STRESSED OUT

Environmental and biotic factors and kelp communities

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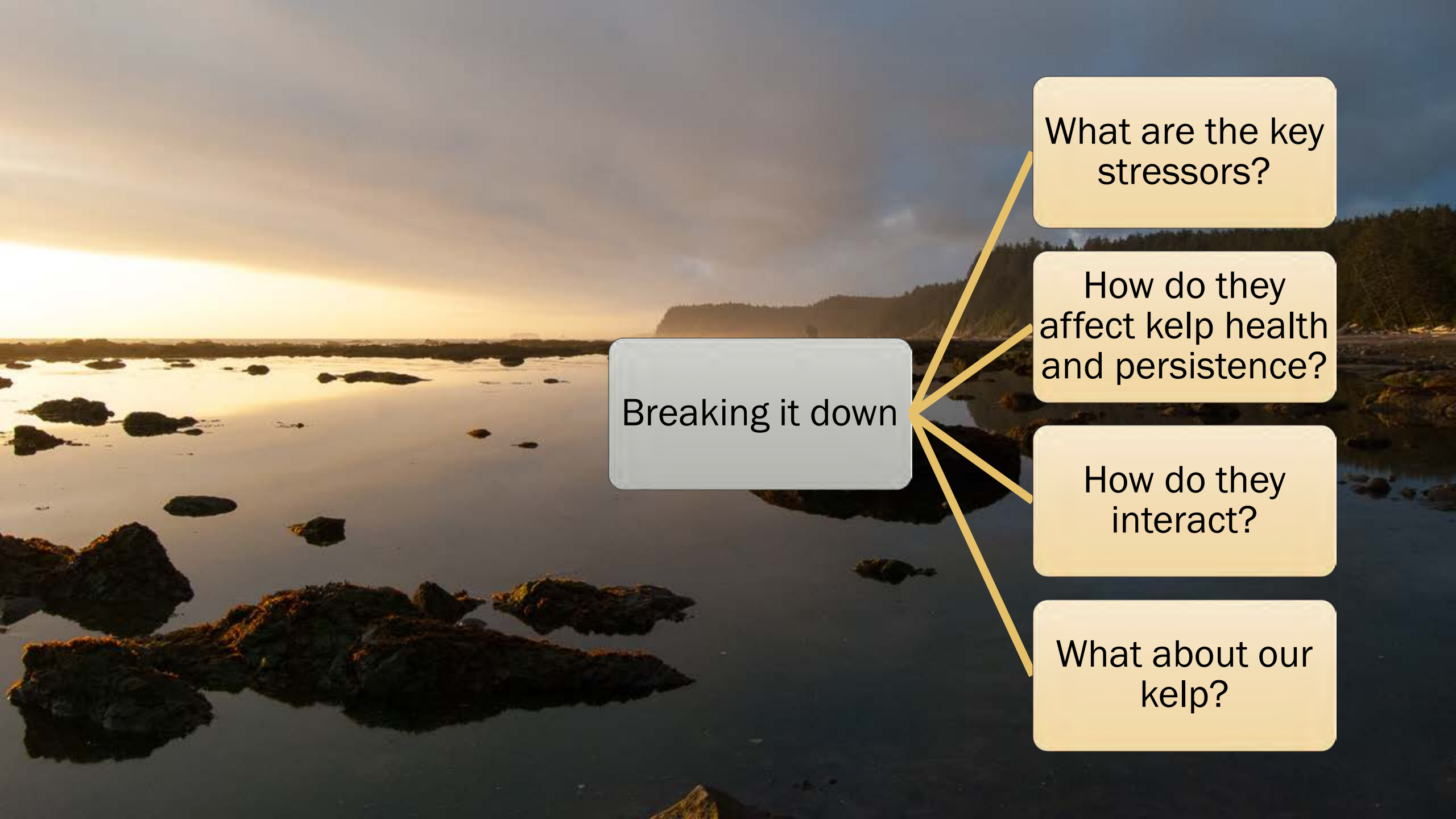
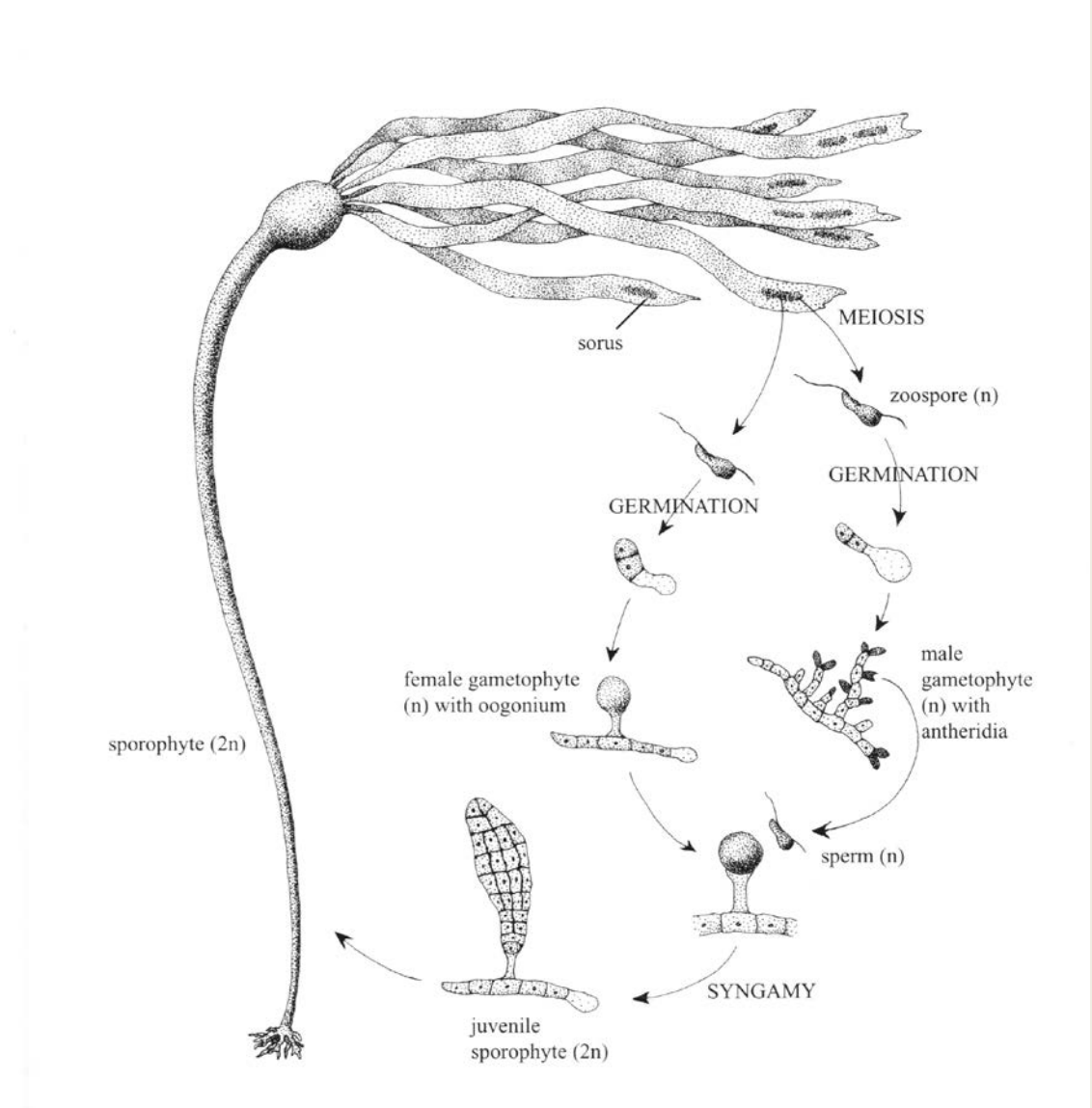
EVERGREEN STATE COLLEGE

MASTERS OF ENVIRONMENTAL STUDIES


Breaking it down
What are the key stressors?
How do they affect kelp health and persistence?
How do they interact?
What about our kelp?

Kelp in a nutshell

- Brown macroalgae
  - *Class Phaeophyceae*
  - *Order Laminariales*
- Heteromorphic life history
- Resilient & disturbance adapted
- Fast growing
- Recruitment limited



Environmental conditions, physical forces and community interactions

Abiotic

- Nutrients
- Light
- Temperature
- Sediment
- Wave action

Biotic

- Predation
- Grazing
- Competition

Synergy!

Grazers love kelp

- Urchin barrens well documented
  - *Result from predator removal*
  - *Boom – bust cycles*
- Snails, common grazer
- Kelp crabs
  - *Prefer Bull Kelp and love fresh greens*

Algae competes for space and light

- Species can block recruitment of other species.
  - *Especially weedy “turf” algae.*
- Timing of recruitment influences light availability

Light

- **Irradiance:** A measure of photosynthetically availability energy
- **Photoperiod:** hrs of daylight
- Total quantity of light most important factor for recruitment

Image Courtesy: Flickr.com, Heath Aleiske

Germination, reproduction and sporophyte growth need different amounts of light

- Different across genera and between species.
- Compensation vs. Saturation
- 150 – 250 (~10% of total solar irradiance) µmoles for saturation
- 20 (~1% of total solar irradiance) µmoles for microscopic stage saturation
- 2 – 11 µmoles appears to be threshold for compensation

Sediment

- More sediment increases turbidity
- Can be suspended in water column, settled on benthos or smother
- Predicted increases in heavy precipitation events due to climate change

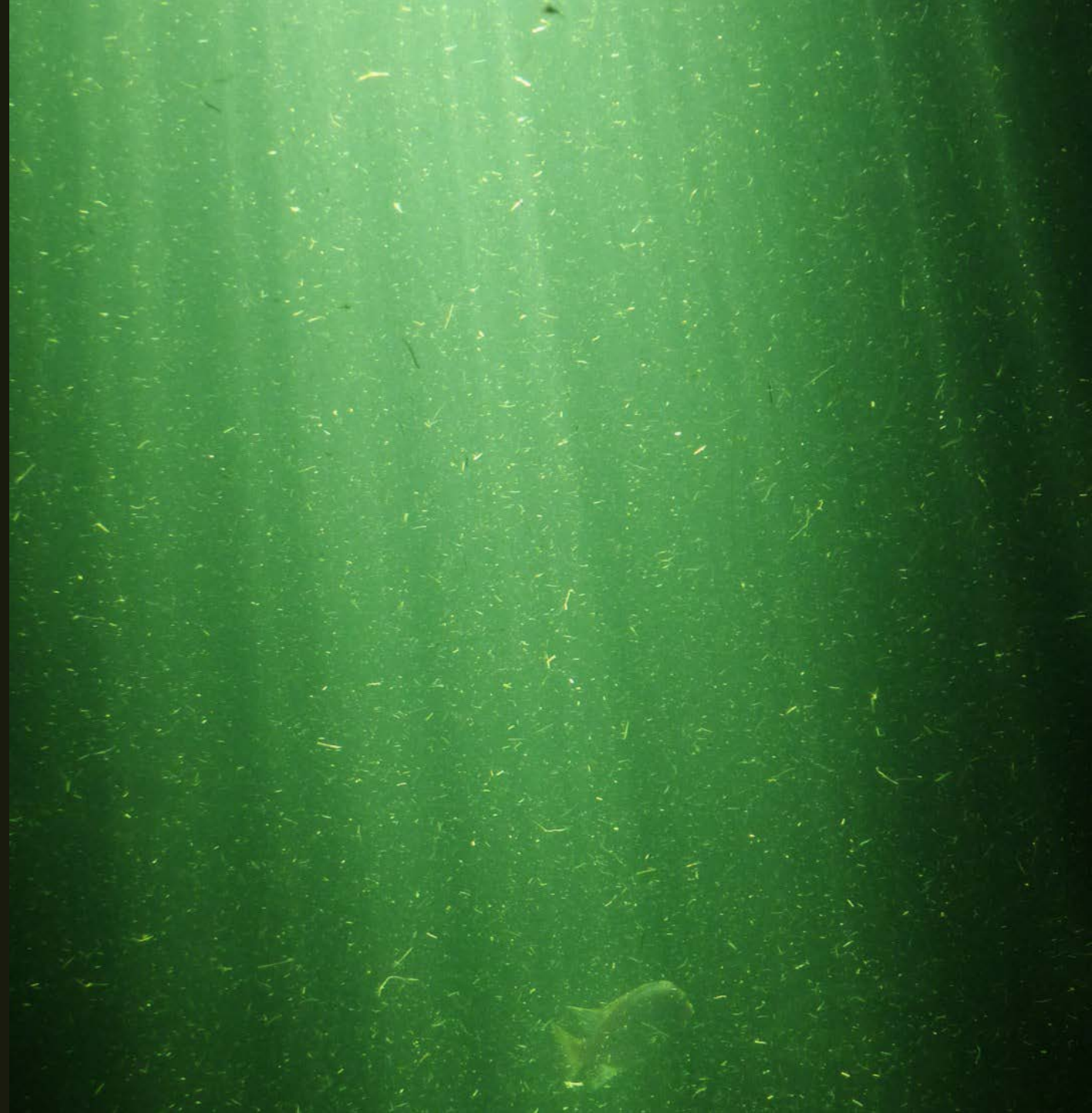
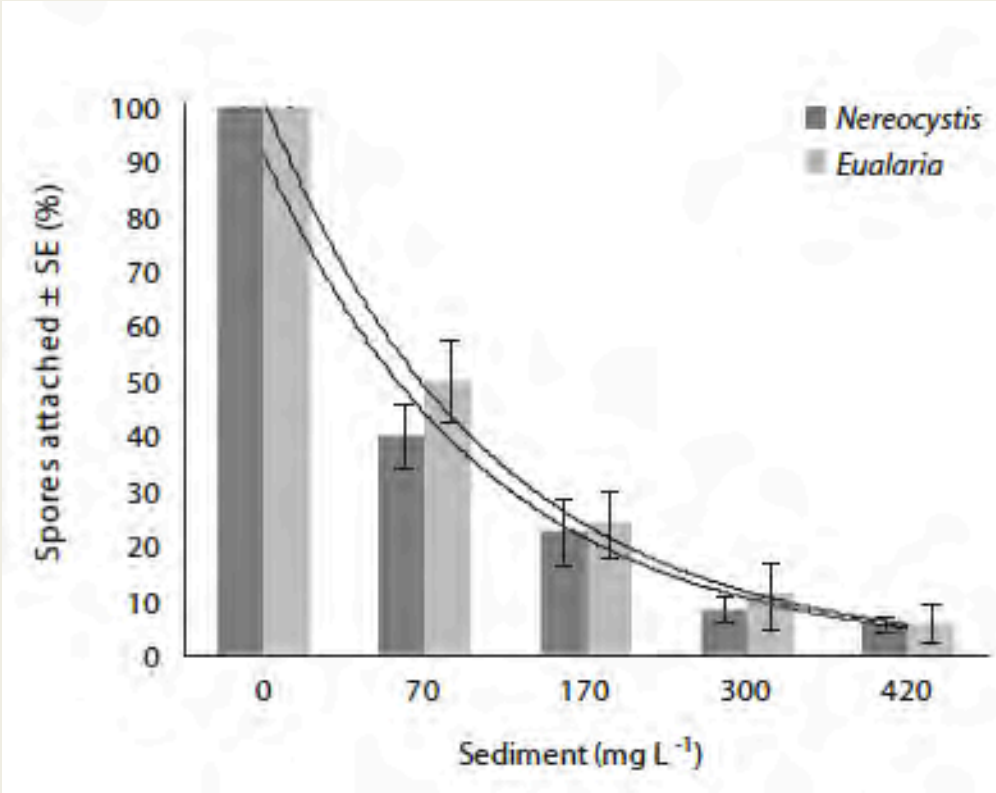


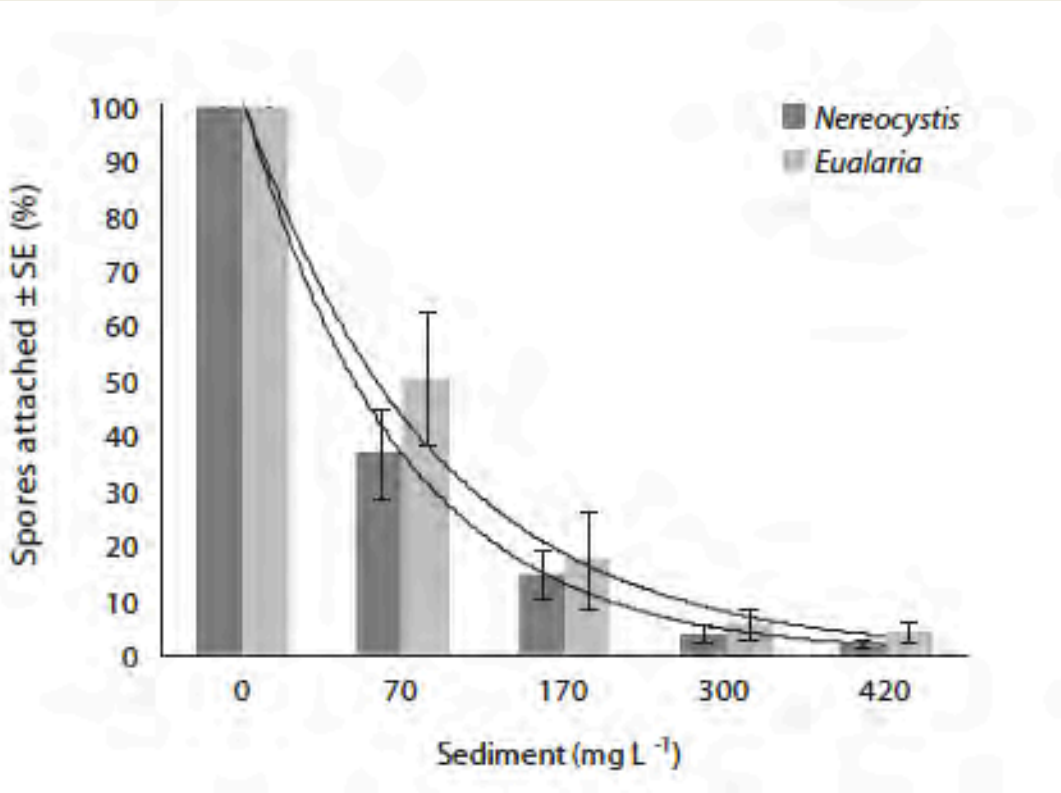
Image Courtesy:Flicker.com, Sarah Klockars-Clauser

Nereocystis

Spore attachment (%). Sediment concentrations based on observations (1-5 mg cm^{-2} day^{-1}) in Katchemak Bay, AK

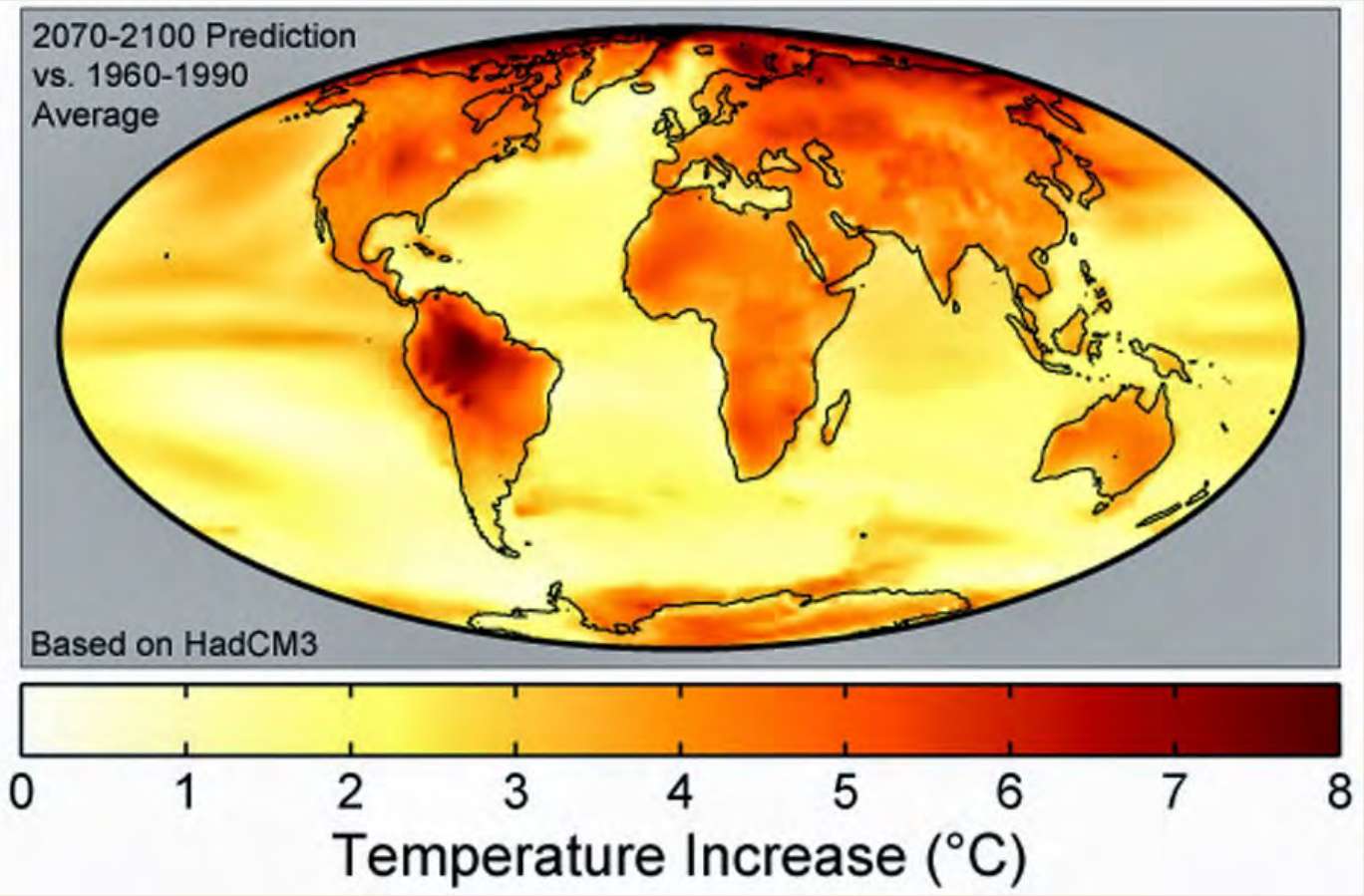


Suspended sediment



Settled sediment

Deiman, Iken & Konar, 2012, *Algae*

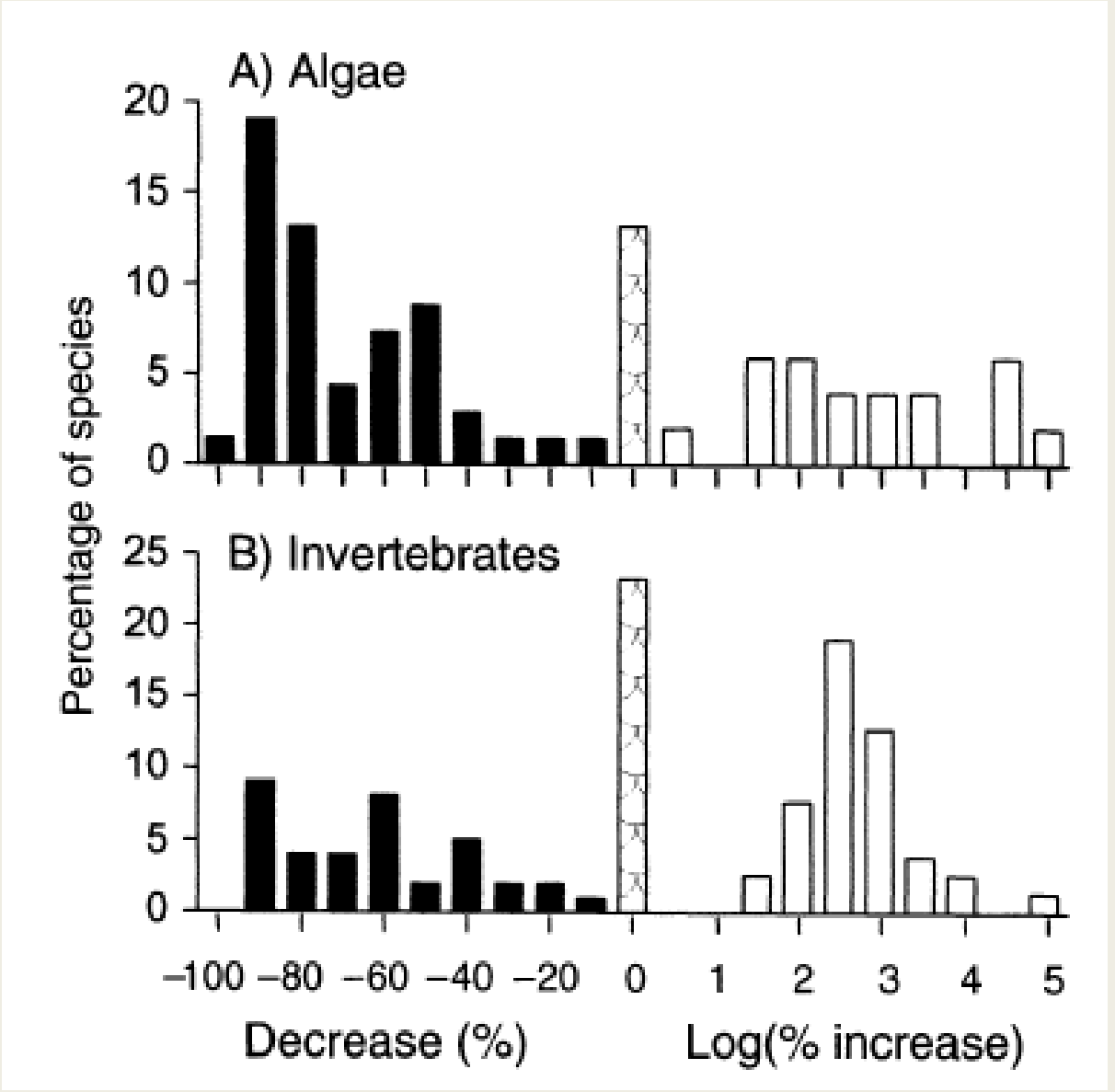


Temperature

- Optimal thresholds look like a bell curve
- High temperatures negatively impact photosynthetic rates

Bull kelp and temperature increases

- 25% plants held at 15.9°C died after 36 days
- 1986 – 1995 mean temp ↑ 3.5°C
- ↓ ~90% *P. californica & L. Setchellii*
- ↓ 97% *Nereocystis*
- ↑ ↑ weedy turfs



Schiel, Steinbeck and Foster, 2016, *Ecology*

Human development

- Changes multiple factors at once.
- Associated with shifts to turf barrens.
  - *Europe*
  - *Australia*
  - *Seattle*

Into the future…

- Observational studies and monitoring important to identify key relationships.
- Need to understand trends in the Puget Sound.

QUESTIONS?