Kelp forest productivity along a turbidity gradient in the Hauraki Gulf

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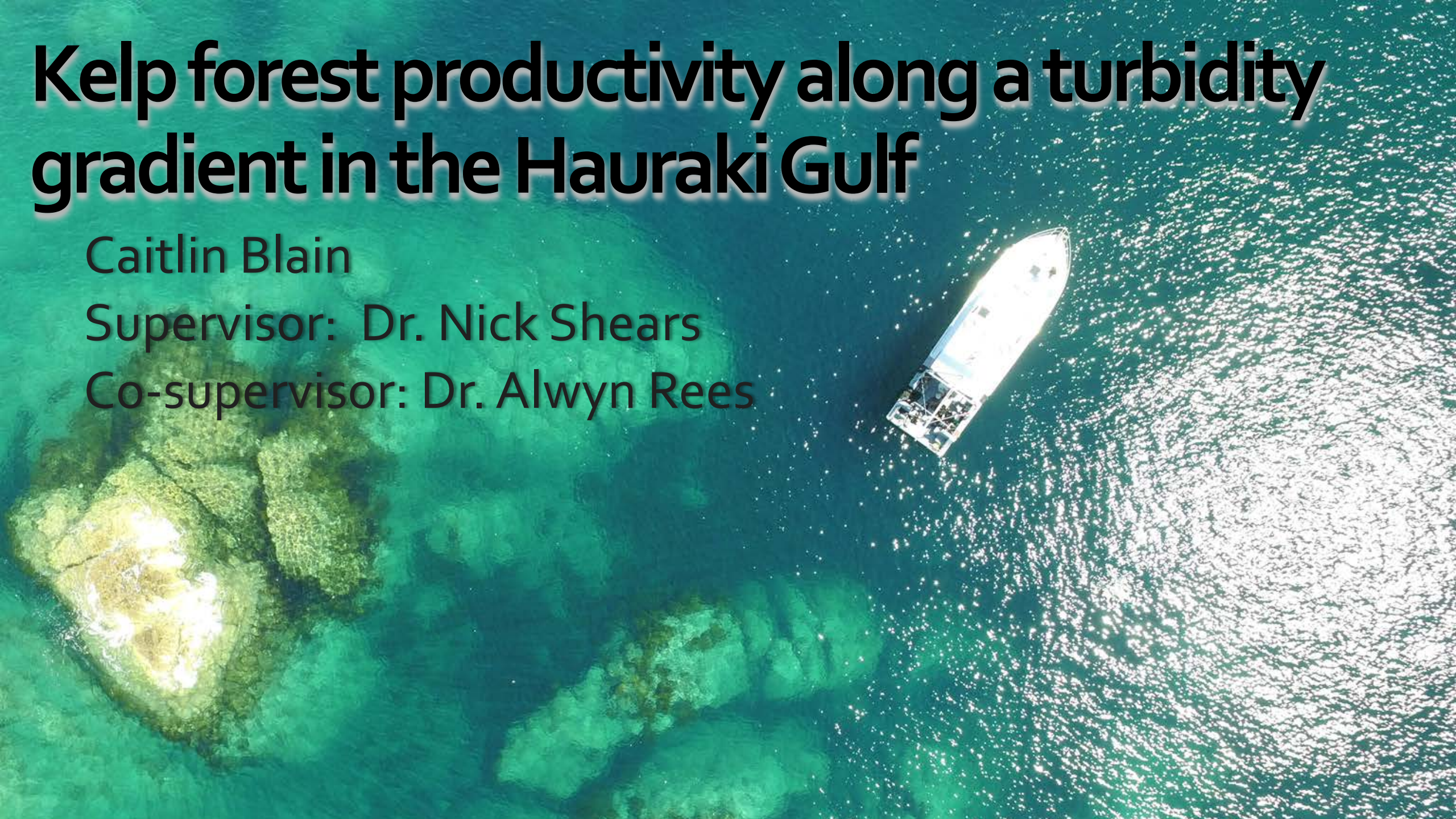


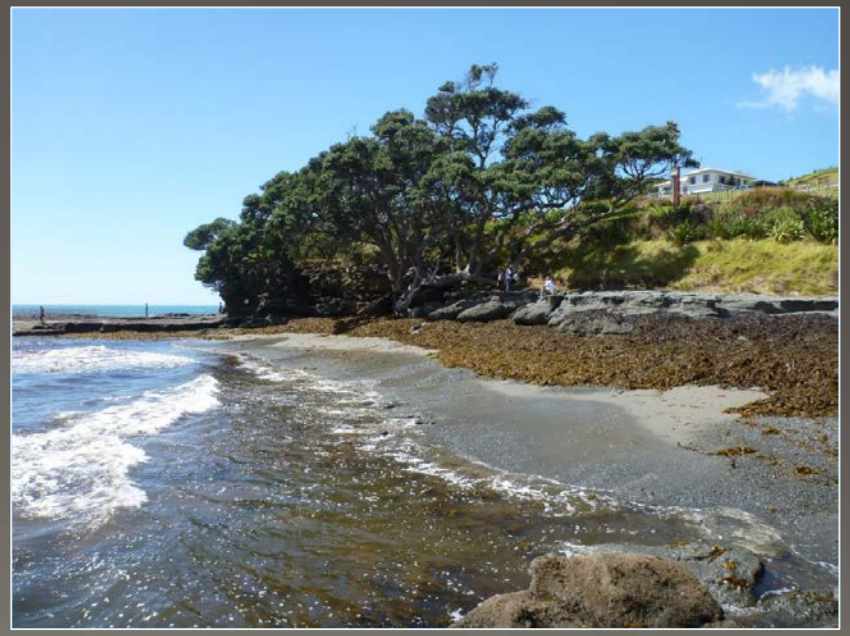
Kelp forests

- Highly productive primary producers
- Alter abiotic and biotic variables
- Provide food and habitat for numerous species

Kelp forests

Productivity and distribution is:

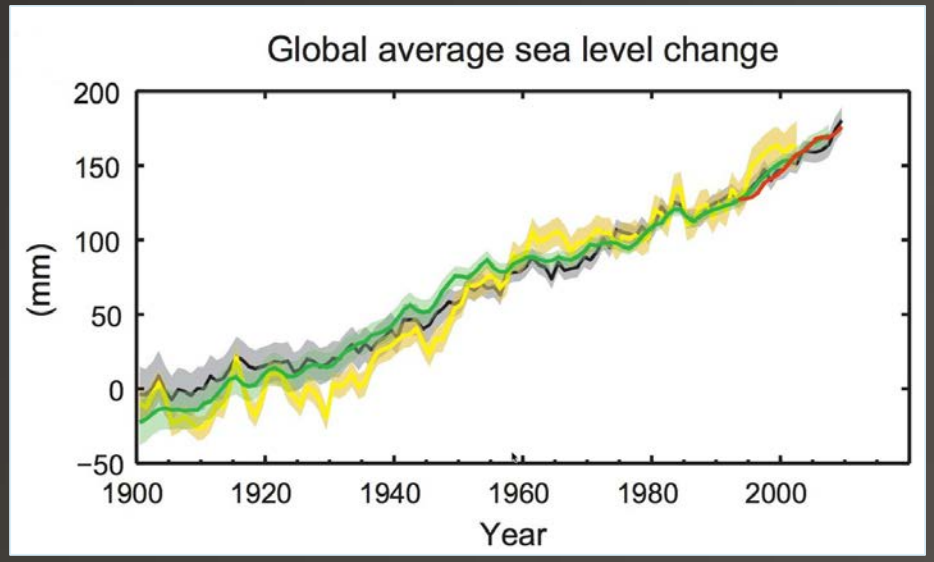
- Temporally and spatially variable
- Effected by a range of biotic and abiotic variables



Anthropogenic induced shifts

- Fishing
- Eutrophication
- Coastal sedimentation
- Climate change
  - Warming sea temperature
  - Ocean acidification
  - Increased storm intensity and frequency
  - Rising sea levels

Rising sea levels and increased storm intensity and frequency



IPCC 2013

➔ Increased sediment runoff and turbidity (Thrush et al. 2004)

Interactions with: farming
logging
development

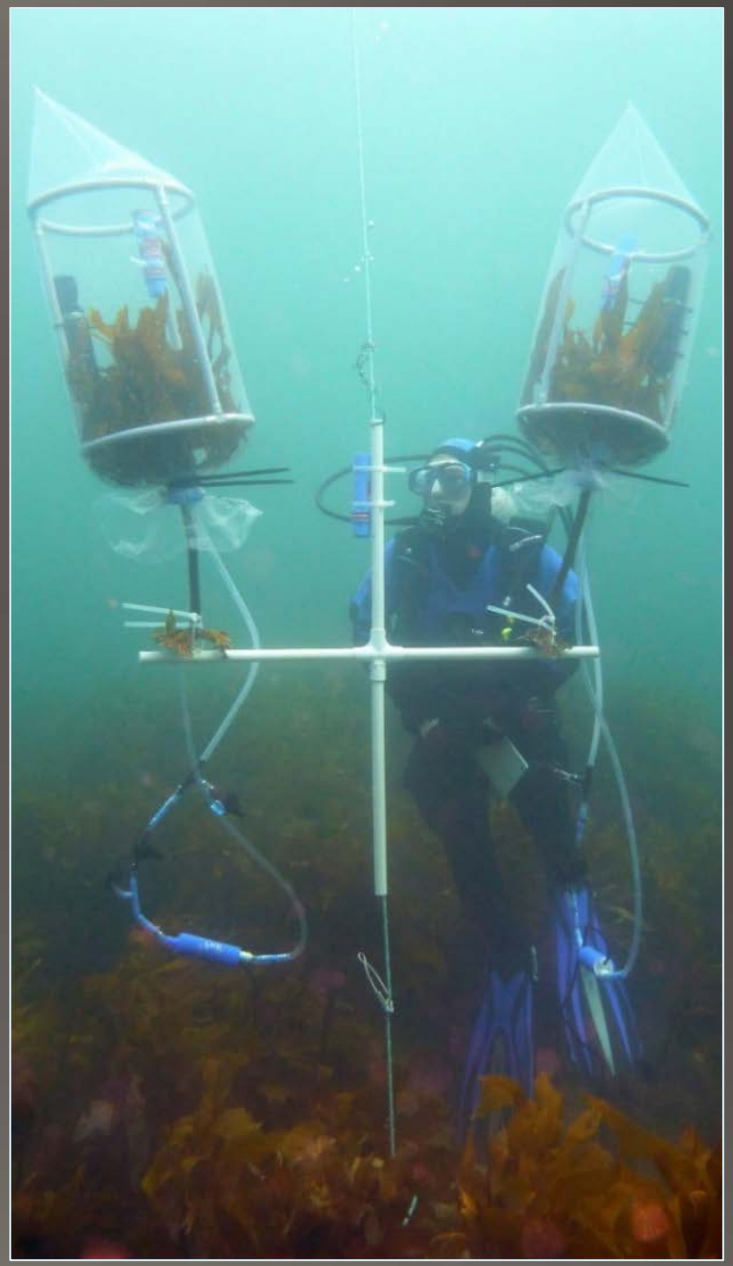
Primary productivity

Light is critical driver of productivity

- Few studies investigate local variation in productivity with turbidity
- Important first step in predicting the effects of interacting stressors

Measured by:

- Growth
- Biomass accumulation
- Photosynthetic performance



Rodgers et al. 2015

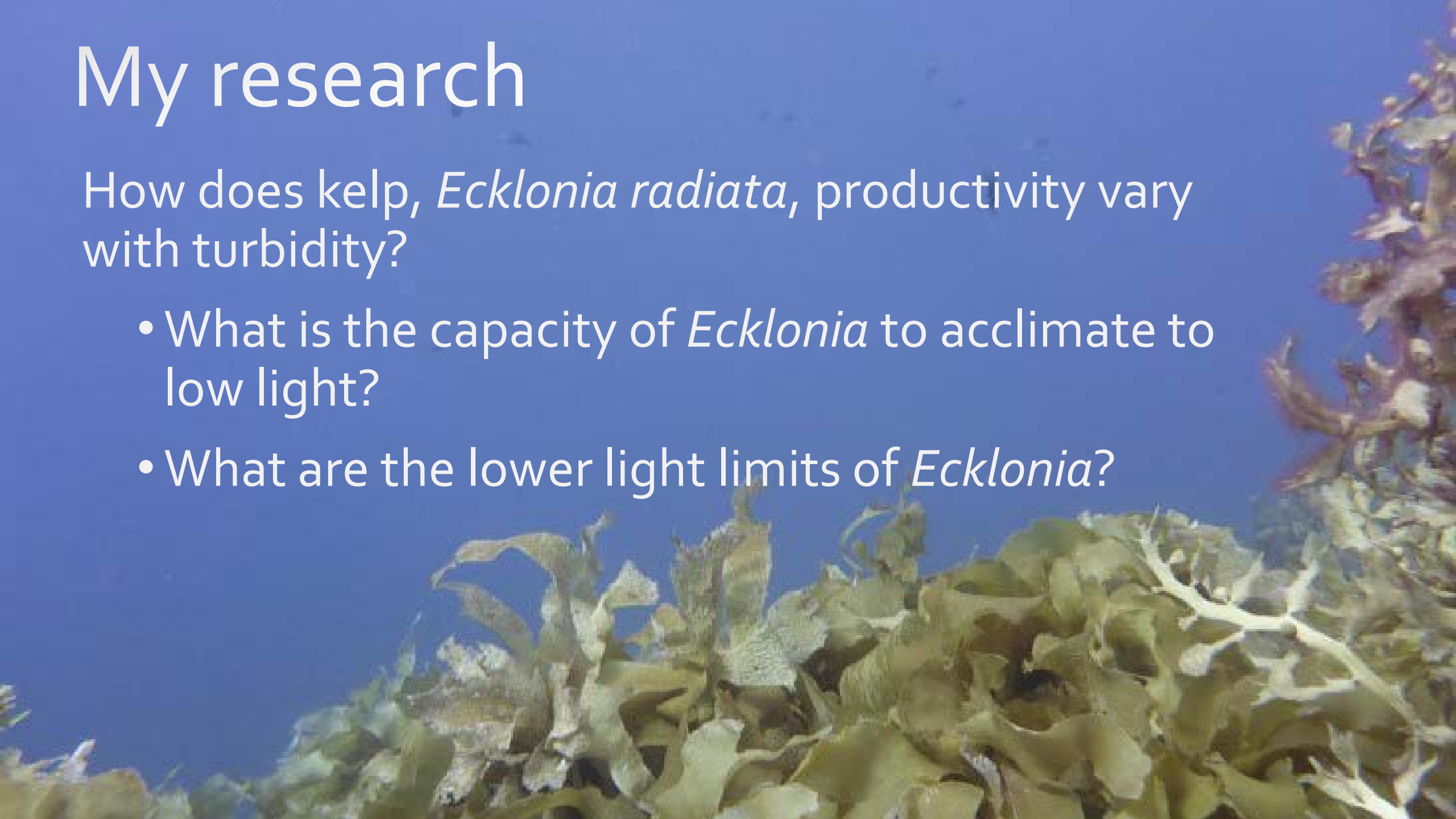
Ecklonia radiata

Ecklonia radiata

My research

How does kelp, *Ecklonia radiata*, productivity vary with turbidity?

- What is the capacity of *Ecklonia* to acclimate to low light?
- What are the lower light limits of *Ecklonia*?



My research

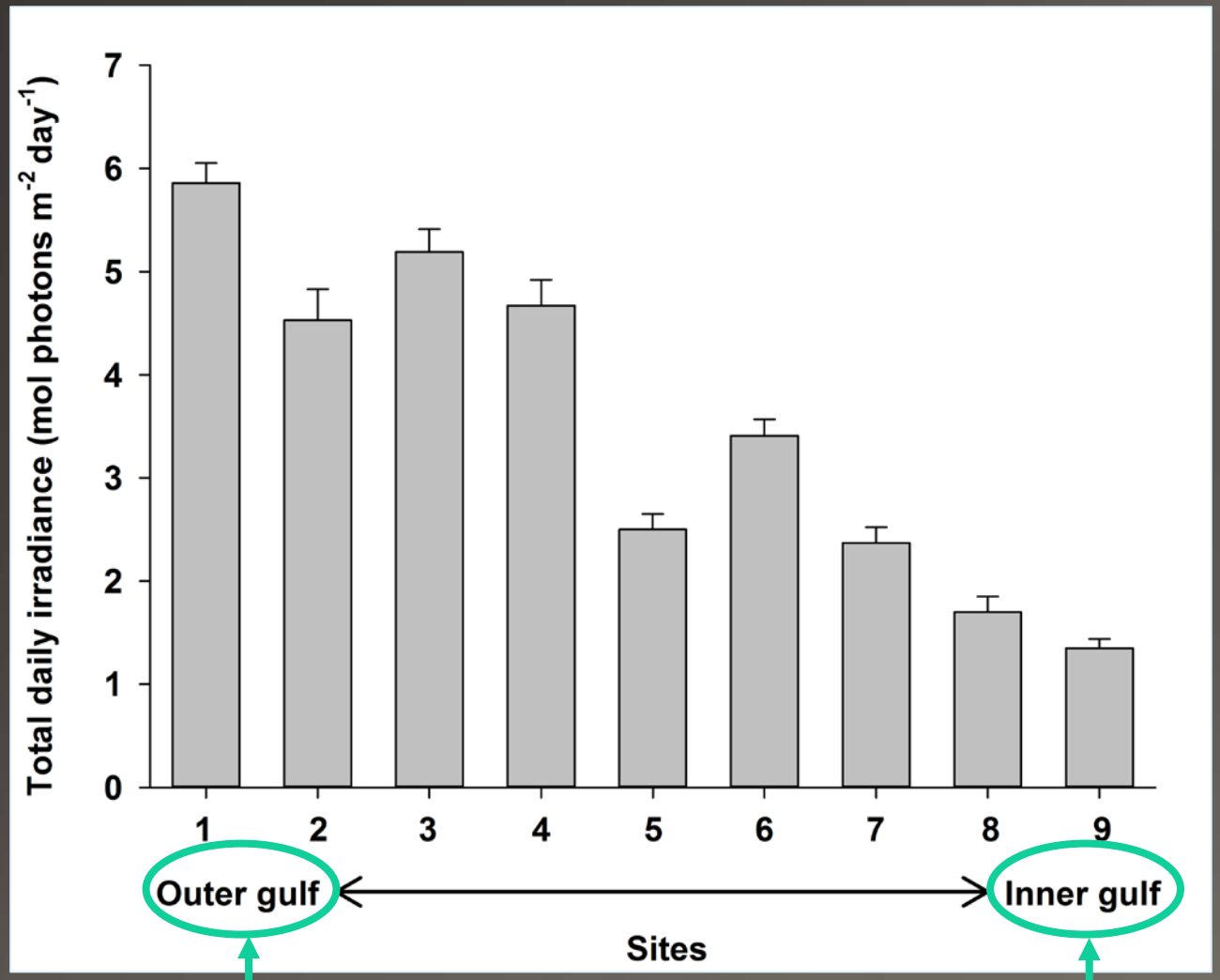
Approach:

- Turbidity gradient (field) and tank experiments
- Growth and biomass accumulation
- Photosynthetic properties

Study sites

- Turbidity gradient
- ~100 km total span
- > 5 km between each site
- Rocky reef @ 10-m depth
- Similar wave exposure

Study sites: light



> 20-m visibility

< 5-m visibility

Light acclimation:

- Thallus morphology
- Pigment content and concentration
- Cellular arrangement and morphology

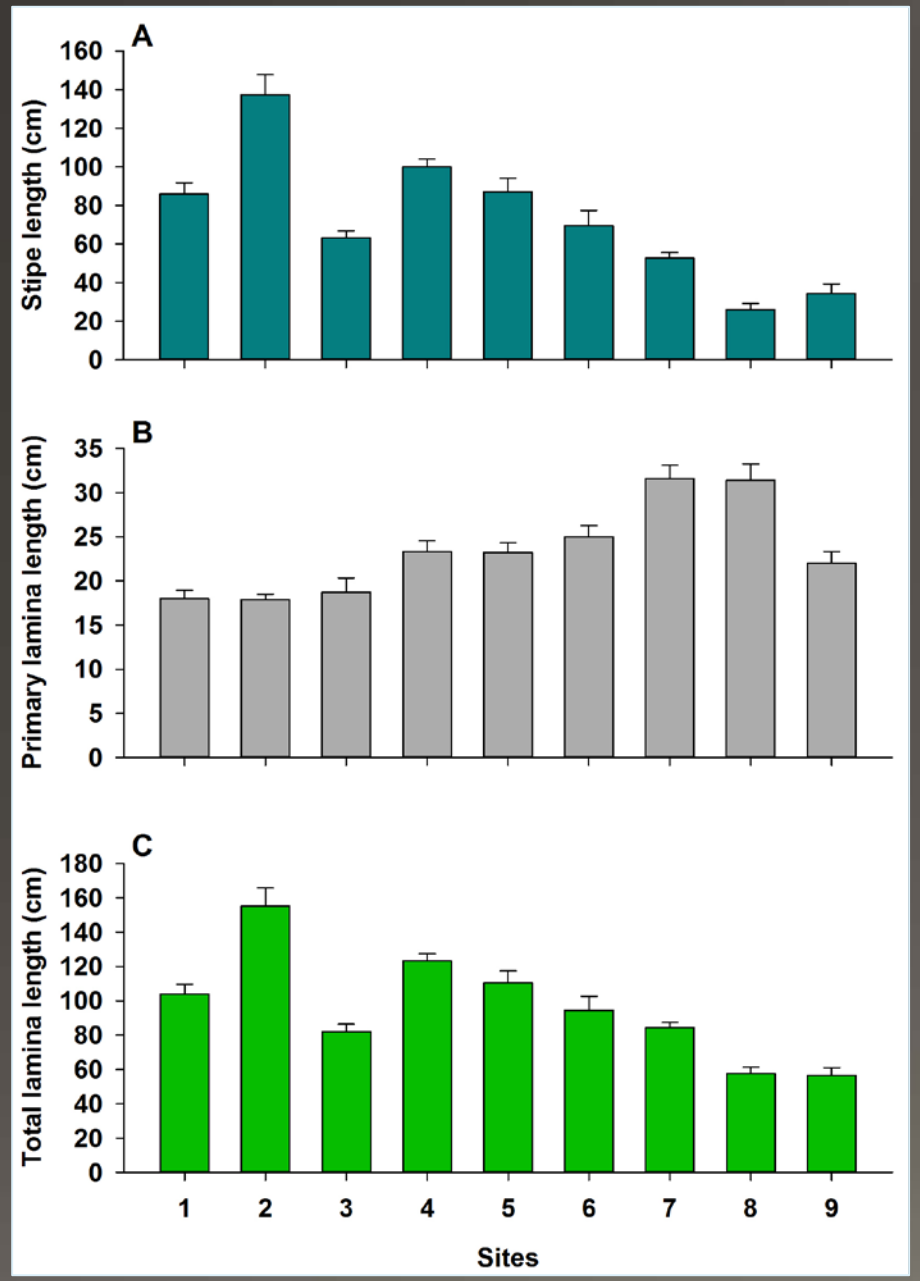
➔ Optimize photosynthetic efficiency and growth

Morphology

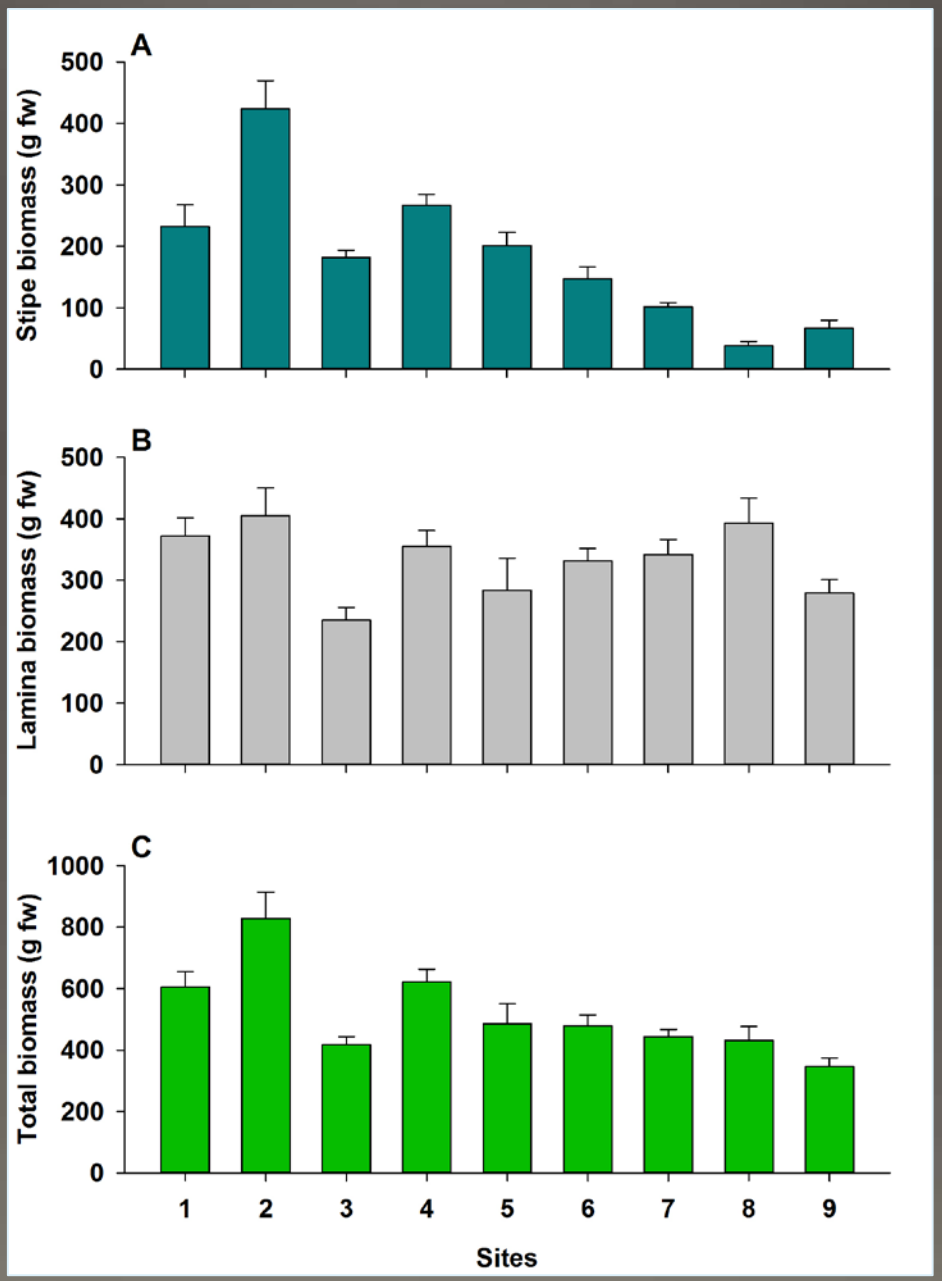
Outer gulf
(clear waters)

Inner gulf
(turbid waters)

Morphology



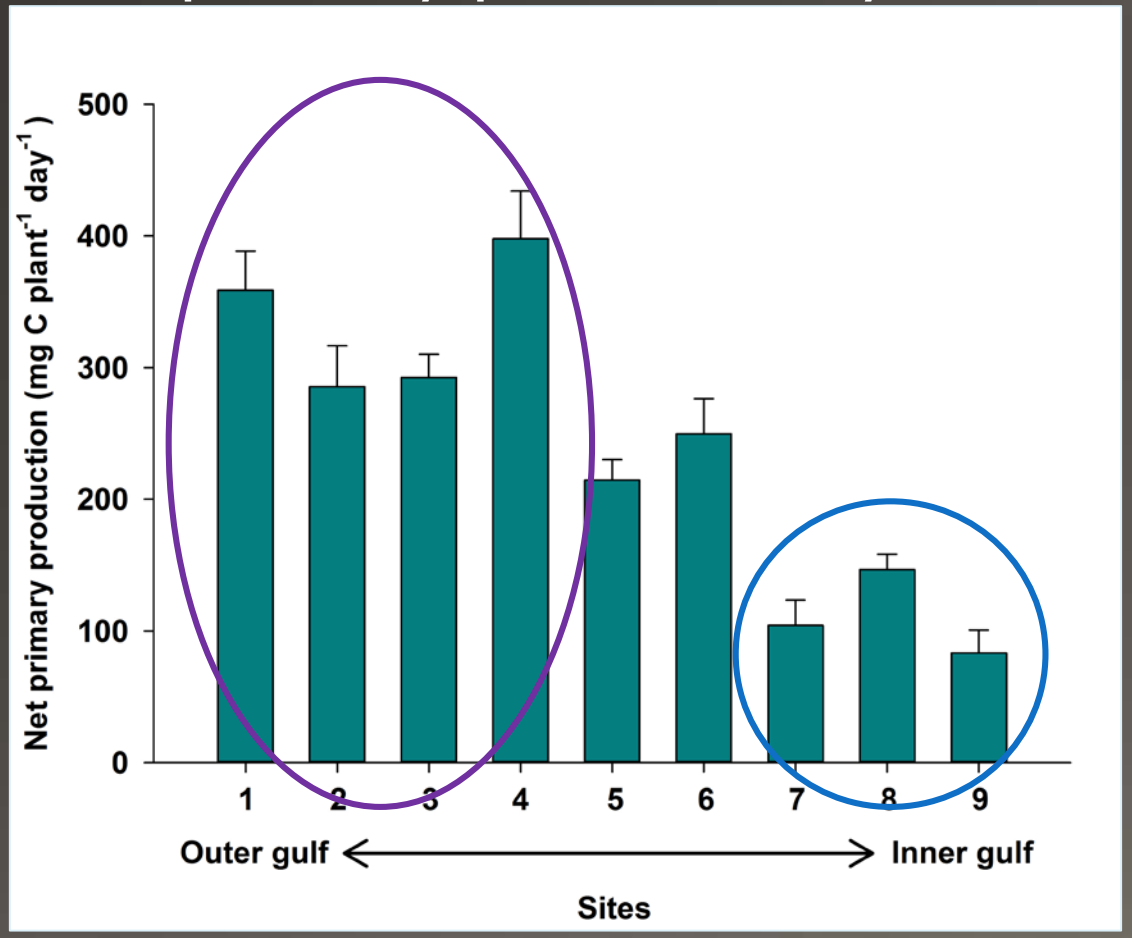
Biomass



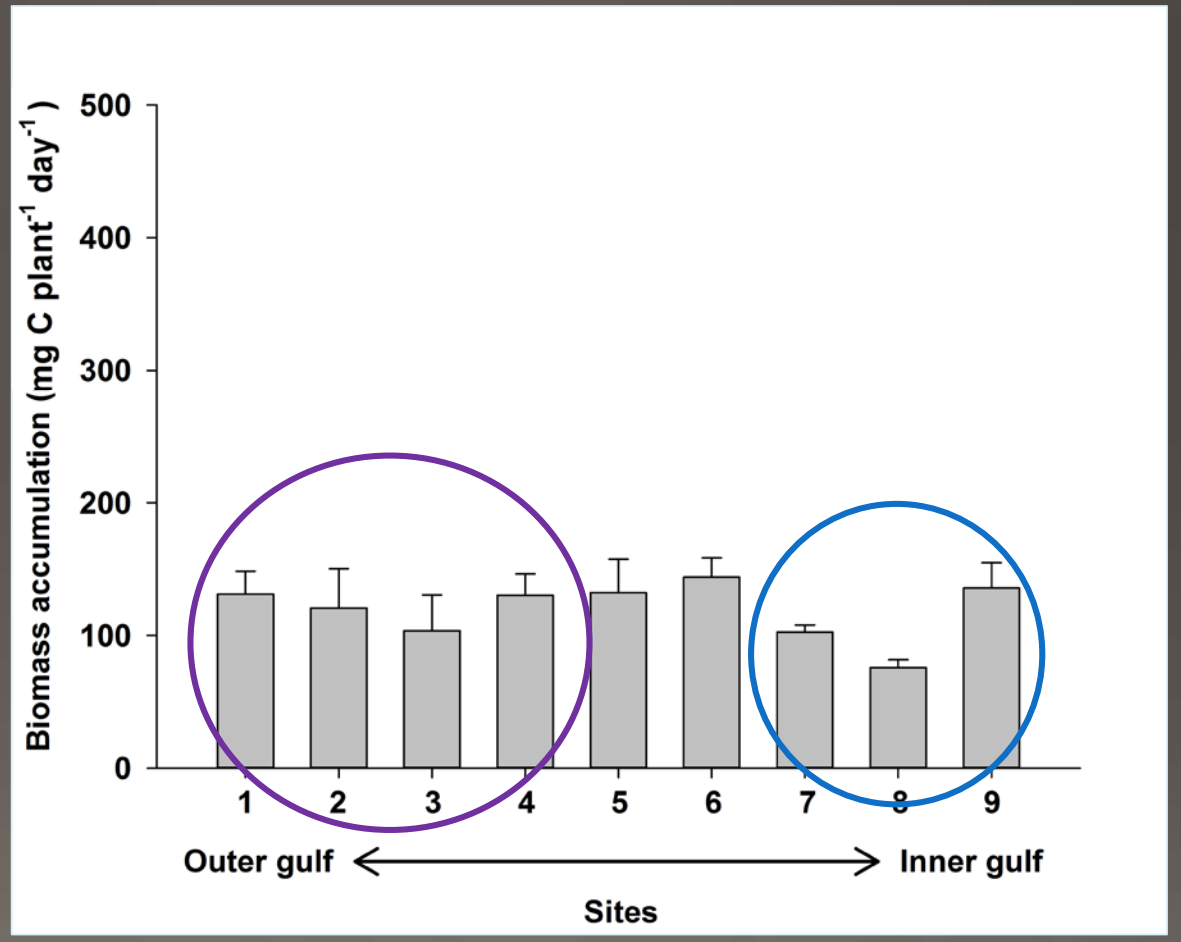
Photorespirometry

Productivity

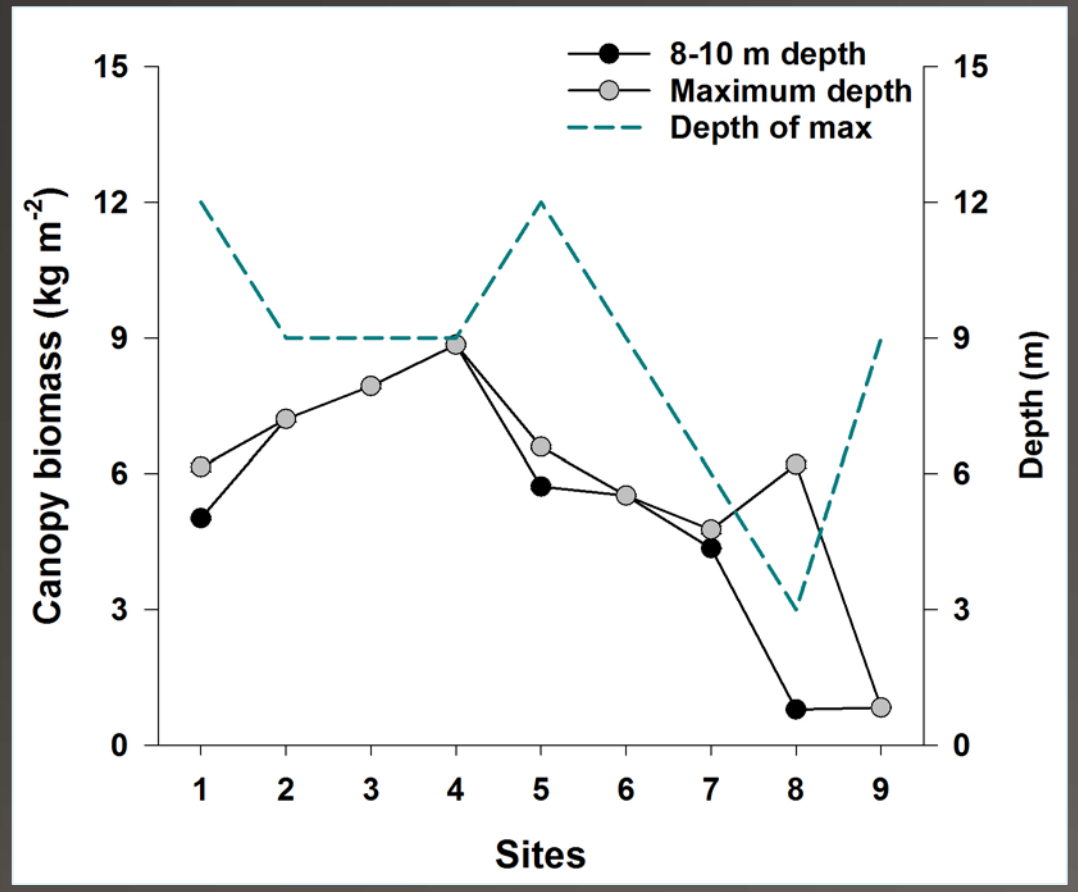
Net primary productivity



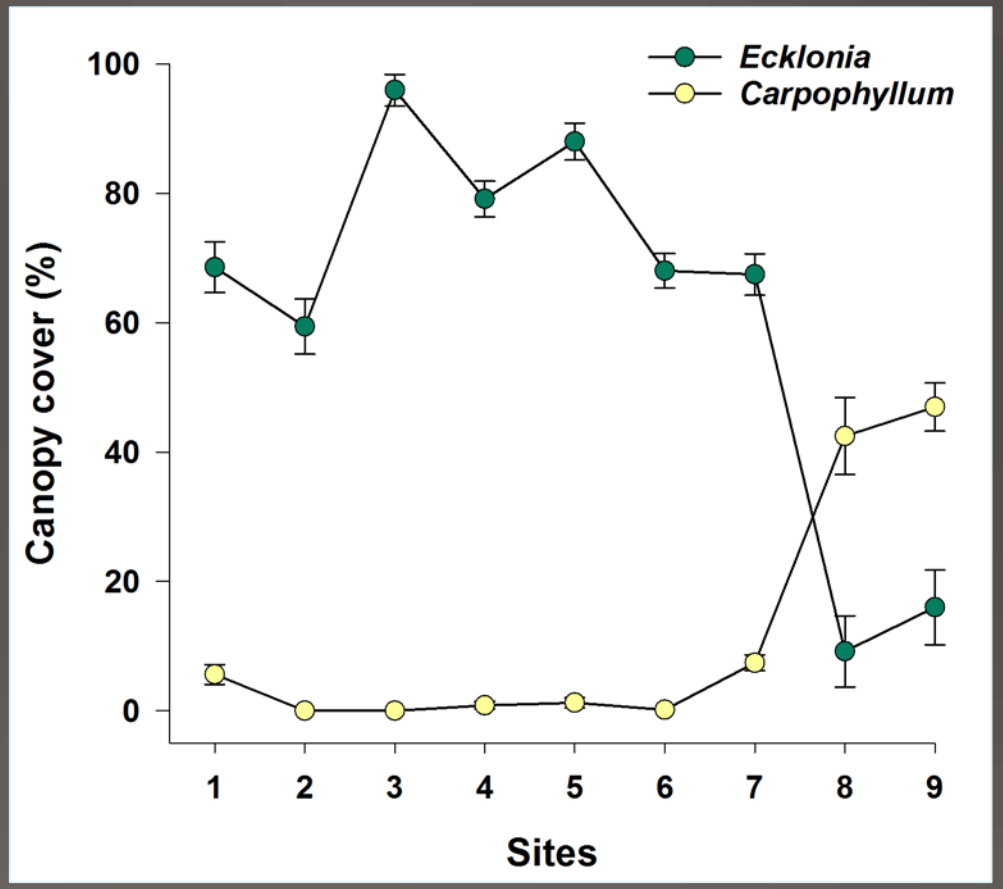
Biomass accumulation



Ecklonia canopy



Competition

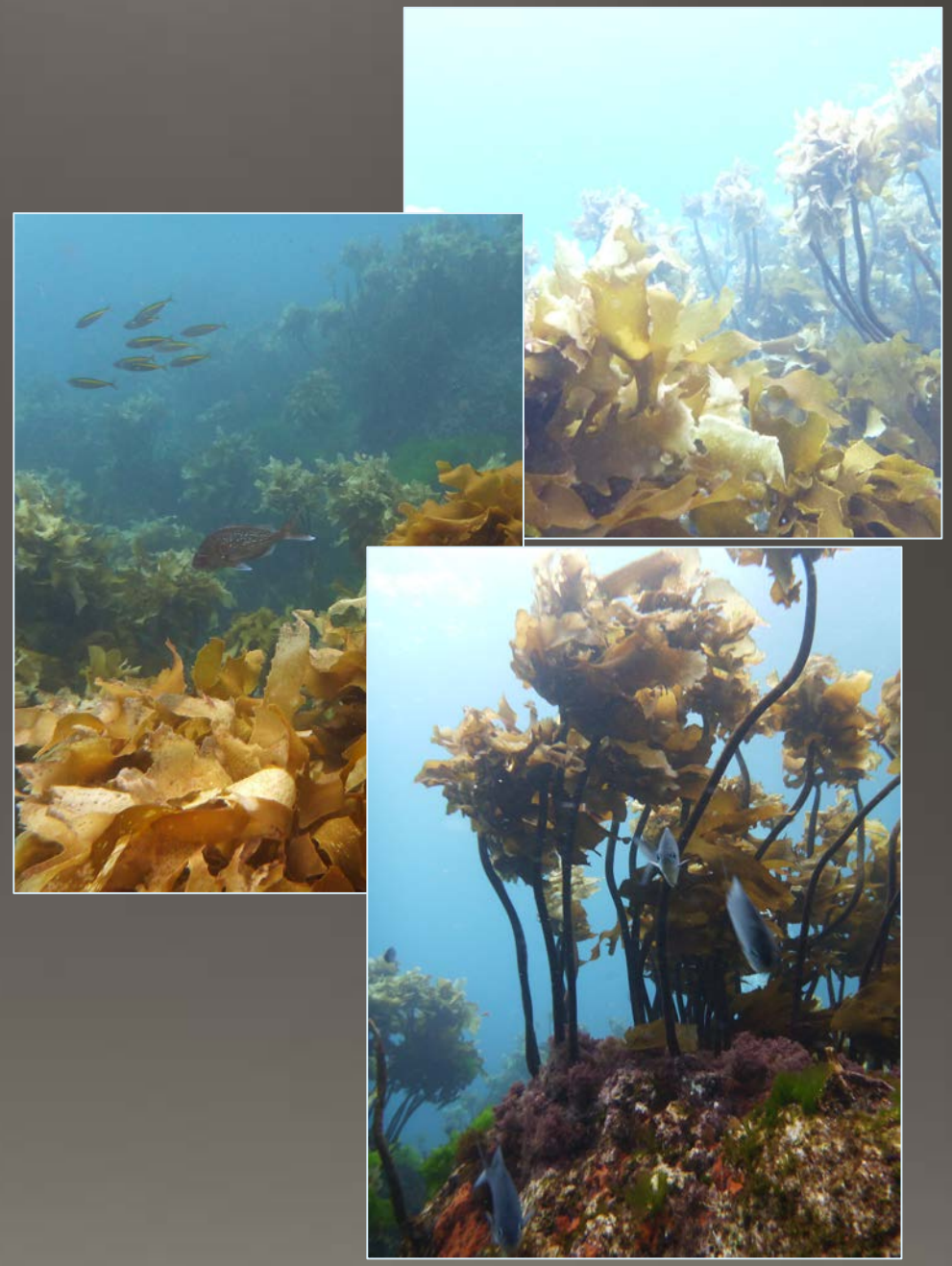


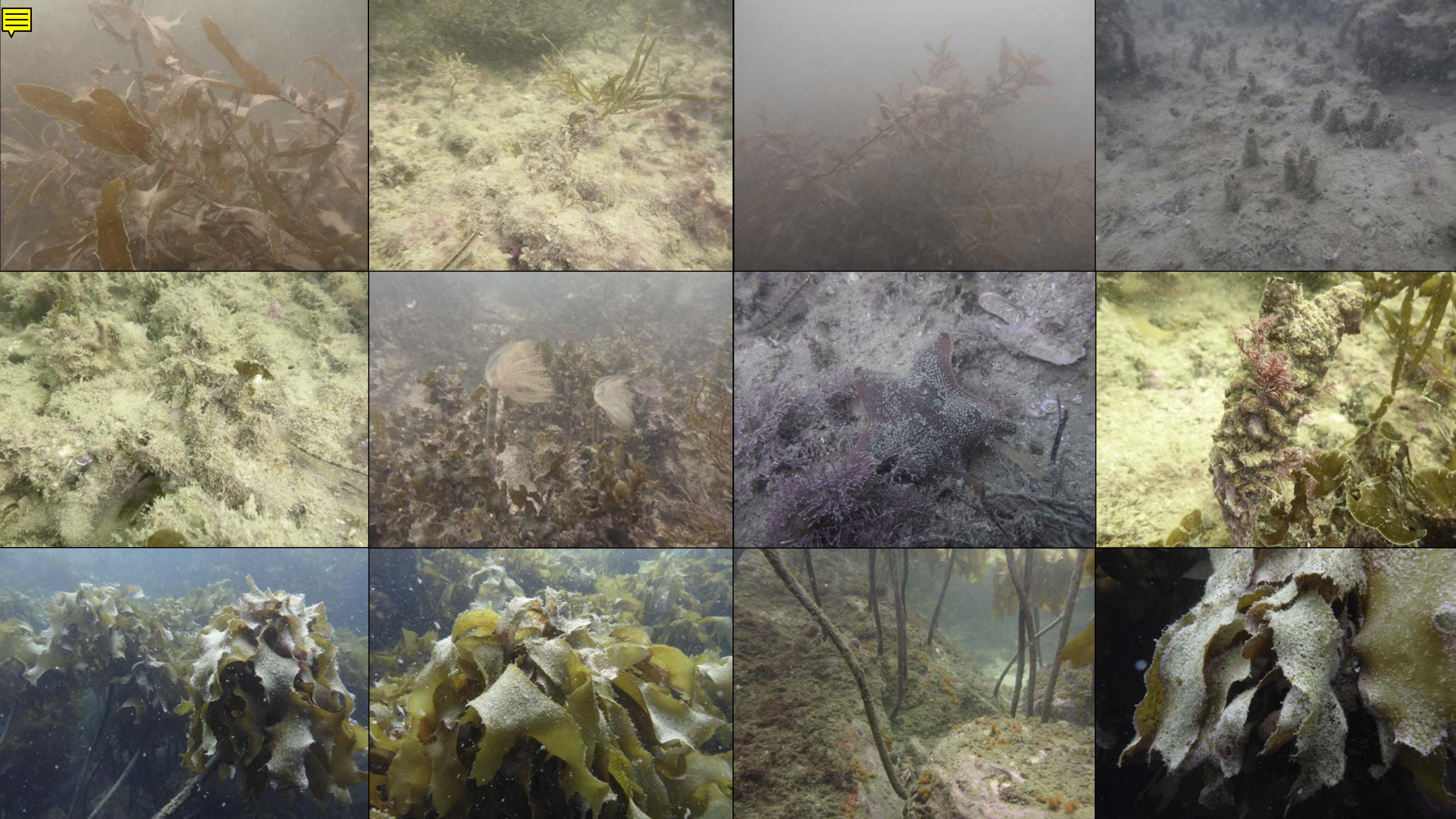
Conclusions

- Despite lower light, adult *Ecklonia* are able to accumulate similar amounts of biomass
- Some acclimation in photosynthetic parameters and morphology, but estimates of NPP were much lower in more turbid waters
- *Ecklonia* at more turbid sites may be less resilient to stressors due to lower potential primary productivity

Concurrent research

- Investigate how productivity relates to other environmental variables
- Repeating field components
  - Seasonality
- In situ and lab experiments
  - Press vs pulse
  - Light x Nutrients





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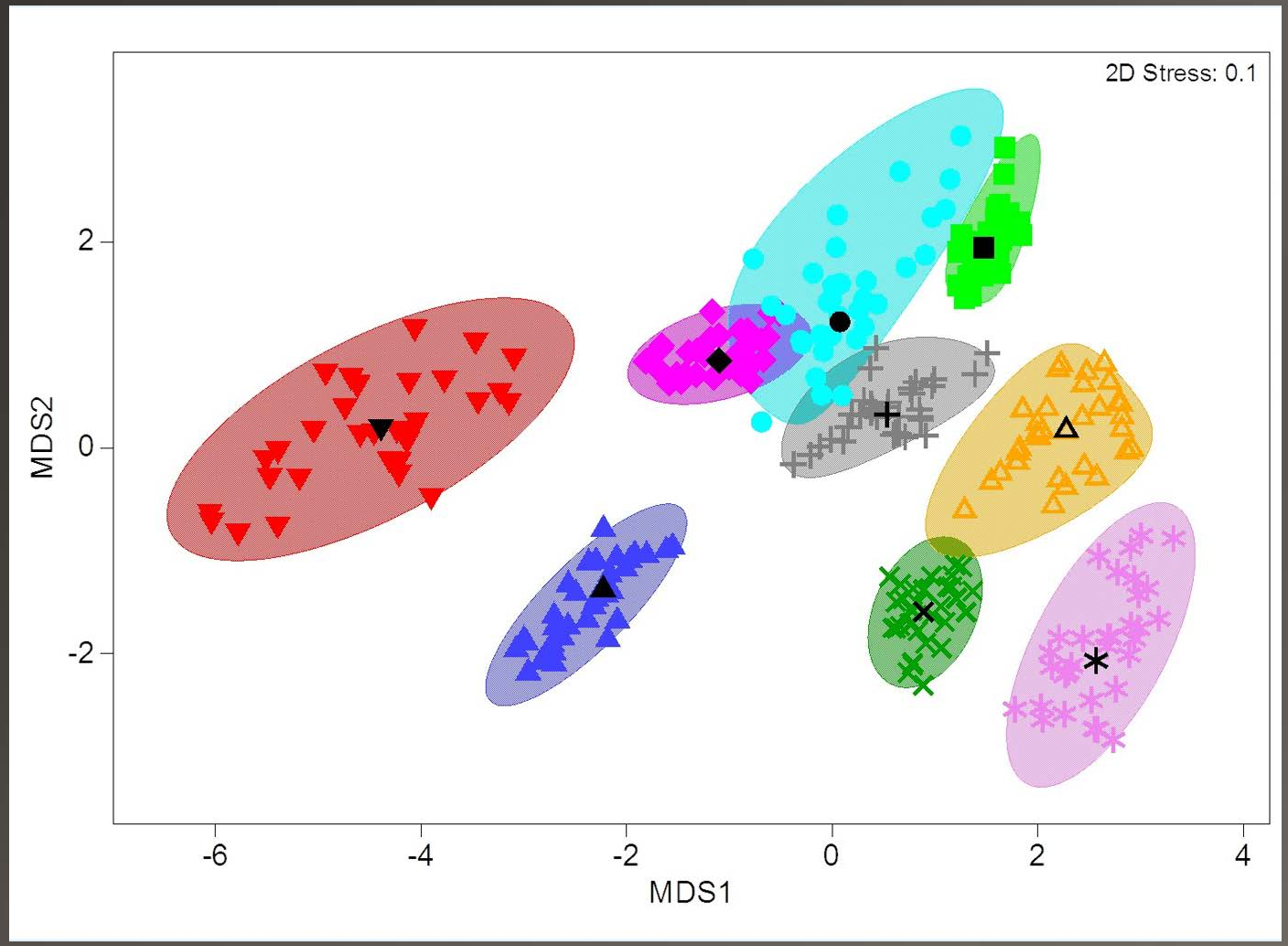
the Royal Society of New Zealand Te Apārangi

The University of Auckland Te Whare Wānanga o Tāmaki Makaurau New Zealand

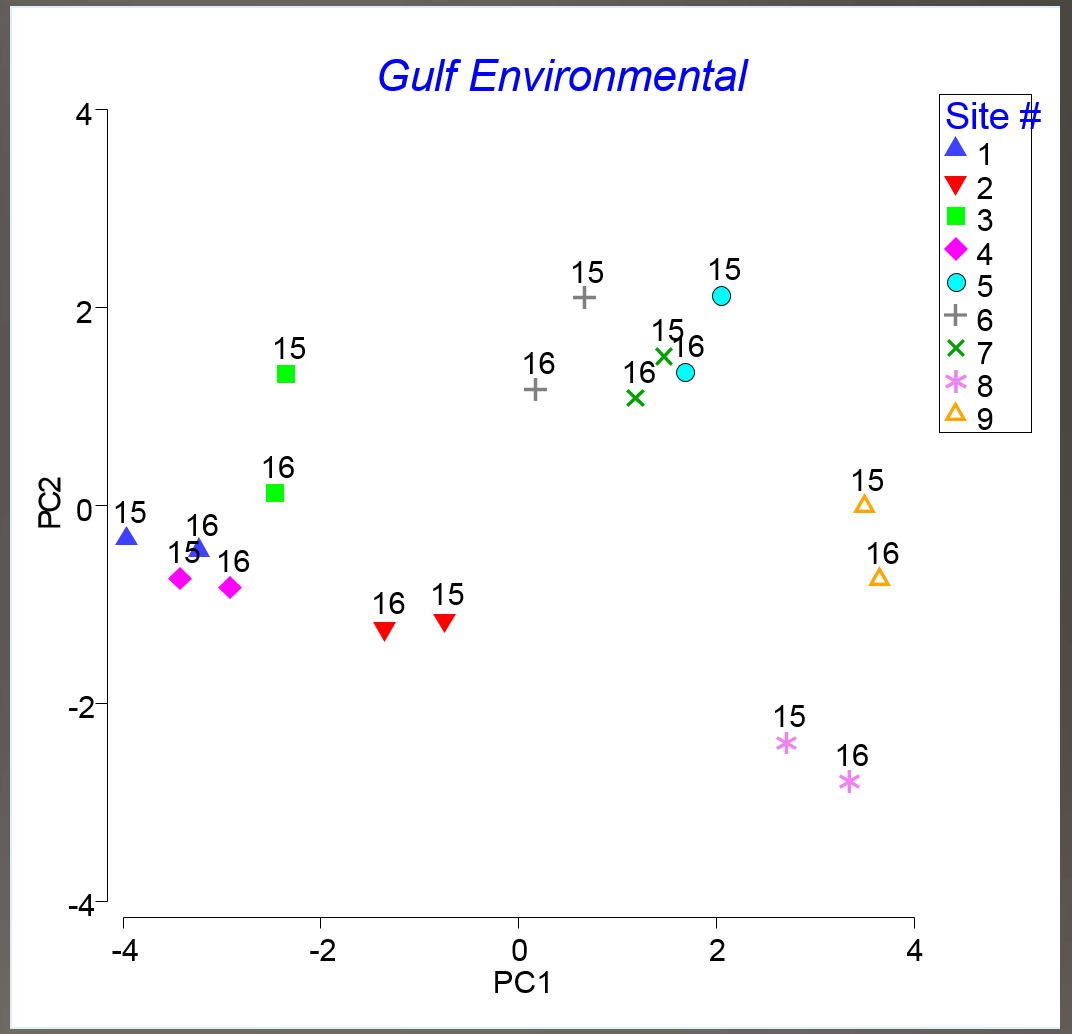
Leigh Marine Laboratory

But what about other gradients?

Morphology



Environment



Productivity Model

$$NPP = (P_{max} * 1 - e^{(-\alpha E/P\max)} - R_d) * b$$

P_{max} = photosynthetic rate at saturating irradiance

α = photosynthetic efficiency

E = incident irradiance on the seafloor

b = macroalgal standing crop

R_d = respiration rate in dark

Webb et al. 1974

Rodgers and Shears 2016