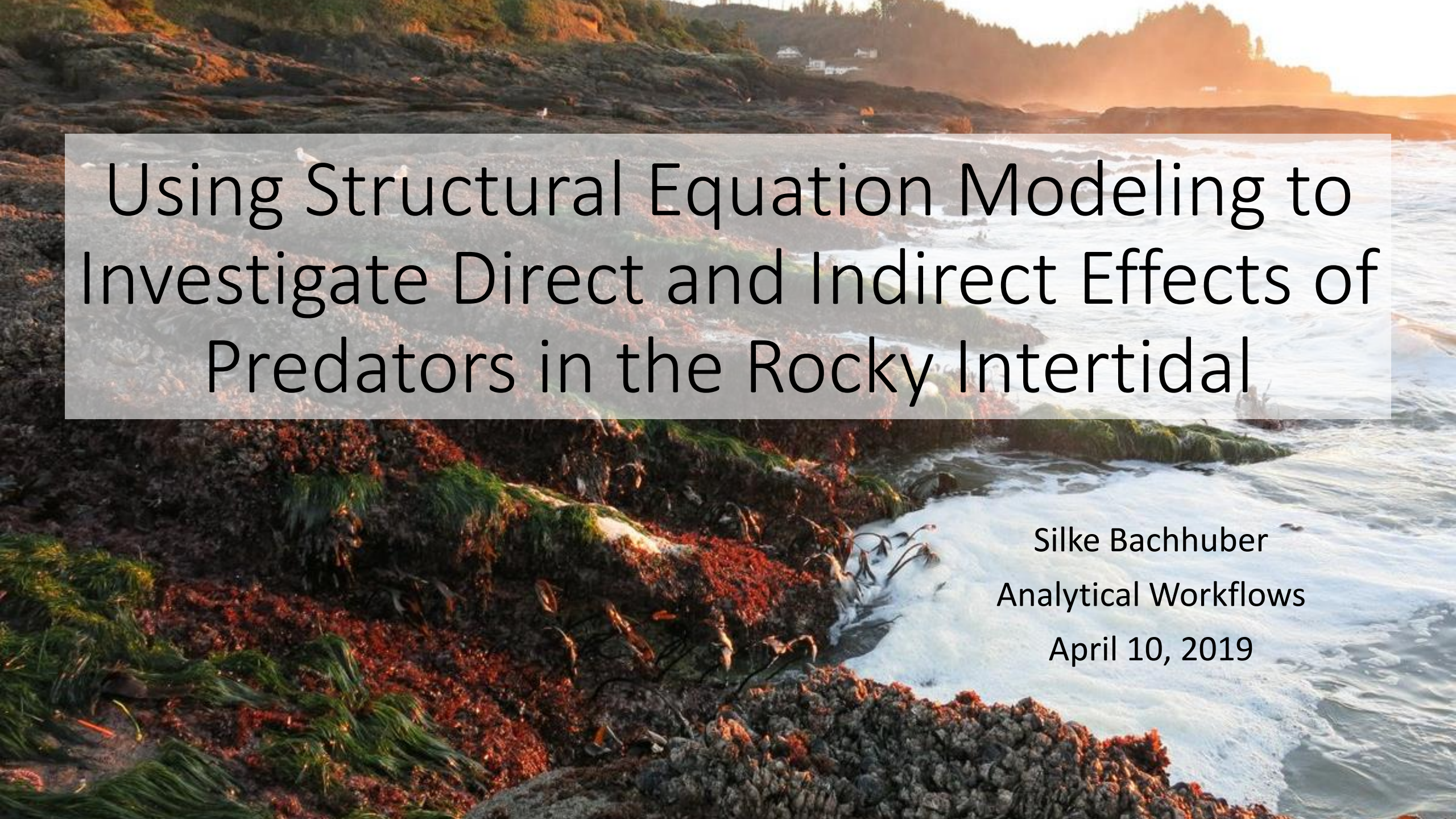


Using Structural Equation Modeling to Investigate Direct and Indirect Effects of Predators in the Rocky Intertidal

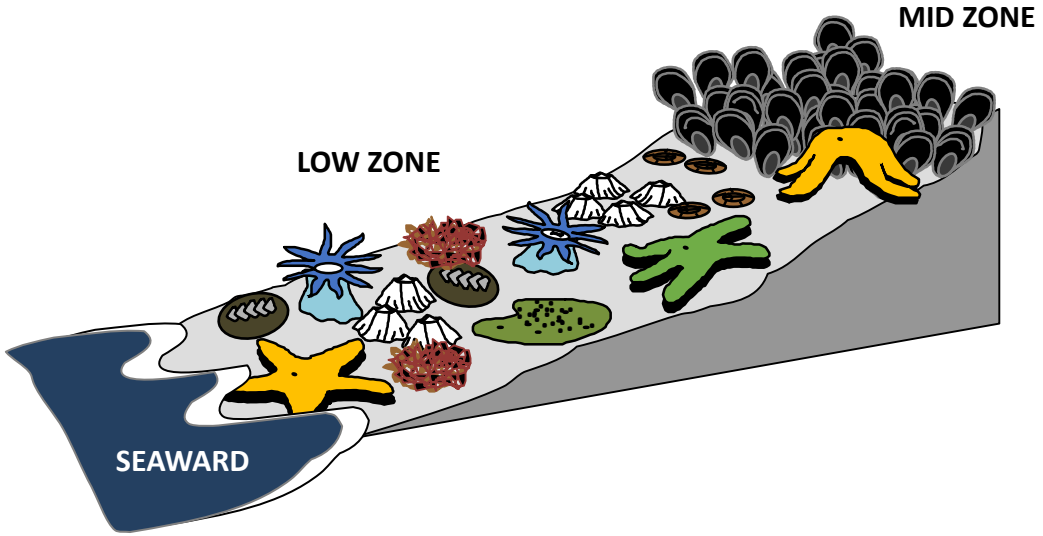
Silke Bachhuber

Analytical Workflows

April 10, 2019

Mechanisms of resistance, resilience to SSWS

Pisaster present



Pisaster removed

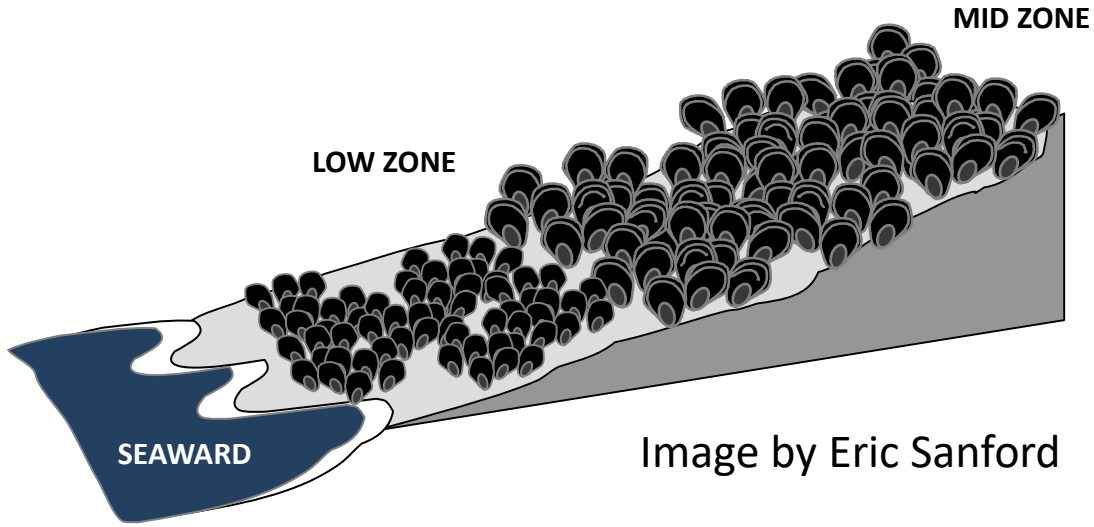


Image by Eric Sanford

- Recruitment of mussels and barnacles
- Large predators (stars and birds)

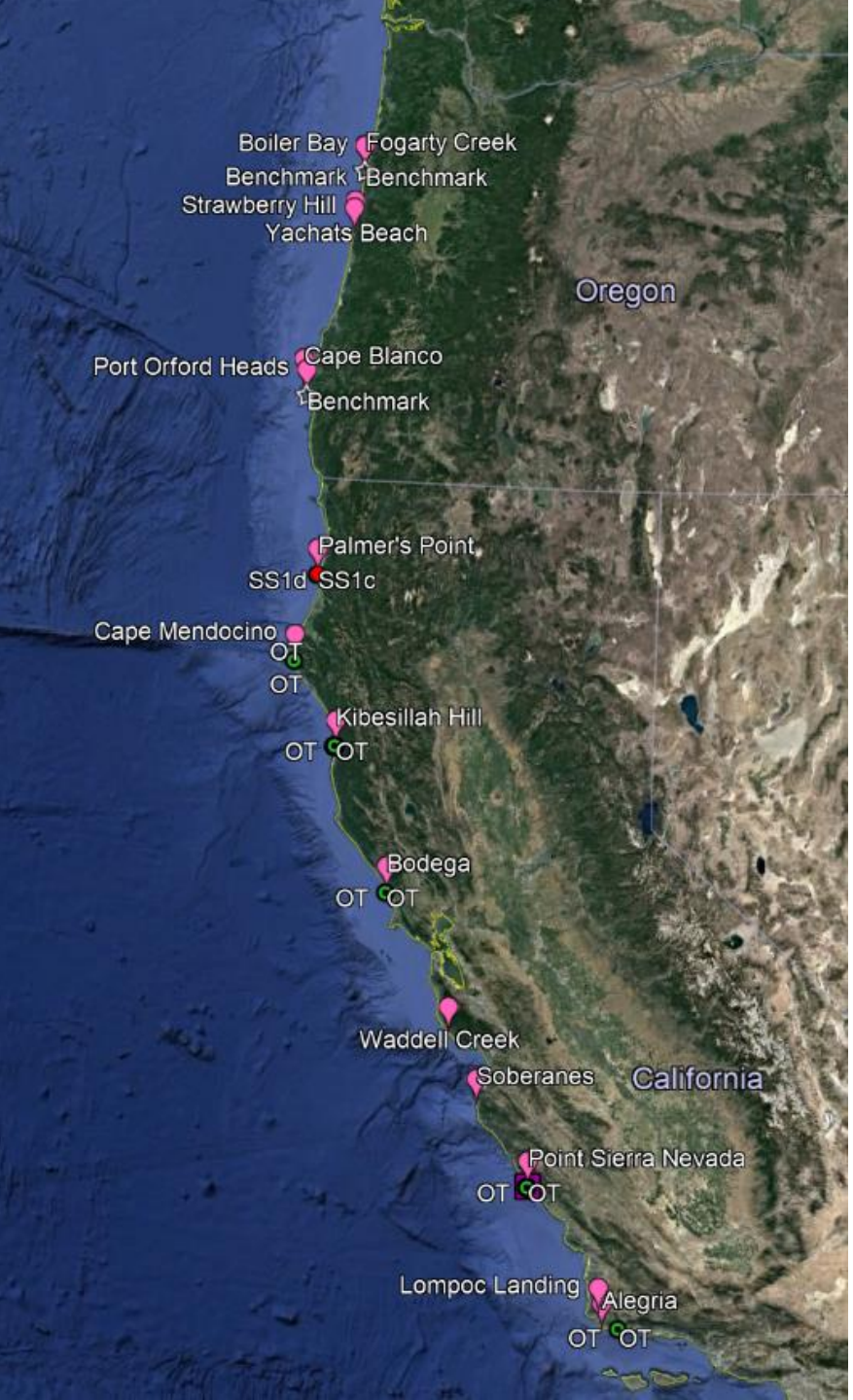
- Facilitation by algae, barnacles
- **Small predators**

Can compensatory predation by *Nucella ostrina* and *Leptasterias spp.* prevent downward spread of mussels into the low zone?

- How does the strength of compensatory predation vary from SoCal to Oregon?

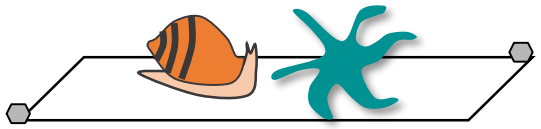
- Hypothesis: higher densities of predator species in OR=increased compensatory predation

- How do recruitment and colonization dynamics vary from SoCal to Oregon over the course of ~16 months?



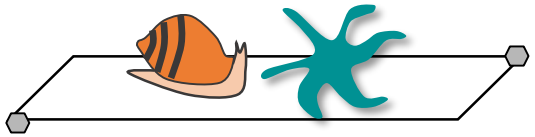
Methods

- 2 plots, 1 fence, 4 cages per site
  - OR: Nucella only, Nucella and Leptasterias, Leptasterias only, no preds (control)
  - CA: Nucella only, no preds (control)
- 15x15 cm cages deployed ~1m under lower limit of mussel bed
- Cleared at experiment start (May 2018)
- Stocked w/preds (site specific density) once prey had recruited
  - OR/NorCal: July 2018
  - CenCal: September 2018 (low recruitment)



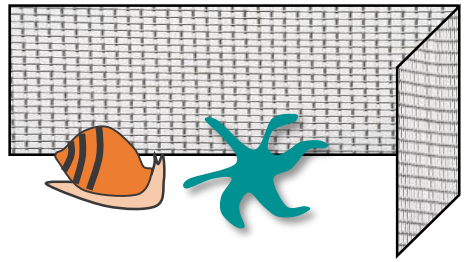
Recruitment plot (cleared ~monthly)

+ Nucella ostrina + Leptasterias



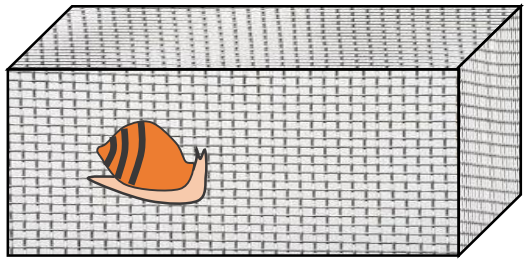
Colonization plot (cleared once)

+ Nucella + Leptasterias



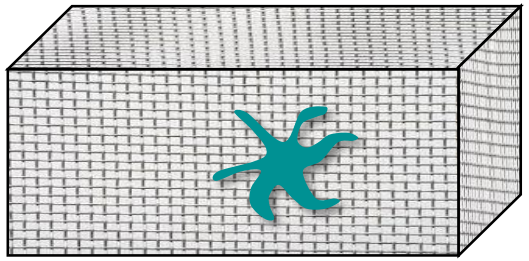
Colonization fence (Cage Control)

+ Nucella + Leptasterias



Nucella only

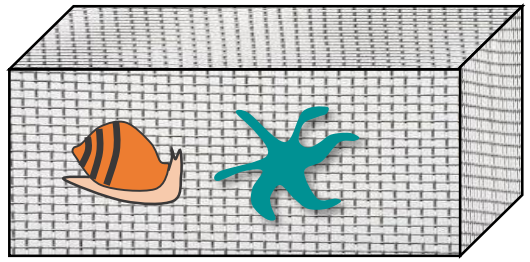
+ Nucella - Leptasterias



Leptasterias only

- Nucella + Leptasterias

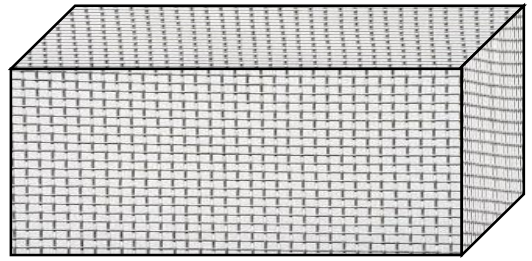
OR only



Both predators

+ Nucella + Leptasterias

OR only



Predator exclusion

- Nucella - Leptasterias

Overarching goal

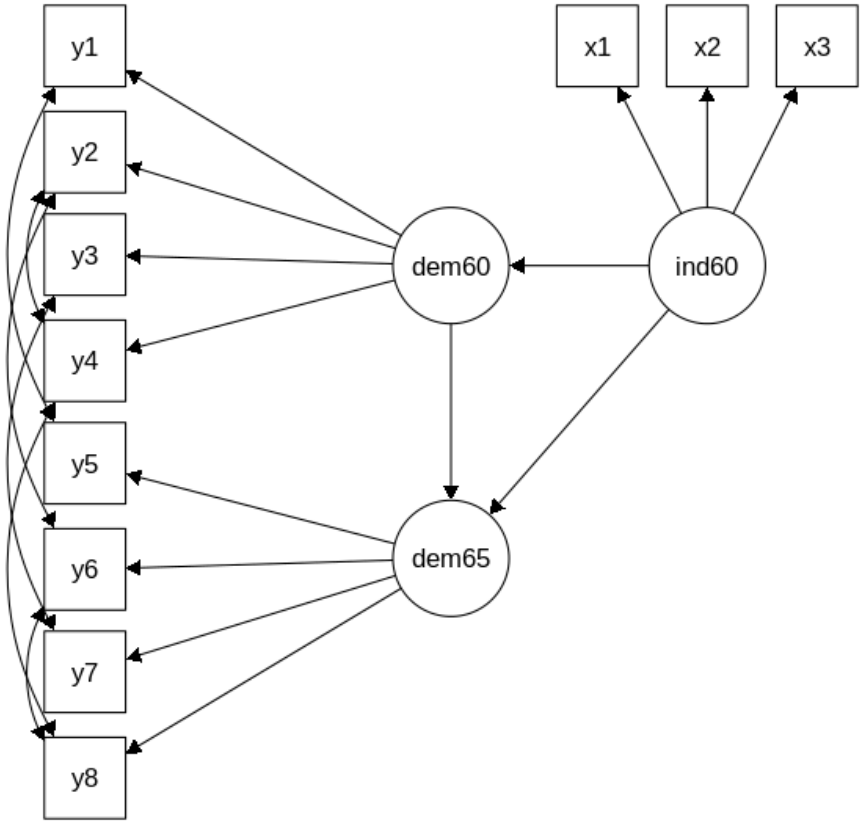
- Build a Structural Equation Model (SEM) – multivariate method that facilitates investigation of direct and indirect interactions

- Investigate mechanisms behind variation in interaction strengths across a wide biogeographic gradient

- Increasing understanding of mechanisms shaping community structure -> increased predictive capacity re: community-level response to climate change

Products of this class

- Generate workflow for vignette in R package lavaan
- Build SEM with this dataset, learn how to use package
- Draw model for my experiment (theoretical framework)



Desired end result

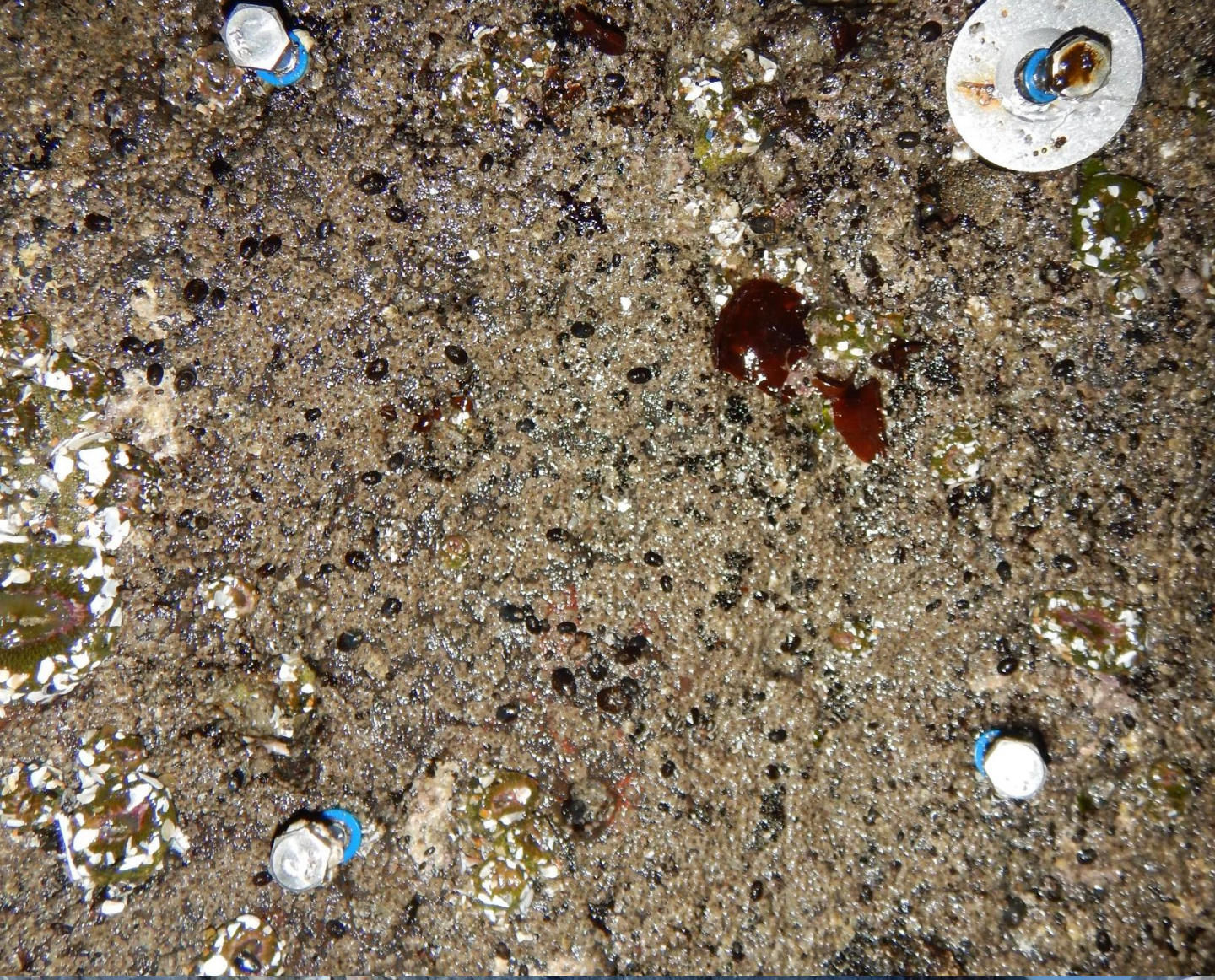
- Workflow for example previously described
- Drawn version of my actual model
- Goal is to have a flexible workflow that I can modify to run my data once I have it

Stretch goal

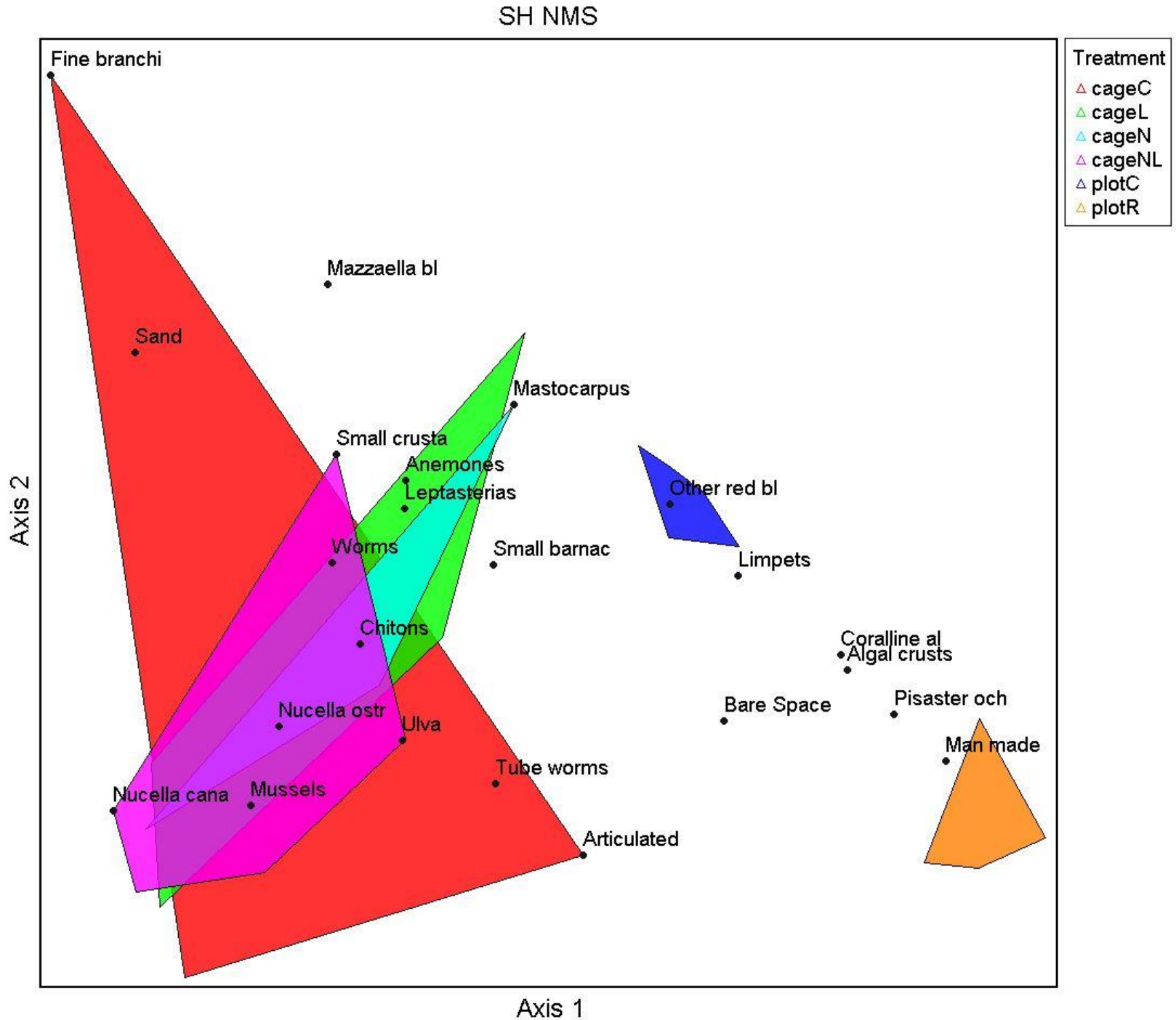
- Developing a theoretical SEM that's good enough to simulate data

- Can use to assess predictive capacity of the model once I have fit it to my actual data + ground truth mechanisms

Questions?



CENTIMETERS
INCHES
Cat. No. 09-016
Fisher Scientific
PRINTED IN U.S.A.


SH NMS
Fine branchi
Mazzaella bl
Sand
Mastocarpus
Small crusta
Anemones
Leptasterias
Other red bl
Worms
Small barnac
Limpets
Chitons
Coralline al
Algal crusts
Nucella ostr
Ulva
Bare Space
Pisaster och
Man made
Tube worms
Nucella cana
Mussels
Articulated
Axis 2
Axis 1
Treatment
cageC
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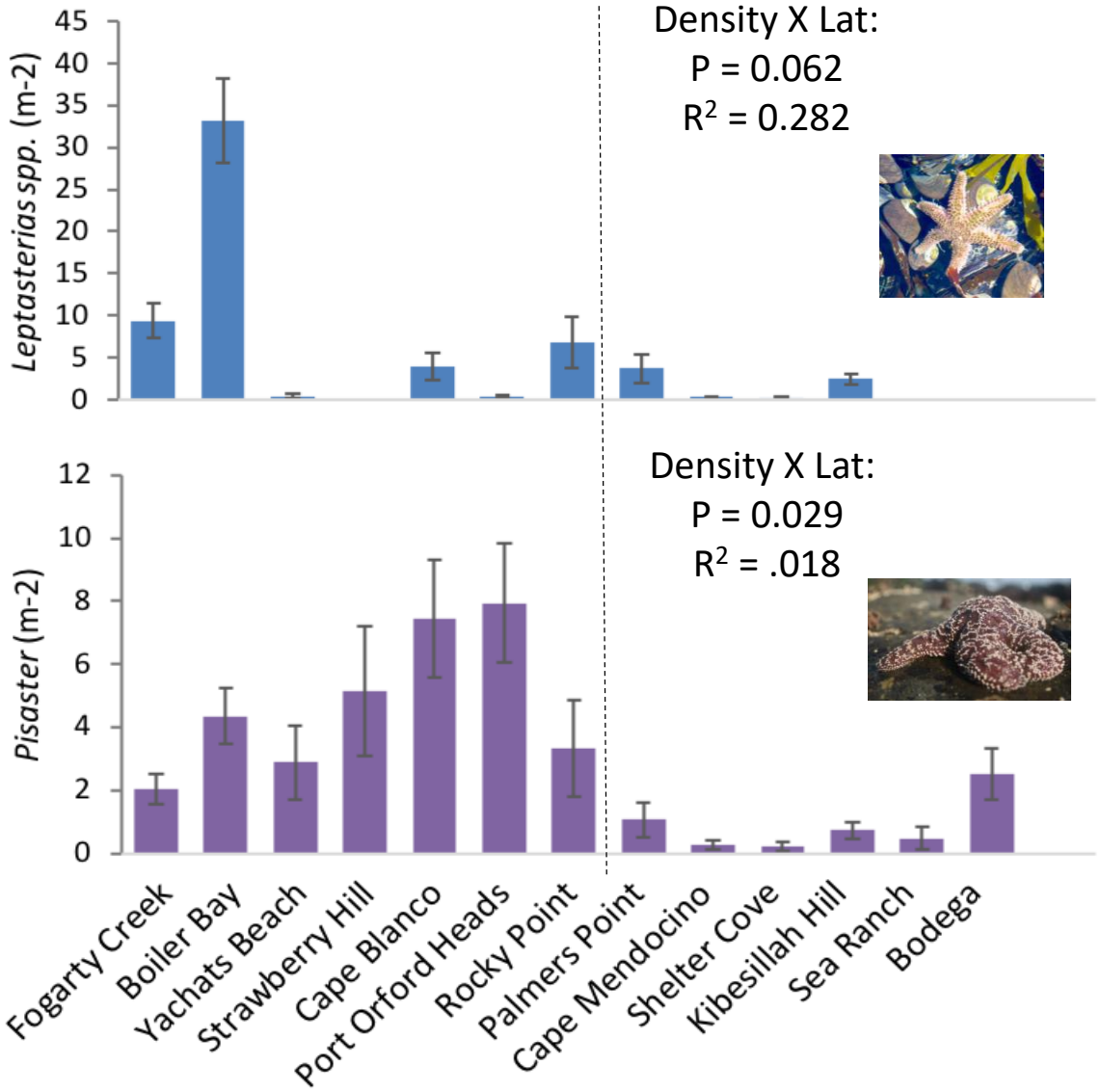
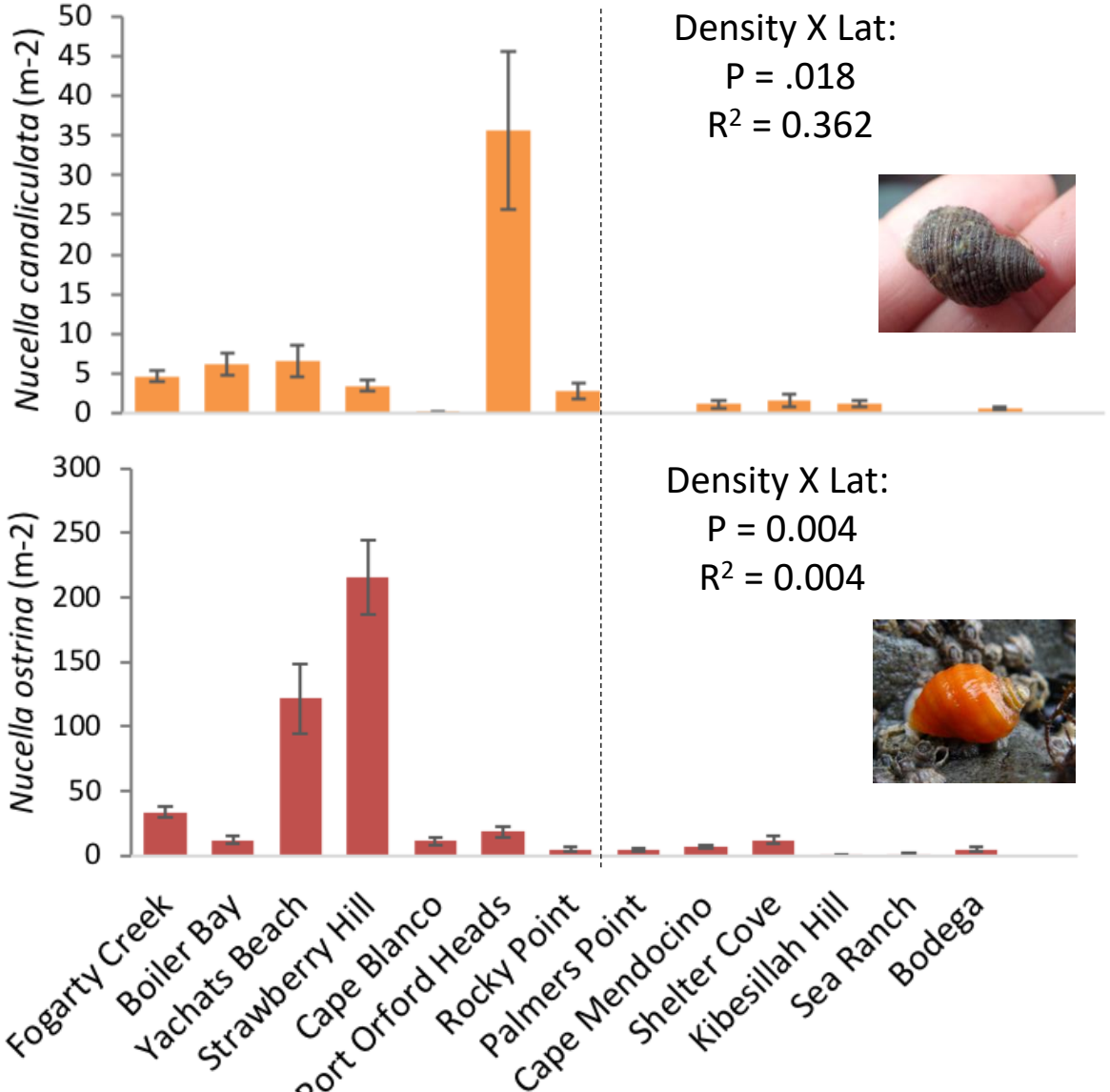
cageN
cageNL
plotC
plotR

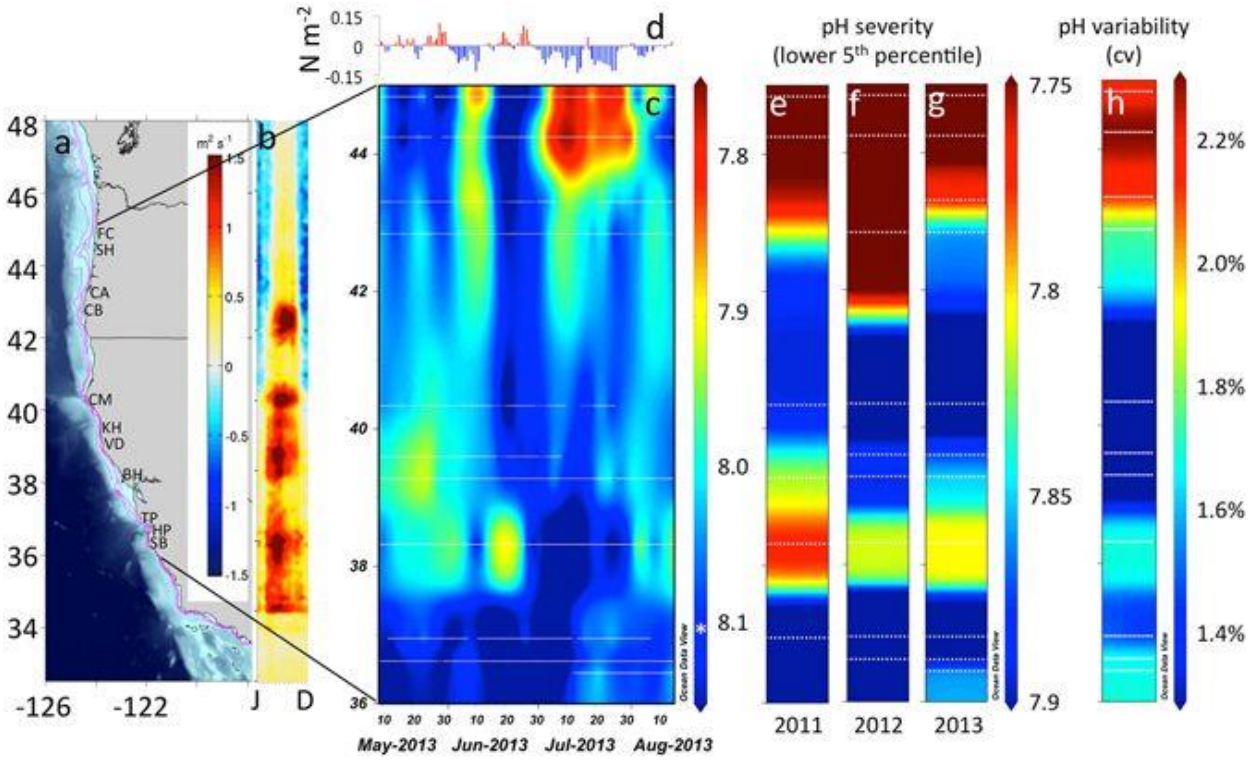
Predator Densities

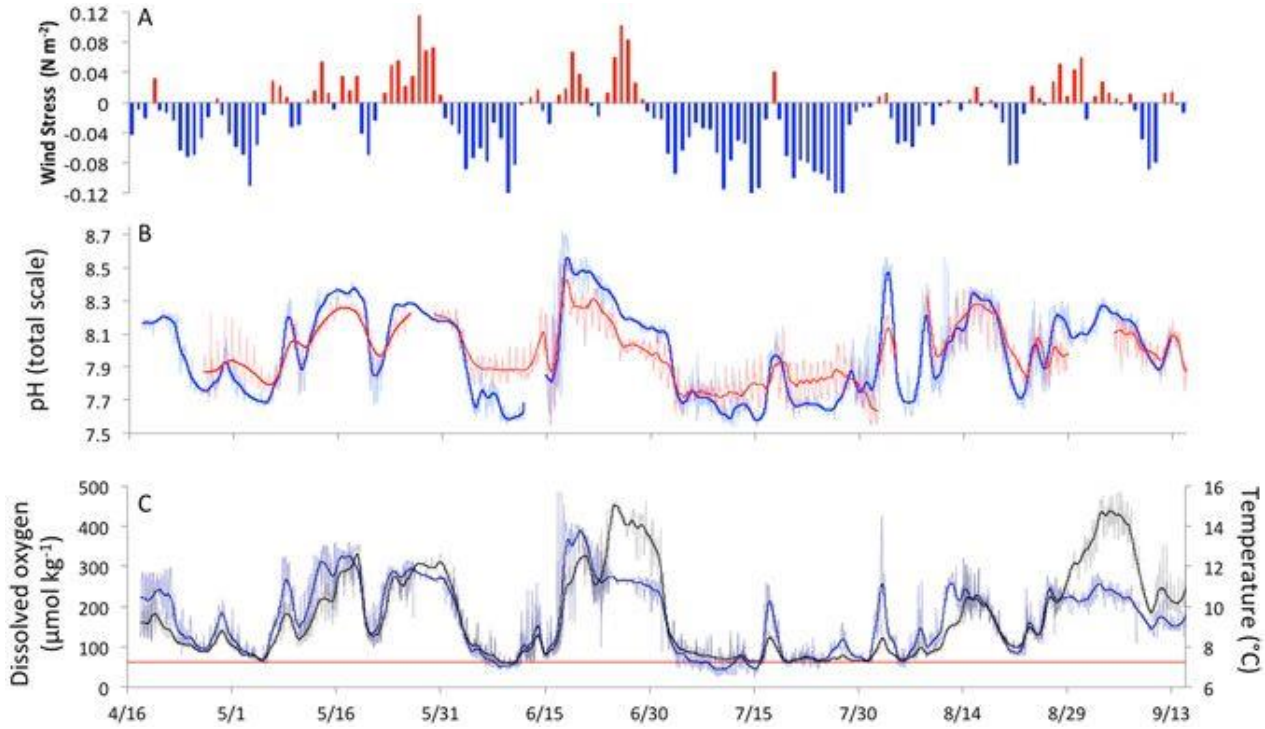




The system is both spatially variable

…and temporally variable





Chan et. al. 2017 *Sci Reports*