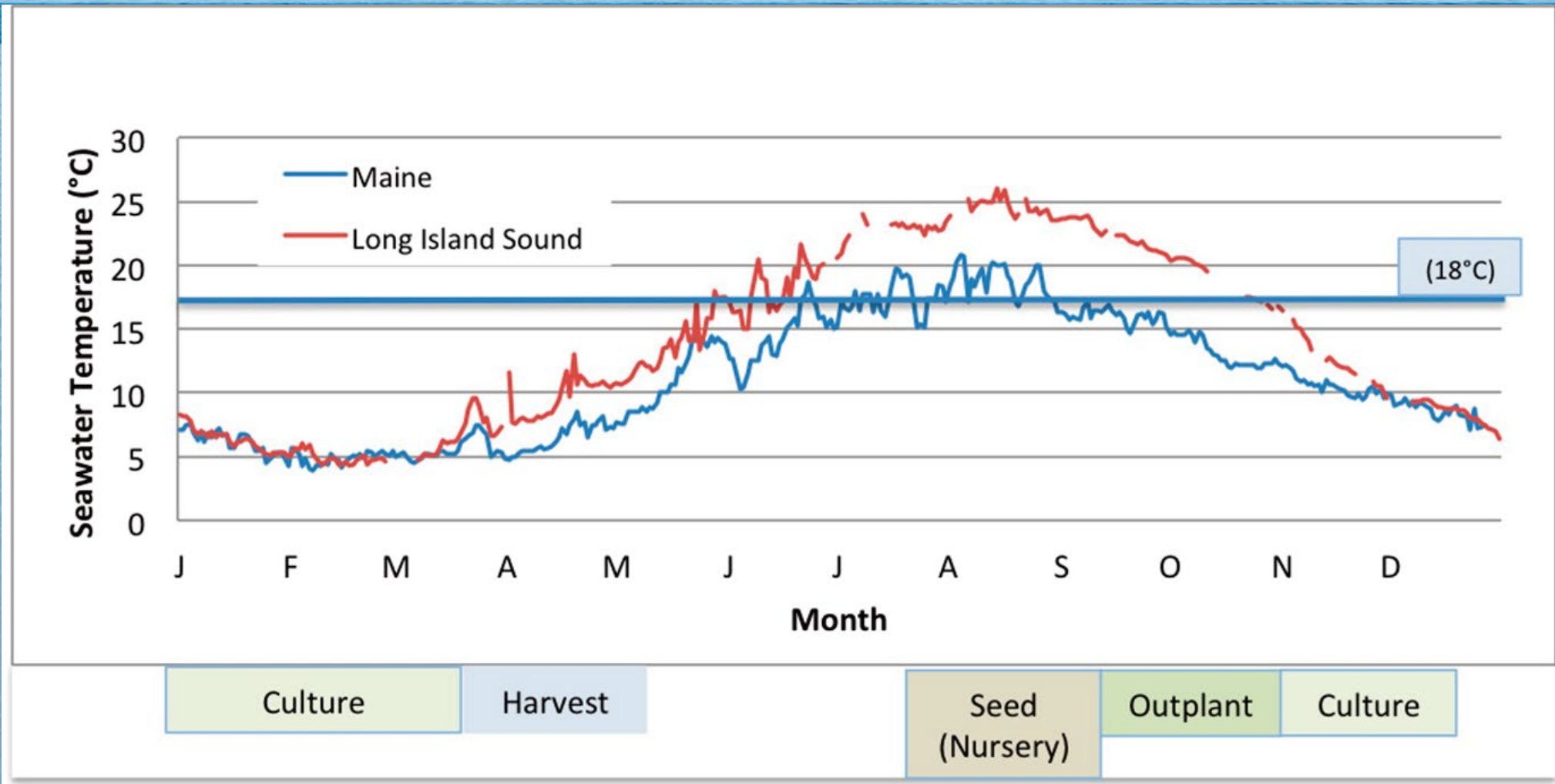
- Collect sorus tissue
- Spore release
- Seeding

Grow-out

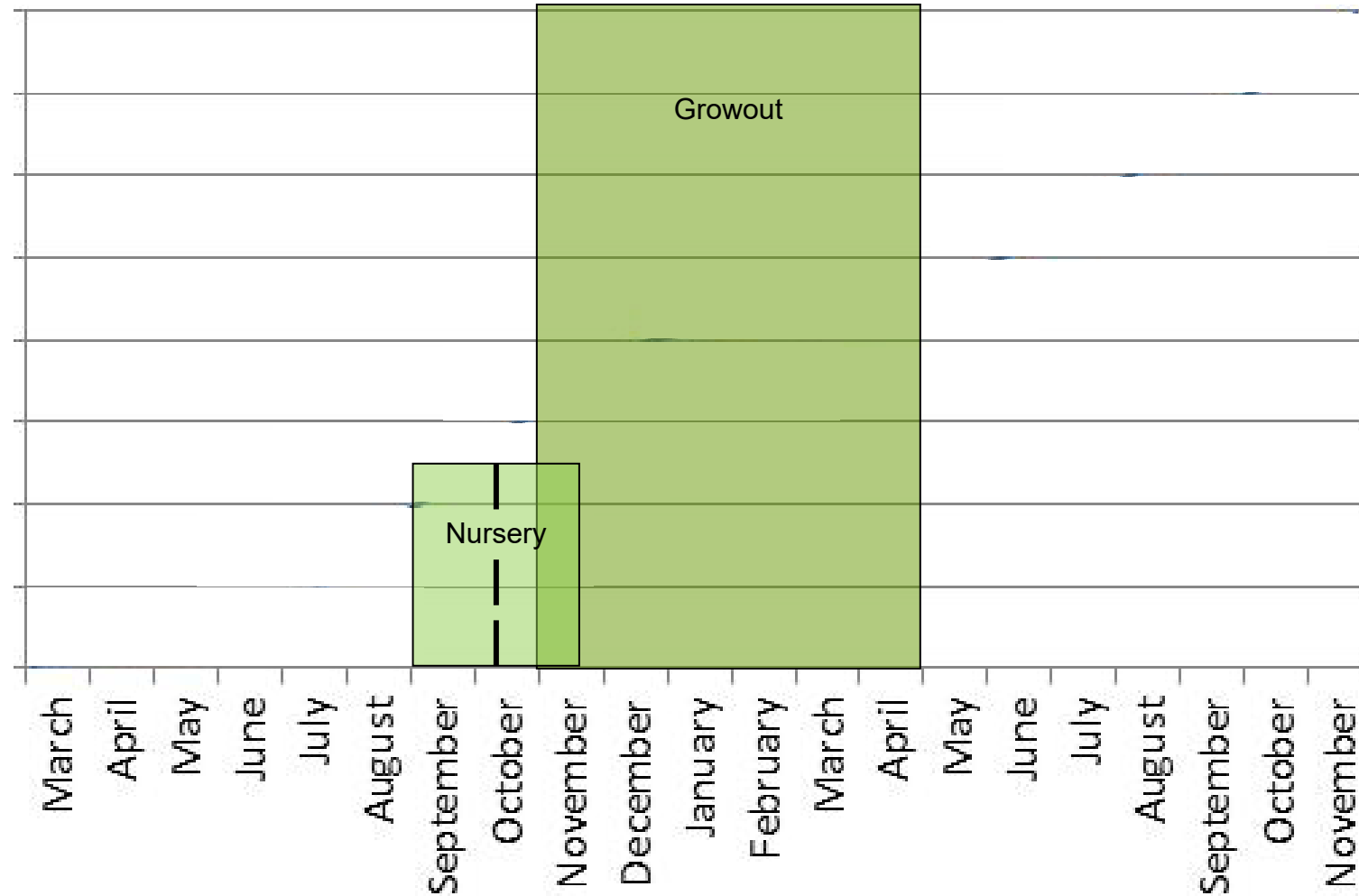
- Outplant
- Culture- final growth in the open environment
- Harvest



Kelp culture – NE timeline



Kelp Aquaculture: Stages (RI)



Seaweed Culture - Nursery

Tissue Prep.

- Collect reproductively active sorus tissue
- Disinfect
- Chill
- Assess readiness of spore release



Seaweed Culture - Nursery

- Count density of spores in beaker
- Calculate setting density
 - Avg 5,000 to 10,000 cells/ml
- Spores set on string wrapped around PVC
- Maintain at 50°F



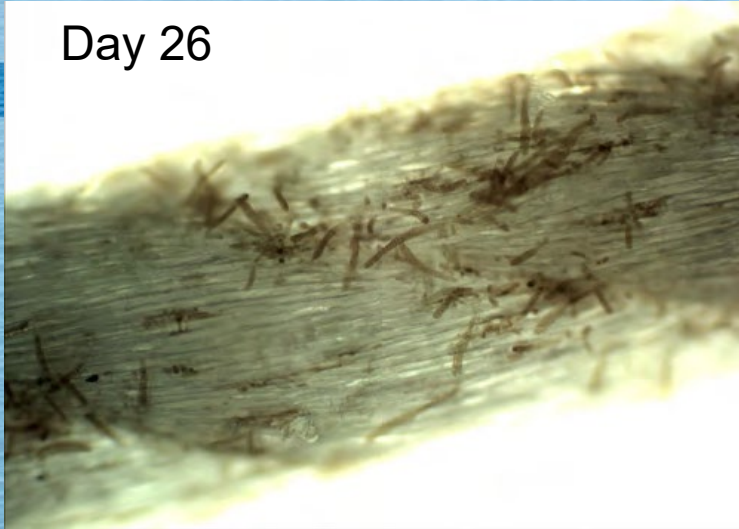
Seaweed Culture - Nursery

- **Water:**
Filtered to 5um
Sterilized
- **Temp:** 50 °F
- **Salinity:** 28-32 ppt
- **Light:** 12L : 12D
25-150 $\mu\text{mol}/\text{m}^2\text{s}^{-1}$
- **pH:** 7.8 – 8.2
- **Aeration:** hepa filter
- **Nutrients:**
PES
F/2



Kelp sporophytes on thread

Day 26



Day 31



Day 37



Day 40



Kelp sporophytes on thread

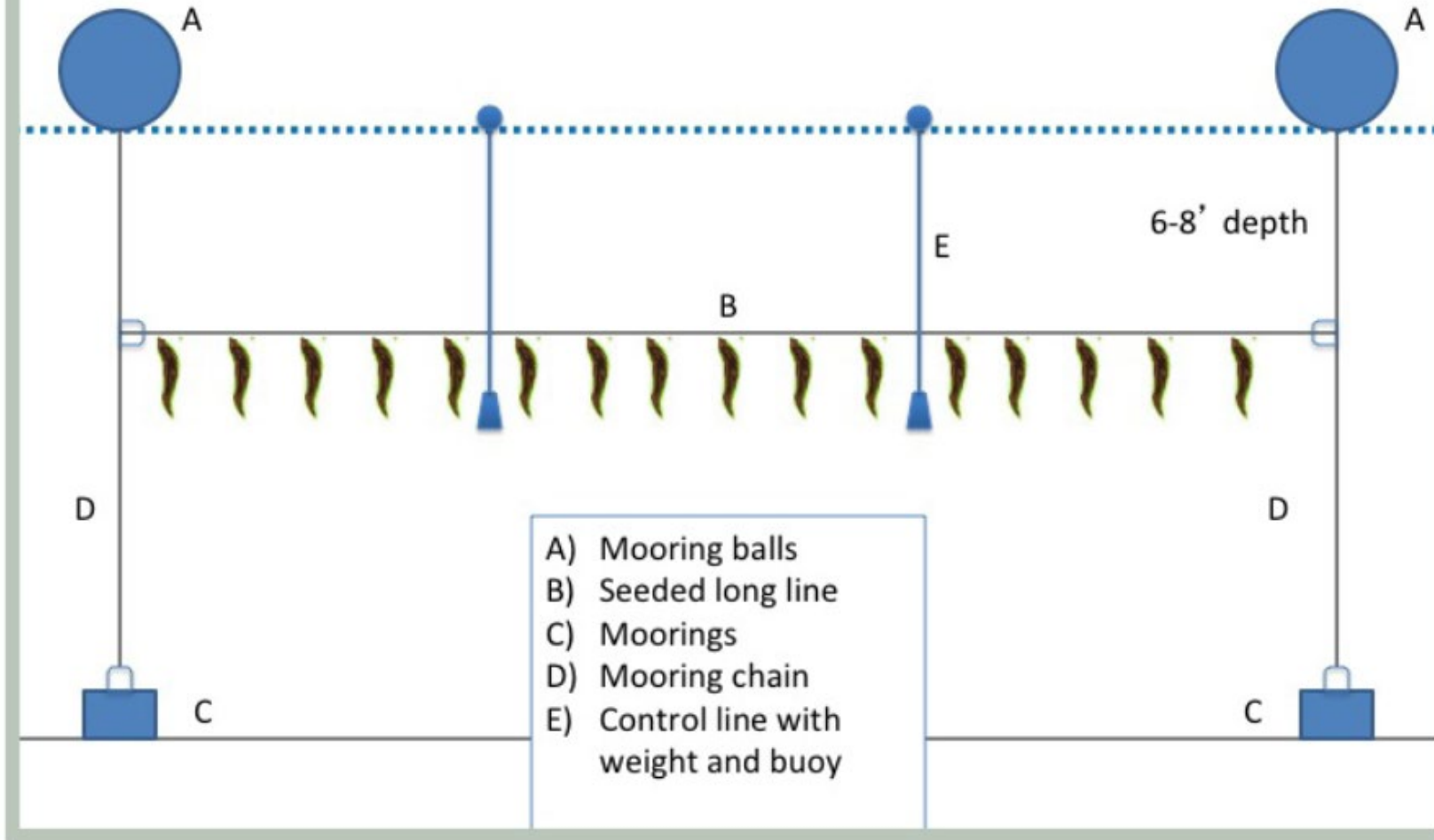


Technology & Methods

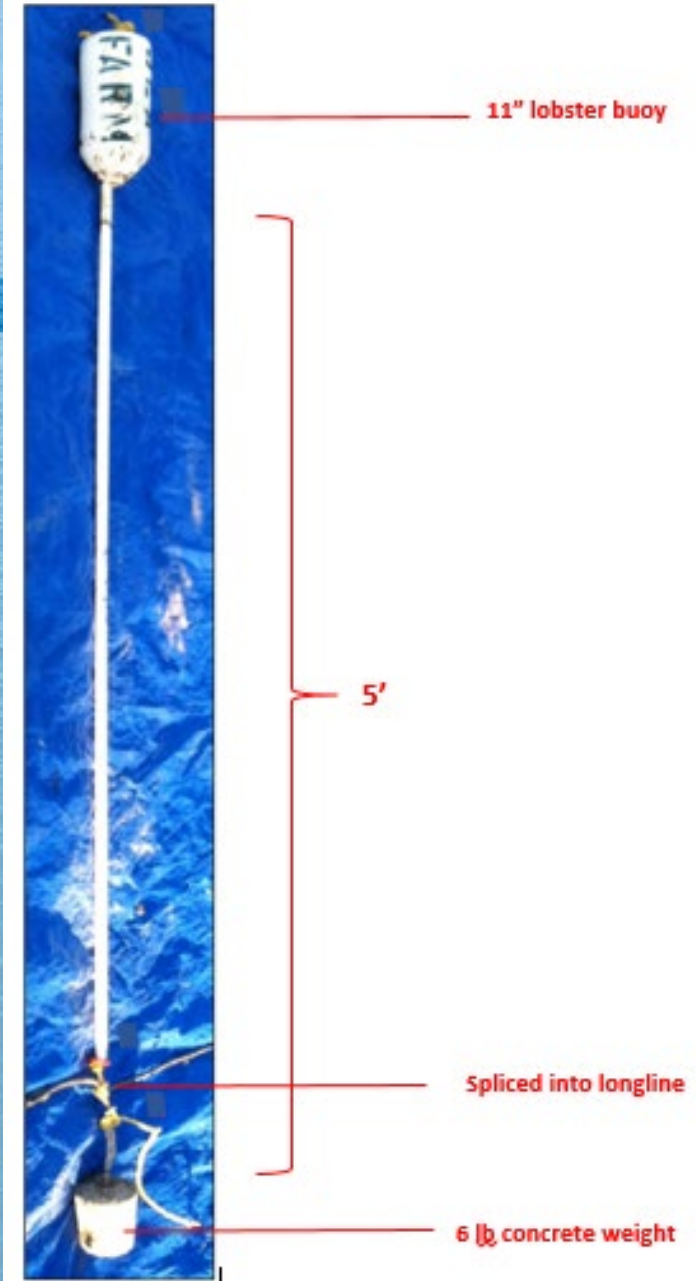
- Seaweed Bioreactors (SBRs) by Industrial Plankton
 - Gametophyte stage
- Methods
 - Spraying spools



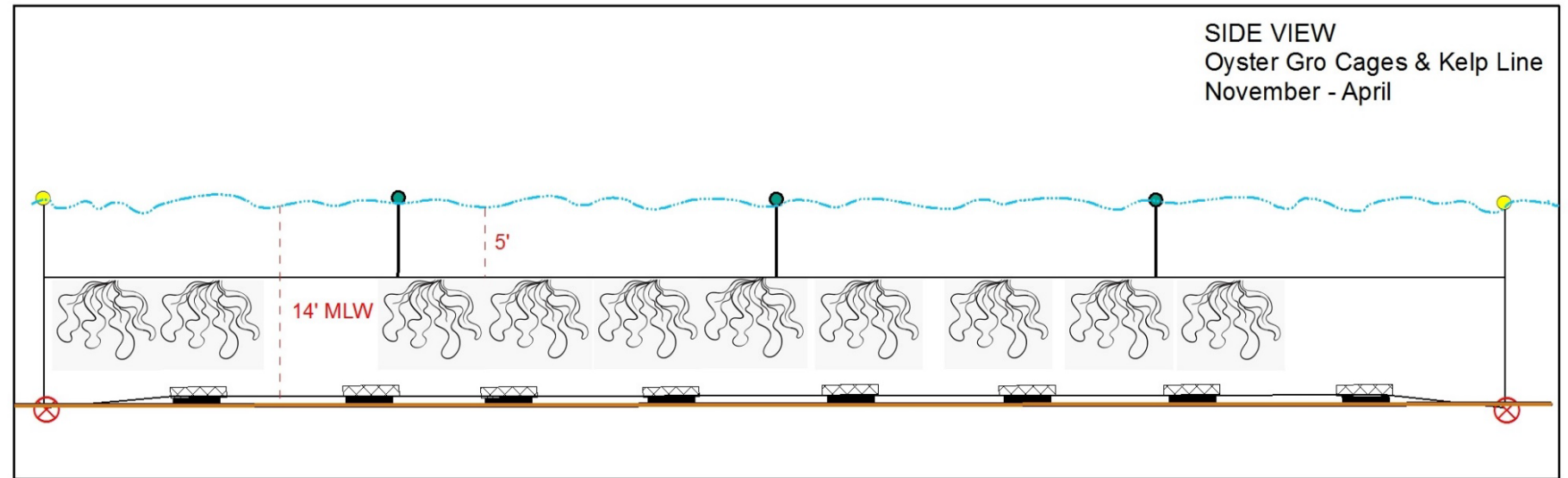
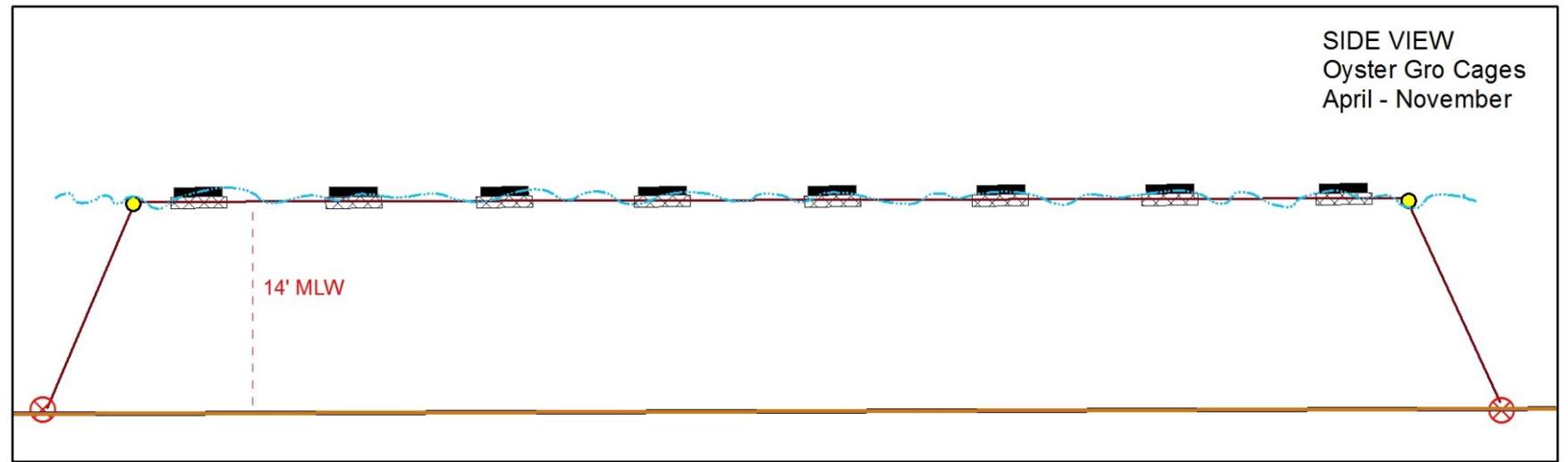
Basic Kelp Longline System Design



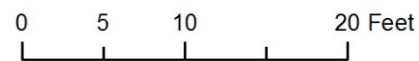
Kelp grow-out line set-up



- 3 Acres » 9,000' of kelp line » 45,000 lbs (5lbs/foot)



**Proposed Commercial Viability Lease
Species: Oysters and Kelp**



1 inch = 10 feet
NAD 1983 RI State Plane

Oyster Gro cages will float on the water surface from April to November and will be sunk to sit on the bottom during winter. Kelp lines will be deployed over the Oyster Gro cages during winter months (November - April).

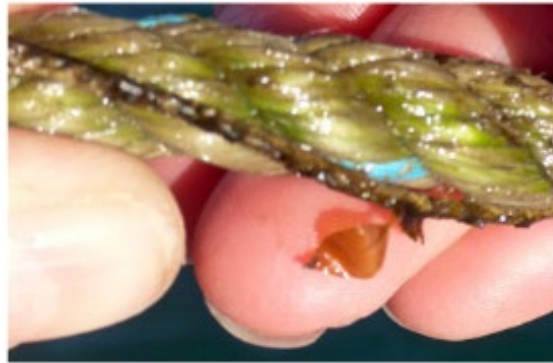
Legend

- 11" Lobster buoy
- 18" Poly float
- ⊗ Helical Anchor
- Longline
- 1/2" PVC spacer
- ⊞ Oyster Gro
- 🌿 Kelp

Diagrams are to scale with the exception of kelp symbols.

Seeding the farm

- The young sporophytes are outplanted on horizontal long lines
- Outplant in November (maybe Dec.)
- A line is passed through the seed spool
- The seed line is spooled off around the line as it passes through



Young kelp
on line



Deploying the kelp sporelings



Farm Maintenance

- Keep lines from crossing
- Assure anchors are holding
- Weight lines as kelp becomes buoyant
- 5–10' blade length
- Harvest ~ 5lbs/ft



Research & Education

- Kelp for RI animal agriculture industry
- Kelp as soil amendment in RI land-based farms
- Kelp - growing for ecosystem services
- Student mentoring
- K-12 soft skills building and mentored research



Advantages

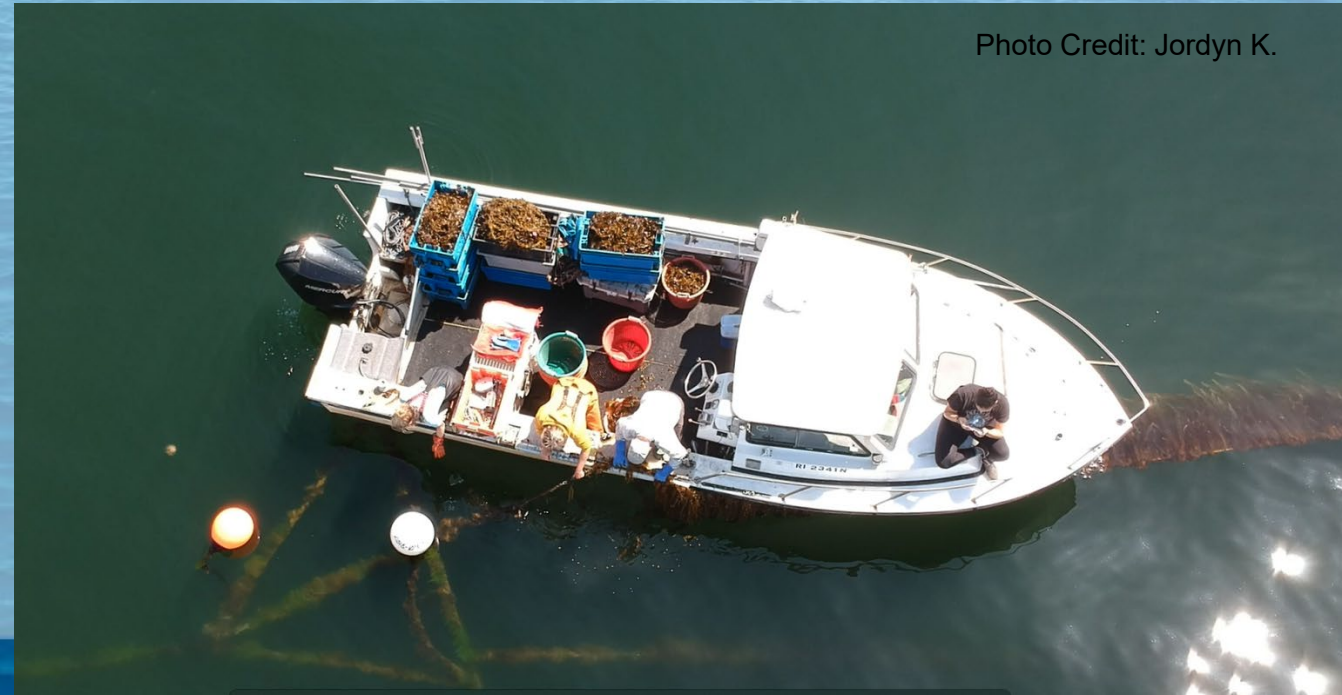
- Because kelp is a winter crop, it can be grown in the “off-season”
- Winter kelp farms have great potential in the region to provide
 - a means for crop diversification
 - a way to increase seafood production
 - ecosystem services



Photo Credit: Jordyn K.

Challenges/Bottlenecks

- Developing market
- Use conflicts
- Difficult moving large quantities of product locally
- Add value post- harvest processing in SNE
- Short harvest season
- Price point for sales?
- Local growth?



New England Kelp Harvest Week

DATE: All day from April 20, 2023 to May 1, 2023

REGISTRATION: <https://newenglandkelp.com/>

Eat & drink *amazing culinary creations* at many of the best restaurants in New England. Brought to you by the Sugar Kelp Cooperative

Late April is the harvesting sweet spot for farmers in CT and RI, and this 10-day event works to synchronize kelp specials (appetizers, entrees, desserts, or cocktails) that feature locally cultivated sugar kelp in some way. The local kelp farmers get a much-needed boost in sales, the restaurants receive marketing and promotional boosts as well as a chance to work with a local sustainable ingredient, and the general public gets a chance to learn how versatile and delicious this native super food can be.

Where to buy kelp

For those looking to cook with sugar kelp at home you can find freshly harvested sugar kelp in season (April - May) at many local places. The list below is not comprehensive but it is a great start:

- FarmFresh RI
- Fiddleheads Cooperative in New London CT
- Yellow Farmhouse Farm Stand in Stonington CT
- Mike's Organic Market, Stamford CT
- Stonington Farmers Market
- Westport Farmers Market
- City Seed Farmers Market
- Healthy PlanEat
- Seawell Seafood Stonington CT

Potential Supply Chains for Seaweed Produced for Food in the Northeastern United States

Carole Engle, Azure Cygler, Dawn Kotowicz, and Jennifer McCann

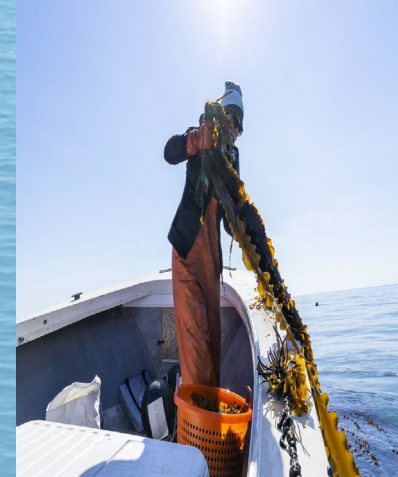
Final Report
August 13, 2018
USDA FSMIP Award No. 16FSMIPR10004

THE
UNIVERSITY
OF RHODE ISLAND
GRADUATE SCHOOL
OF OCEANOGRAPHY



The Sugar Kelp Cooperative

- 5 kelp farmers from RI, CT and MA
- Elevate kelp as a culinary superhero in New England
- “A rising tide floats all boats”
- New England Kelp Harvest Week, April 2024 <https://newenglandkelp.com/>



COAST TO KITCHEN

HANDLING HARVESTED KELP BASED ON BEST AVAILABLE DATA

HARVEST

Immediately after harvest, kelp must be kept as cold as possible.

FRESH KELP

Kelp sold directly after harvest should be labeled as raw.

BLANCHING

Briefly submerging kelp in hot water reduces pathogens and must be validated.

DRYING

Air-drying and freeze-drying significantly reduce the pathogen load of edible kelp. Kelp with lower water content has less microbial activity. Shelf-stable commercial products range in water activity between 0.3-0.65.

SALTING

Salted kelp has lower microbial activity. When combined with drying, salted kelp is shelf stable.

FERMENTATION

Fermented kelp requires a pH below 4.6 followed by heat processing or refrigeration.

PROCESSING

Adhere to these thresholds to reduce levels of harmful bacteria.

STORAGE

Follow these timelines to consume kelp.

REFRIGERATION

Fresh kelp must be kept refrigerated and used within days.

FREEZING

Fresh or blanched kelp properly packaged can be kept frozen for several months.

SHELF-STABLE

Properly packaged dried or dried-salted kelp is shelf stable for months.



For more information, visit <https://sites.une.edu/byronlab/foodsafetyinfographic>



Design by Cara Blaine, May 2022

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Resources:

- Seaweed Hub:
<https://seaweedhub.extension.uconn.edu/>
- CRMC Aquaculture Listserv:
<http://www.crmc.ri.gov/aquaculture.html>
- RI Aquaculture Permitting:
<https://www.riaquaculturepermitting.org/>
- RI Sea Grant – Sustainable Seafood:
<https://seagrants.gso.uri.edu/our-work/sustainable-seafood/>
- Previous Bay SAMP Webinars:
<https://web.uri.edu/crc/narragansett-bay-samp/>



Thank You!

Rob Hudson: Rhudson@uri.edu



One of Griffin's sea-veggie creations:
Sugar kelp, rock shrimp, haddock and
ricotta lasagna with mozzarella gratinée
and oyster cream. (JWU)

- Flavin, K., Flavin, N., & Flahive, B. (2013). Kelp farming manual: a guide to the processes, techniques, and equipment for farming kelp in New England waters. *Ocean Approved LLC, Saco.*
- Redmond, S., Green, L., Yarish, C., Kim, J., & Neefus, C. (2014). New England seaweed culture handbook.
- Hasselström, L., Visch, W., Gröndahl, F., Nylund, G. M., & Pavia, H. (2018). The impact of seaweed cultivation on ecosystem services-a case study from the west coast of Sweden. *Marine Pollution Bulletin, 133*, 53-64.