

# Project S.O.A.K. - Submersible Oceanic Aquaculture of Kelp



Angela Sarni, Megan Savoie, Jamie Barton, Hannah Root

Advisors: Michael Chambers & Rob Swift



## Introduction

Biology & Engineering

- SOAK is an interdisciplinary project
- Goal: grow Sugar Kelp on frame system

Why Kelp?

- Health Benefits
- Environmental Benefits
- Sustainable aquaculture

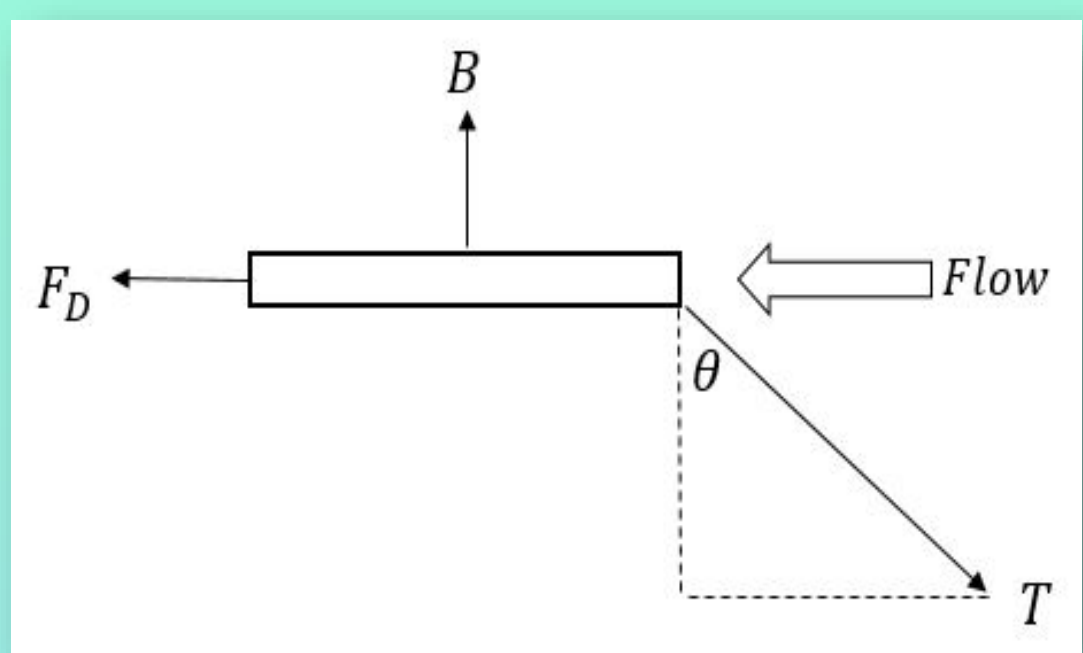
## Project Design

Design Considerations

1. Withstand forces during coastal storms
2. Convenience when submerging & raising
3. Efficiency growing kelp in a reduced area

Site Conditions

- $u \approx 0.6 \text{ m/s}$  Flood tide velocity
- $u \approx 0.15 \text{ m/s}$  Ebb tide velocity (back eddy)
- $T_{avg} \approx 5 \text{ s}$  January 2016 Storm 'Jonas'
- $H_{max} \approx 1.6 \text{ m}$  January 2016 Storm 'Jonas'

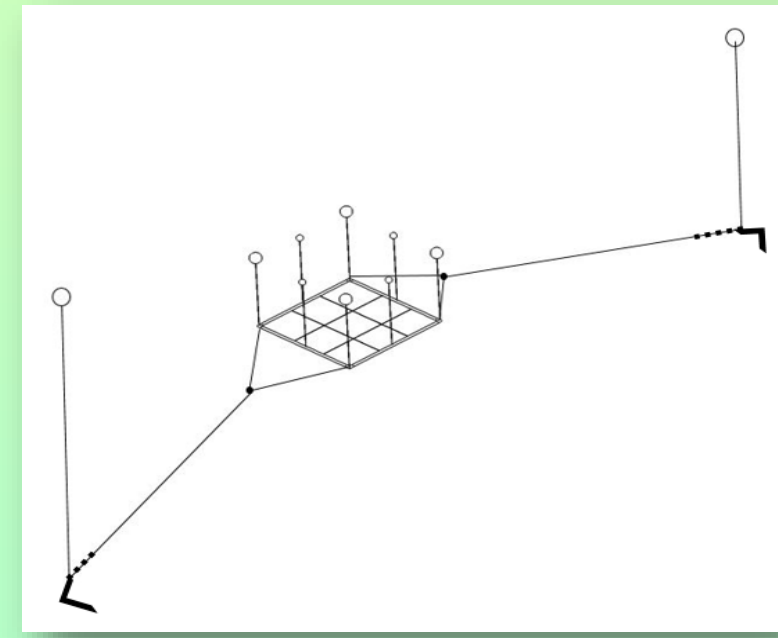
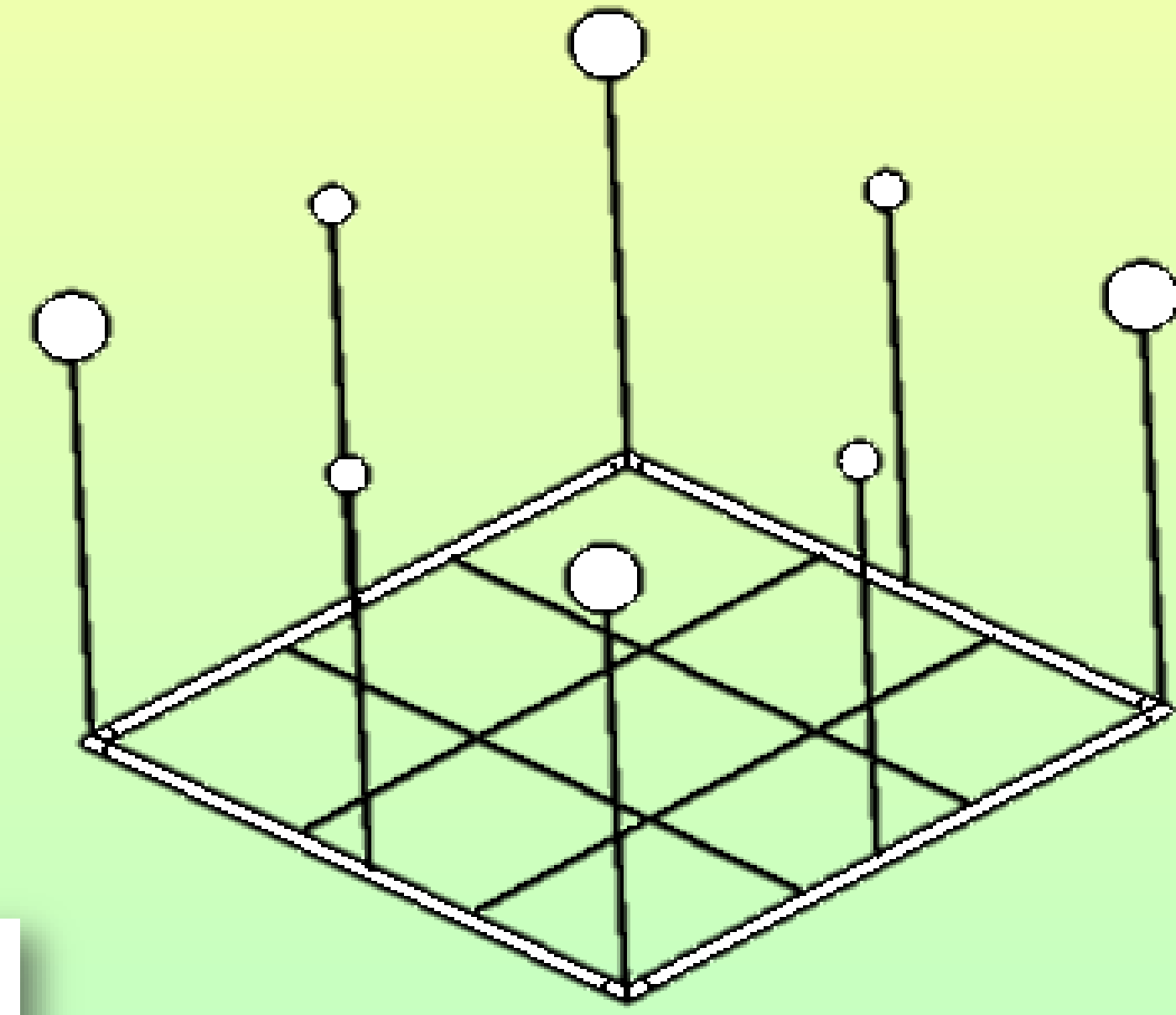


$$F_D = \rho C_D A_p u^2$$

$$u_{max} = \frac{HgT \cosh(k(h+z))}{2L \cosh(kh)}$$

- $u \approx 0.60 \text{ m/s}$  Max velocity - river current
- $u \approx 0.43 \text{ m/s}$  Max particle velocity - waves
- $u_T = 1.03 \text{ m/s}$  Total velocity

- $F_D = 6300 \text{ N}$  Resulting drag force
- $T = 6577 \text{ N}$  Tension in mooring lines
- $B = 1890 \text{ N}$  Buoyancy



## Biology

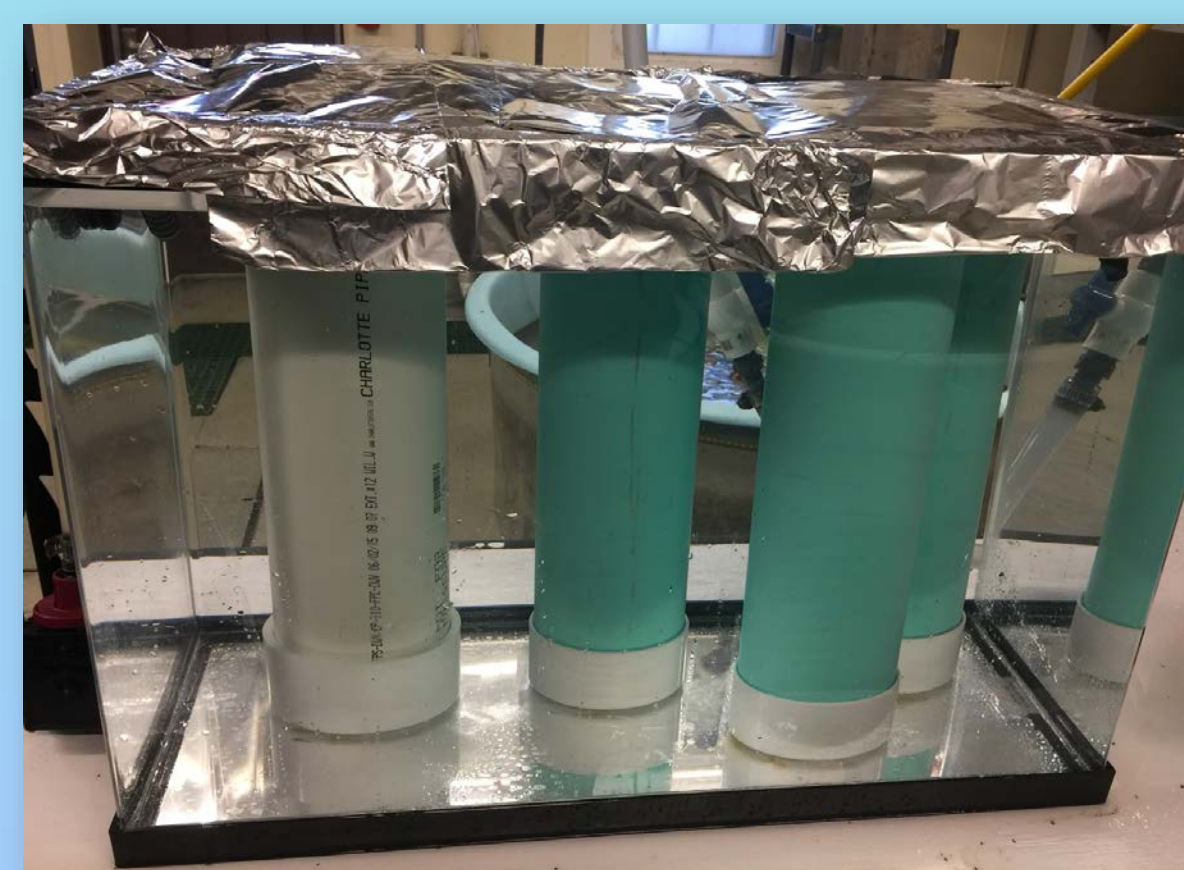
Materials:

- 2 Nursery Tanks
- PVC Pipe
- Twine
- LED lighting system
- PES nutrients



Methods

- Collect mature sorus tissue
- Spawn & transfer to PVC
- 12 hour light cycle
- Weekly nutrients, 4 weeks
- Continue growth in ocean
- Transfer from spools to frame



## Fabrication

- Cut & transport pipes to site
- Fused pipes into frame
- Drilled holes in pipes
- Assembled mooring system



## Deployment



3/24 - Snowstorm

- Seeded lines
- Deployed mooring system



3/28 - Cloudy

- Attached weights & buoys on beach
- Towed frame off beach
- Tied frame to raft in bay temporarily



3/30 - Sunny

- Towed frame to site
- Attached pre-seeded lines
- Attached frame to mooring
- Seeded remaining lines

## Conclusion

- Cohesive interdisciplinary team
- End goal accomplished
- Nature can dictate timeline
- Kelp growth monitored
- Future work prospects

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