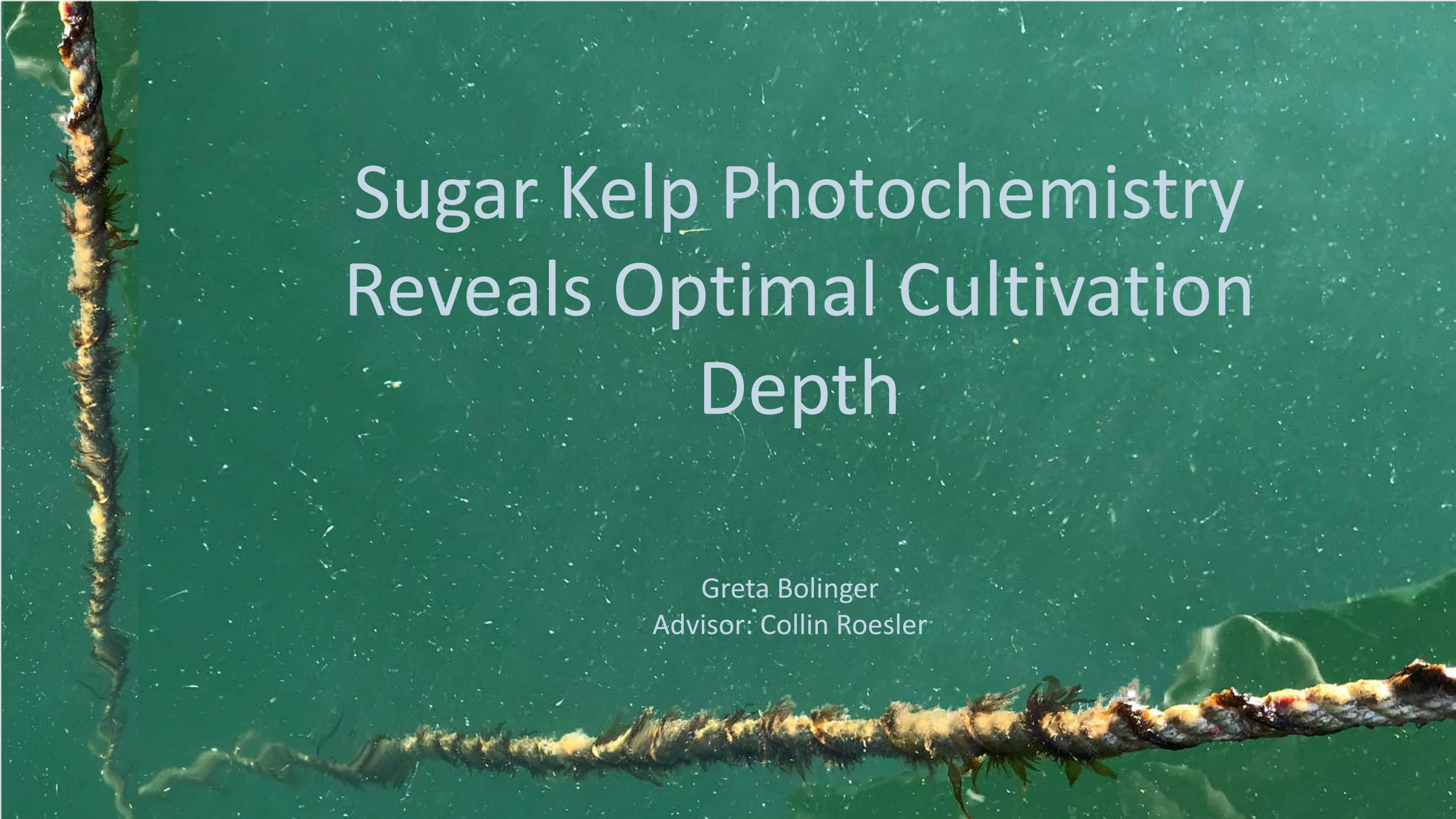


Sugar Kelp Photochemistry Reveals Optimal Cultivation Depth

Greta Bolinger
Advisor: Collin Roesler

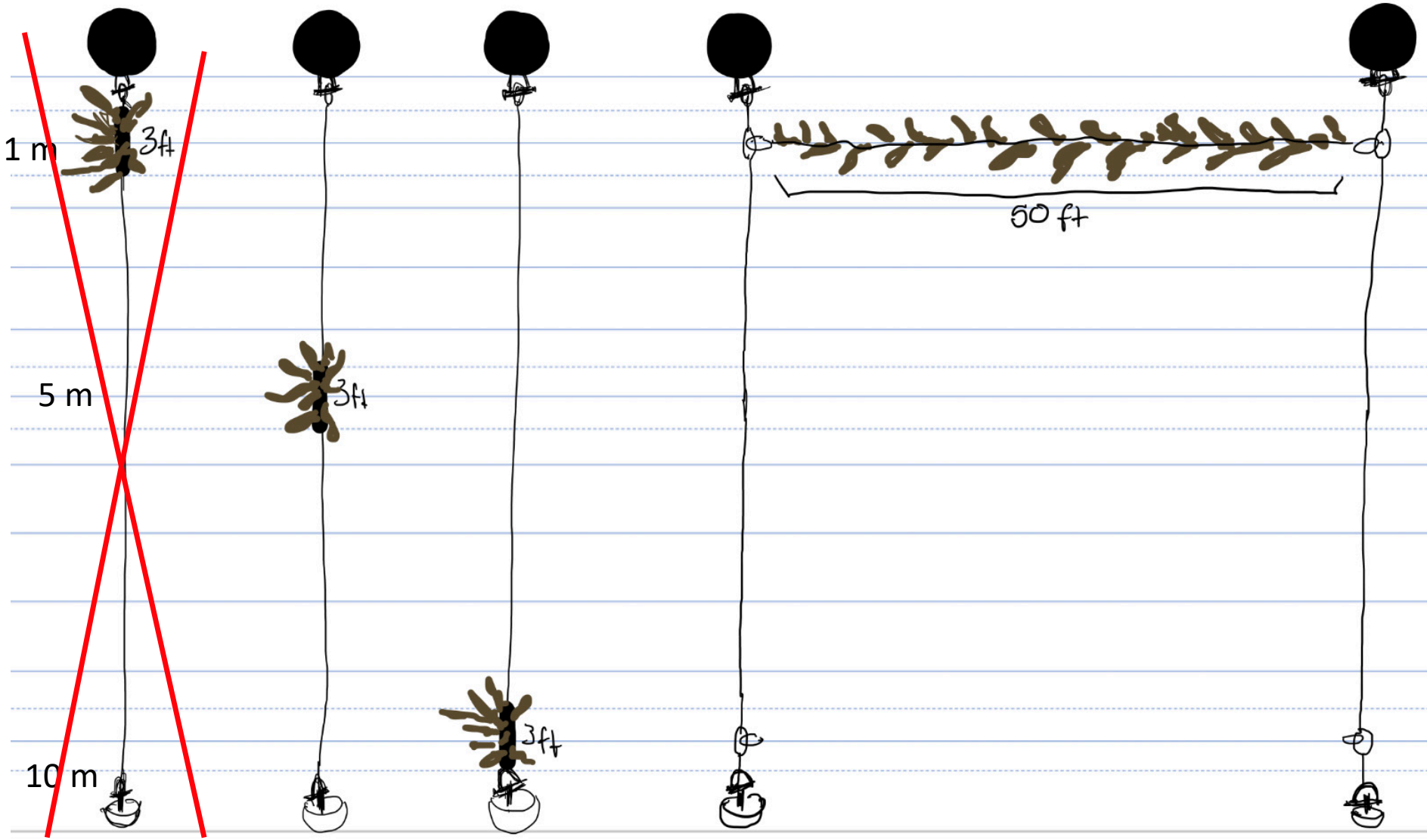
How can I structure a kelp farm that yields both a kelp harvest and an opportunity for aquaculture research?

65% PAR

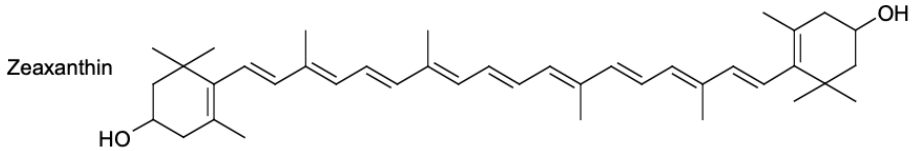
30% PAR

10% PAR

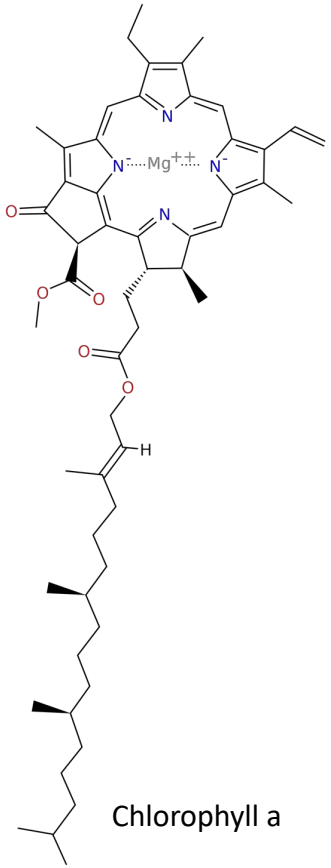
0.25% PAR



Sugar Kelp



- Subtidal photosynthesizer
  - Store atmospheric carbon in kelp tissue
- Light attenuates with depth
- Maintain an active xanthophyll cycle
  - Photosynthetic pigments: chla, chlc1 & c2, fucoxanthin
  - Photoprotective pigments: violaxanthin, zeaxanthin

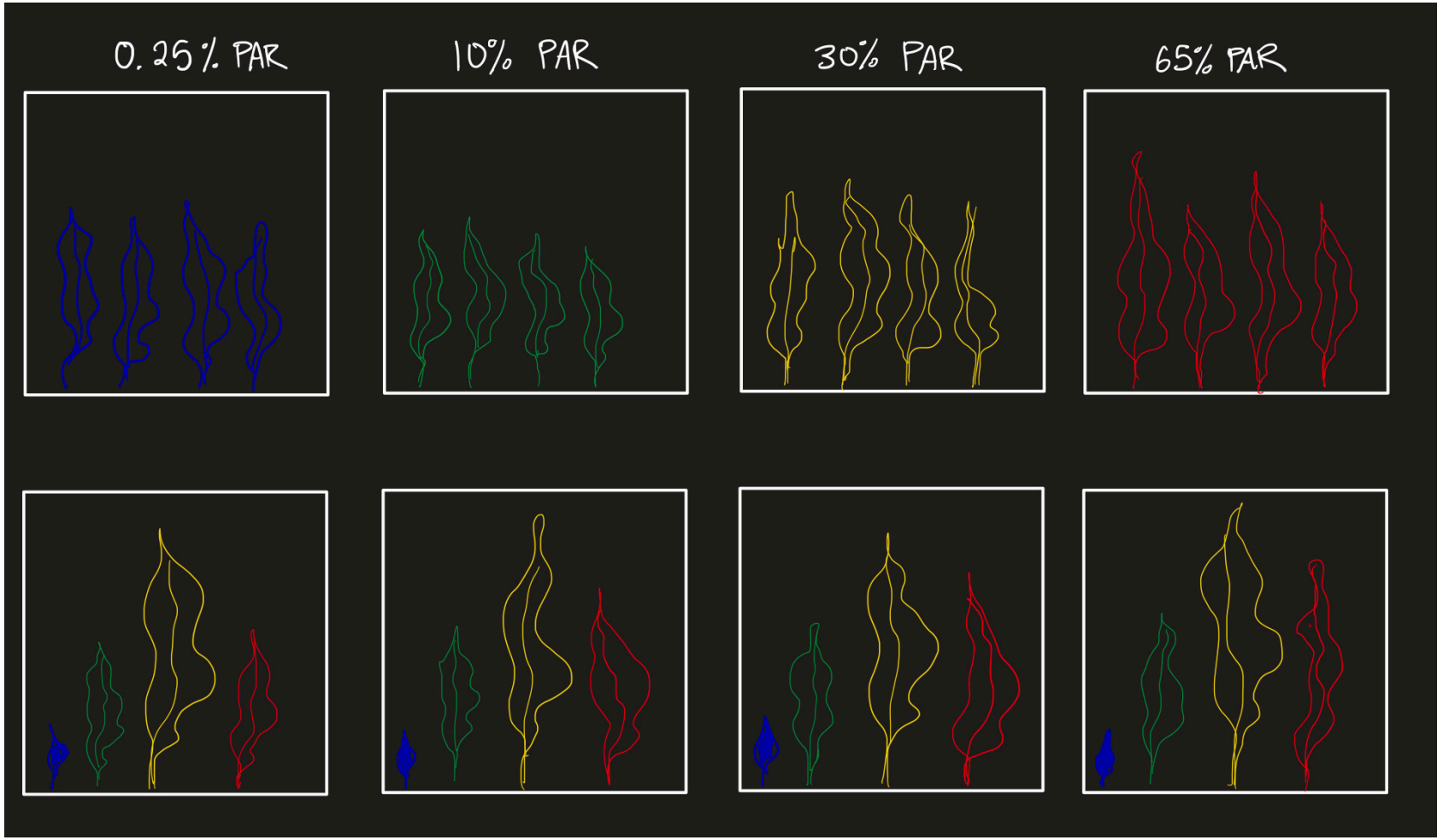


1. How long does it take sugar kelp to photoacclimate to a new light level?

Outplanting

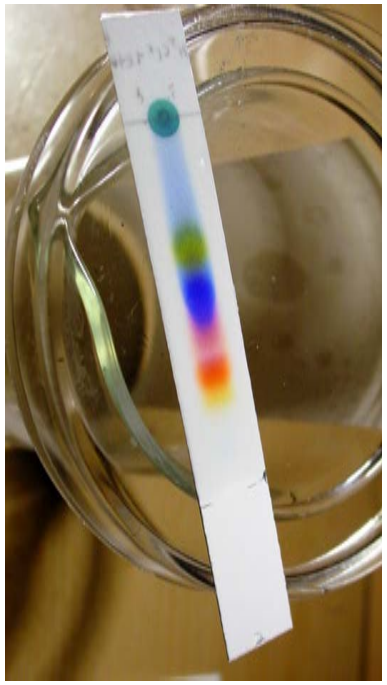
Photo credits: Holly Parker, Lemona Niu, Collin Roesler

Meanwhile, in the lab…



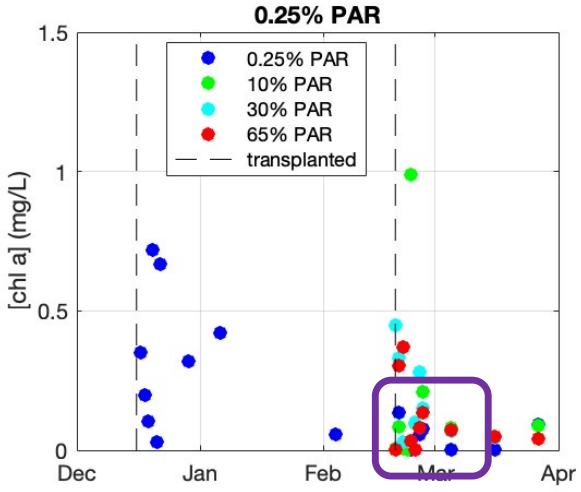
High Pressure Liquid Chromatography (HPLC)

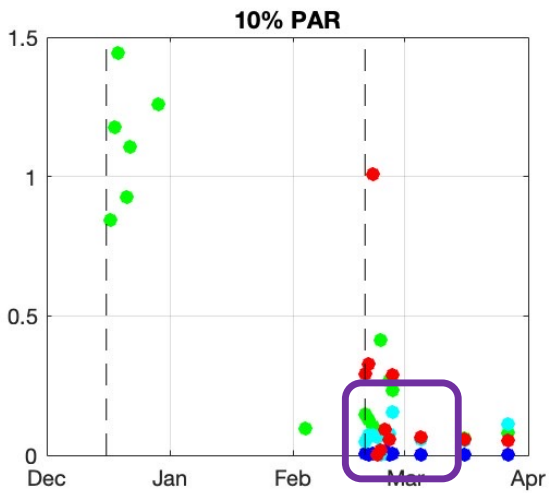
- HPLC
  - Separates pigments based on polarity
  - 400 samples
- Freeze-drying
  - Grind up into powder
  - Measure powder mass
- Pigment extraction
  - In acetone

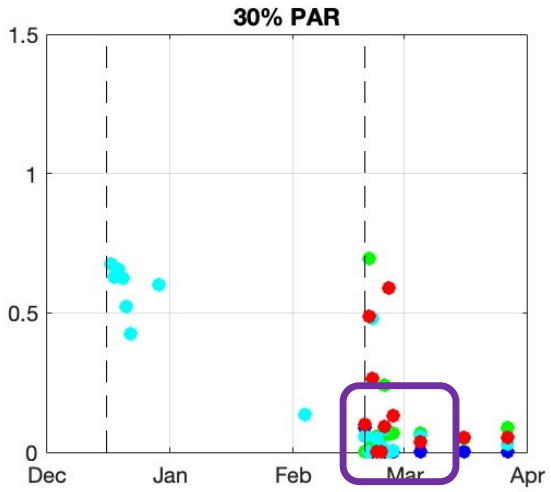


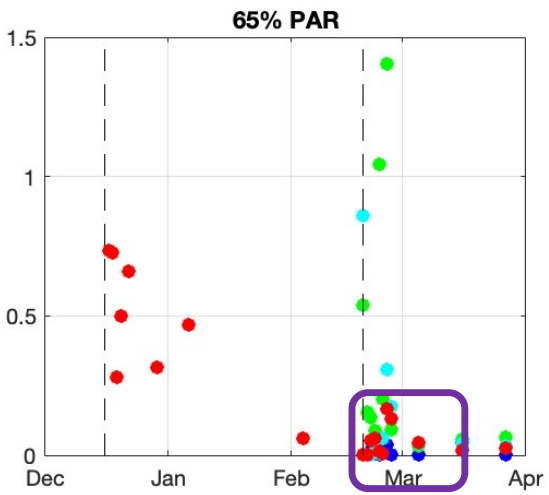
Thin layer chromatography shows pigment separation. Photo credit: Wikipedia

Sugar kelp acclimates on the order of…





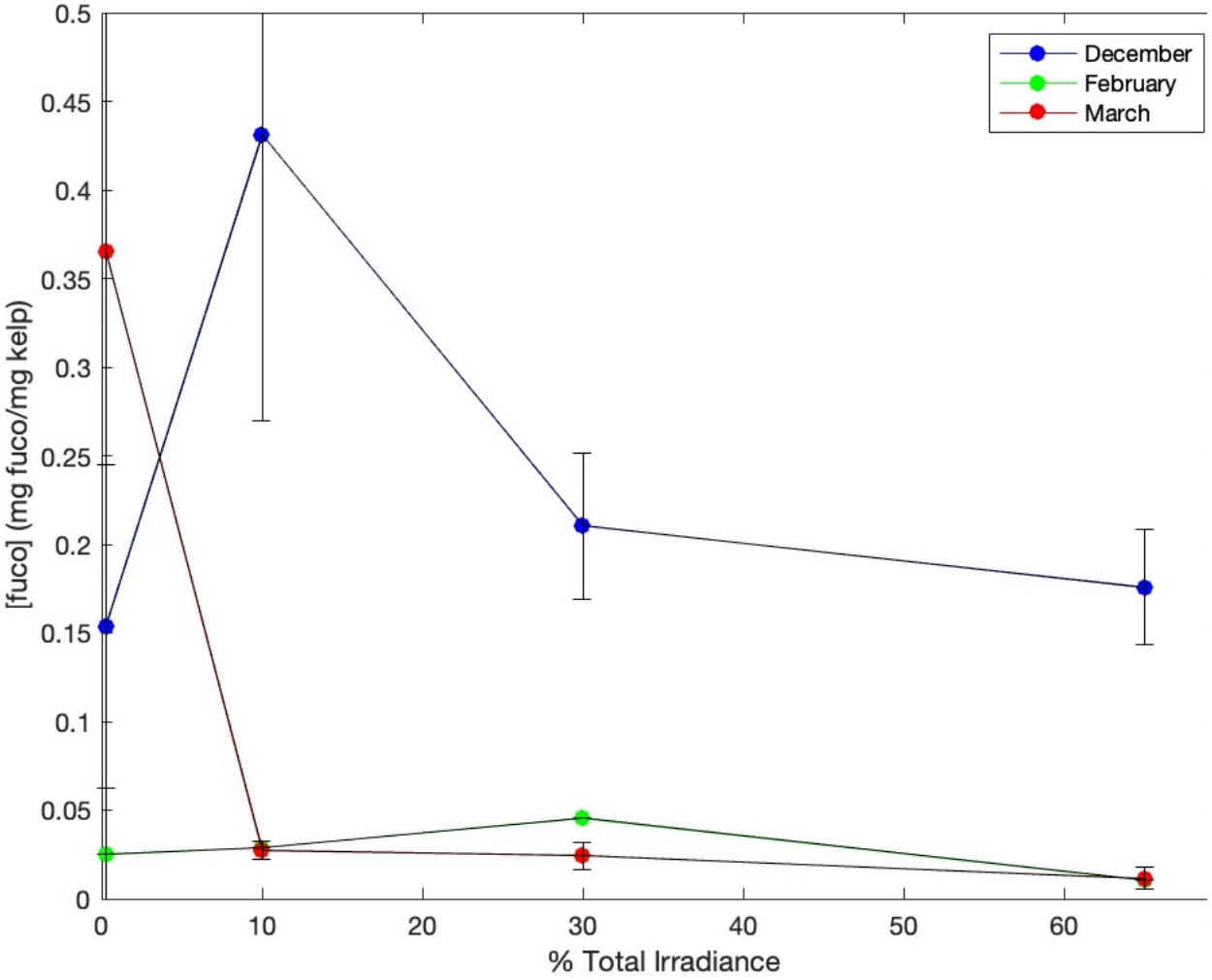




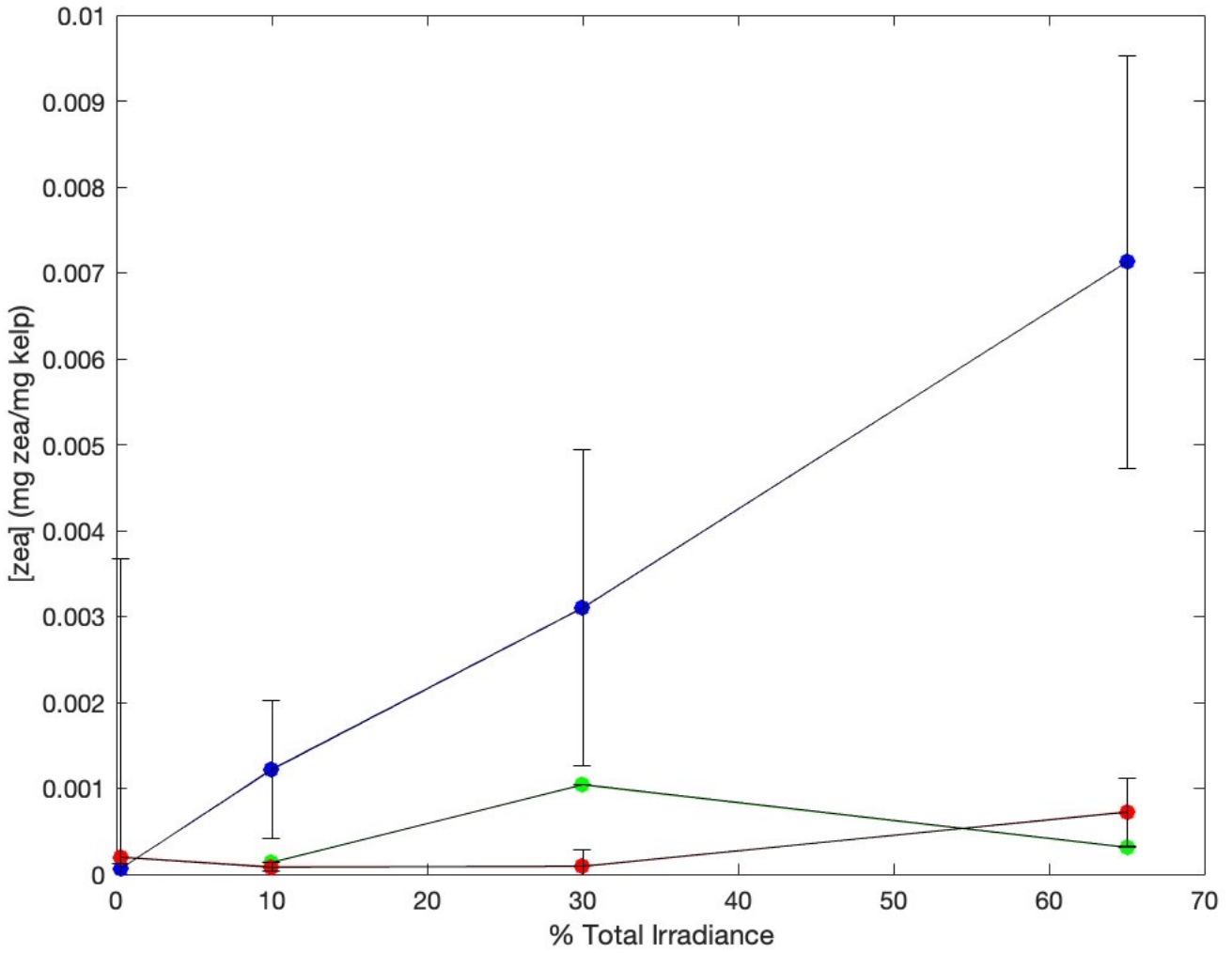
… 7-10 days

2. What does photochemistry reveal about sugar kelp resource allocation during its commercial growing season?

Photosynthetic



Photoprotective



Pigment Shifts

Photosynthetic

Original →

← Transplant	0.25%	10%	30%	65%
0.25%	Control			
10%		Control		
30%			Control	
65%				Control

Original →

← Transplant — Fucoxanthin	0.25%	10%	30%	65%
0.25%	0.37	**0.033**	**0.024**	**0.020**
10%	0.78	0.027	**0.025**	**0.024**
30%	**0.25**	0.028	0.024	**0.018**
65%	0.46	**0.025**	**0.017**	0.011

Photoprotective

Original →

← Transplant	0.25%	10%	30%	65%
0.25%	Control			
10%		Control		
30%			Control	
65%				Control

Original →

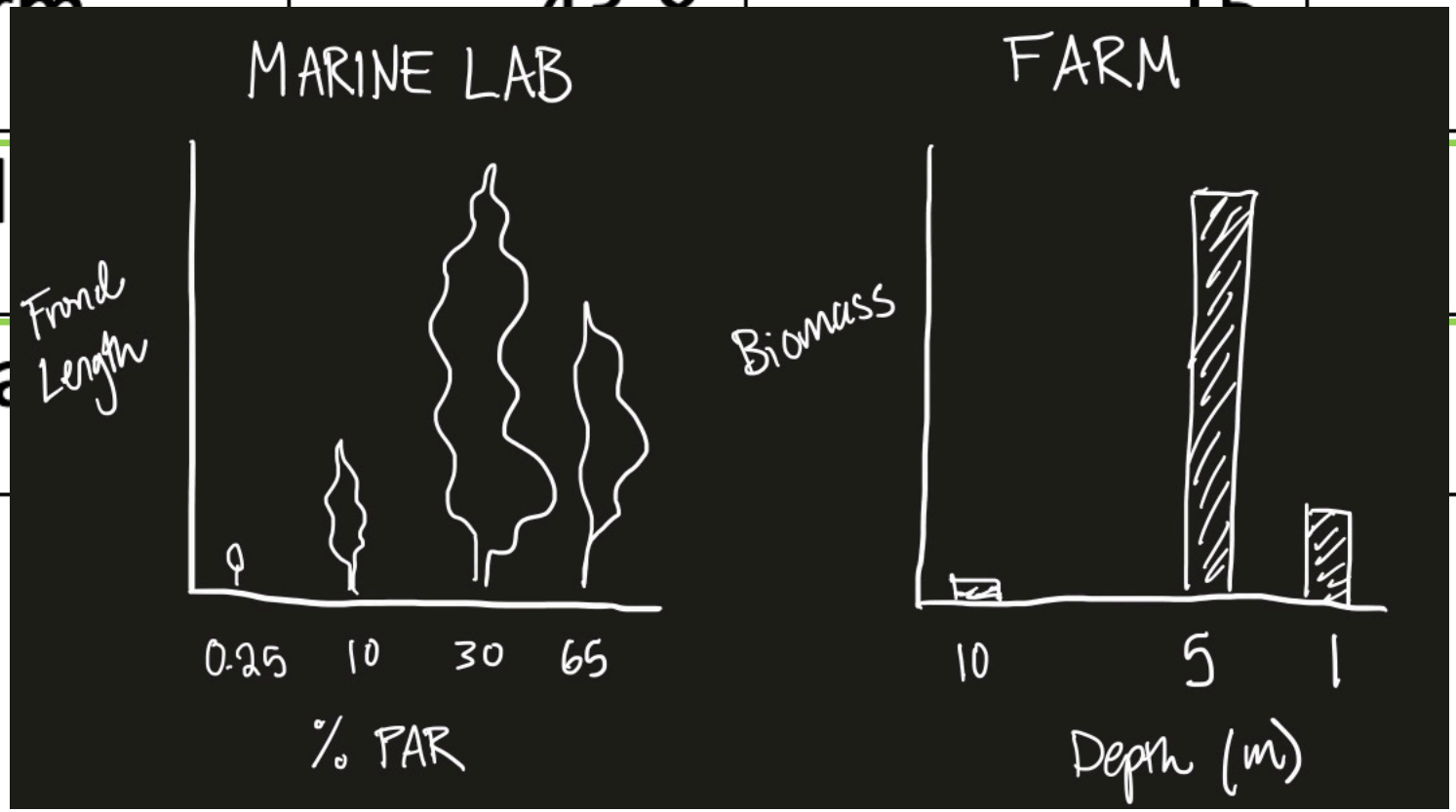
← Transplant — Zeaxanthin	0.25%	10%	30%	65%
0.25%	0.000202	0.000035	0.000077	0.000122
10%	0.000118	0.000087	0.000080	0.000091
30%	0.000297	0.000194	0.000090	0.000160
65%	0.001600	0.000232	0.000191	0.000727

3. At what depth does sugar kelp grow best on a kelp farm?

Kelp Farm - Yields

Photo Credits: Adam Bovie, Holly Parker, Clinton Thompson

Depth (m)	Mass (kg)	Length (m)	Yield (kg/m)
1 – vertical line	lost	lost	lost
1 – kelp farm	43.8	15	2.92
5 – vertical			20.6
10 – vertica			0



Research Qs – Revisited

- How long does it take sugar kelp to photoacclimate to a new light level?
  - 7-10 days!
- What does photochemistry reveal about sugar kelp resource allocation during its commercial growing season?
  - December – growth phase
  - March – reproductive phase
- At what depth does sugar kelp grow best on a kelp farm?
  - 5 m!

Future Directions

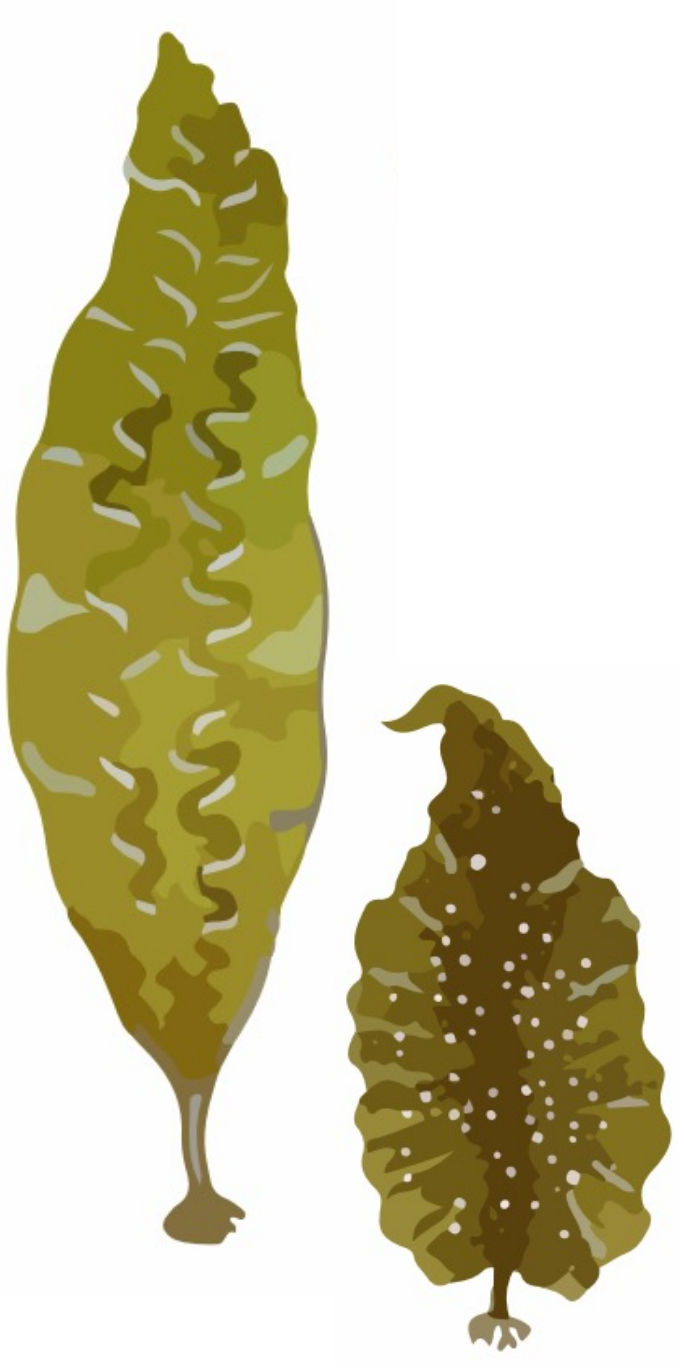
- How does the nutritive value of the kelp change with depth?
  - CHN nutrient analysis

Photo Credits: Adam Bovie

Fate of the Kelp – Growing to Give

Photo Credits: Lemona Niu, Theda Lyden, Sophia Adami-Sampson

How can I structure a kelp farm that yields both a kelp harvest and opportunities for aquaculture research?



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