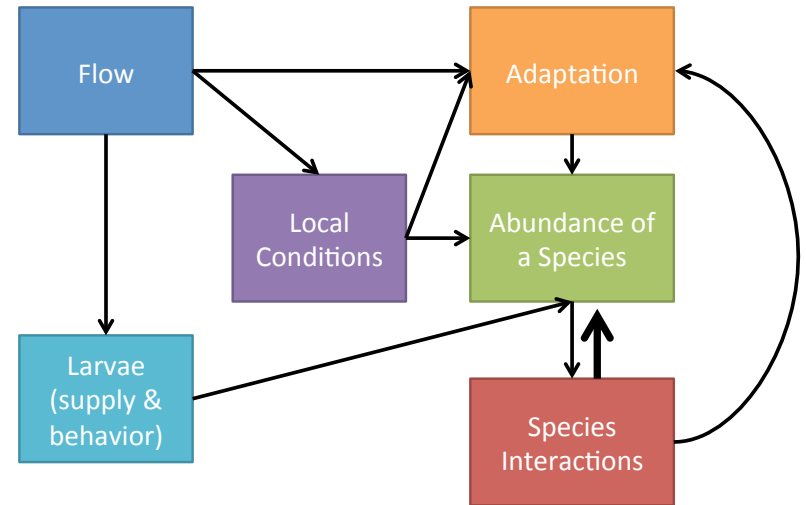


The Story So Far...

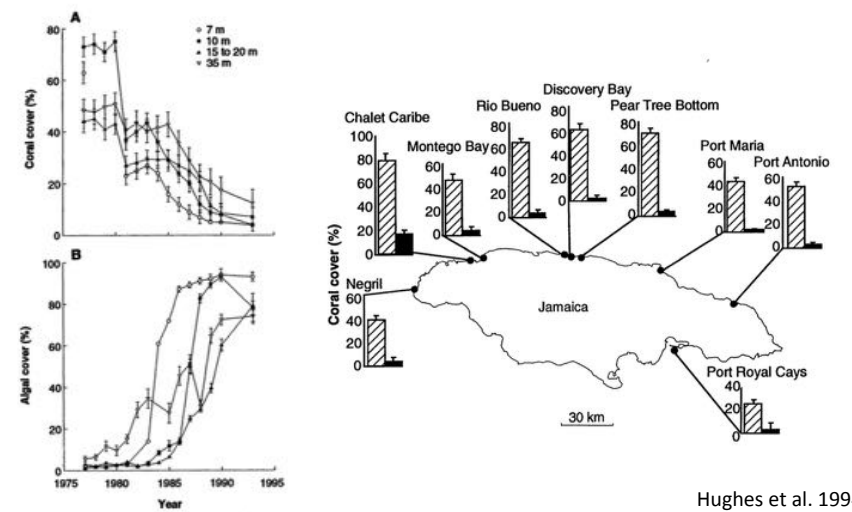


Life or Dinner

1. The importance of consumer pressure
2. Defense! Defense!
3. Inducible Defenses/TMIIIs
4. Evolutionary Implications

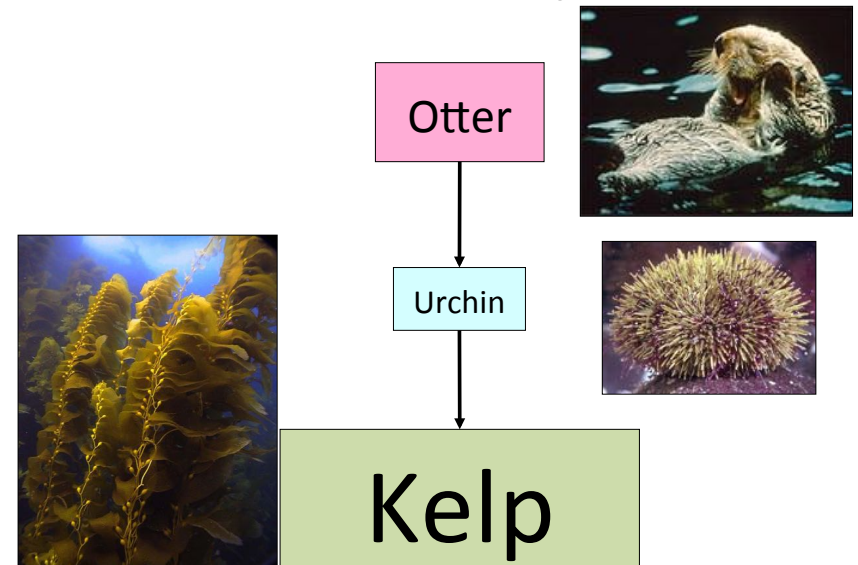


Consequences of Urchin Die-off

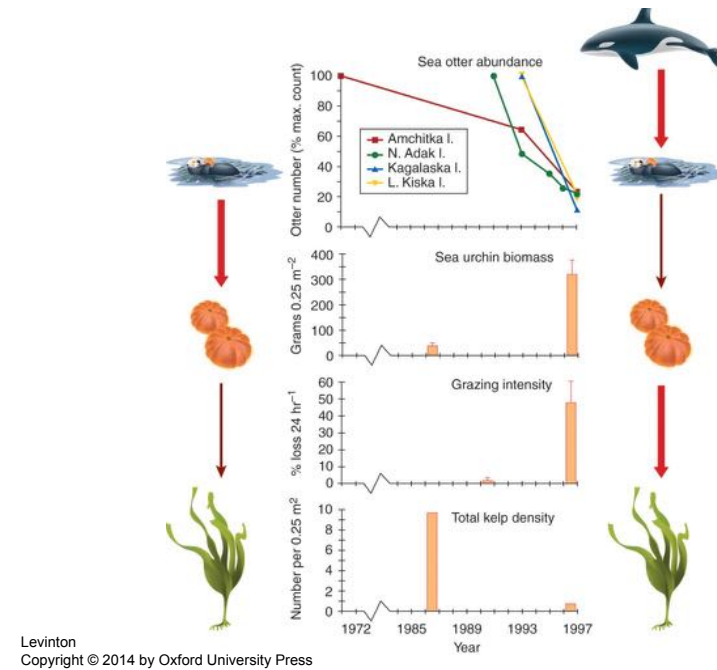
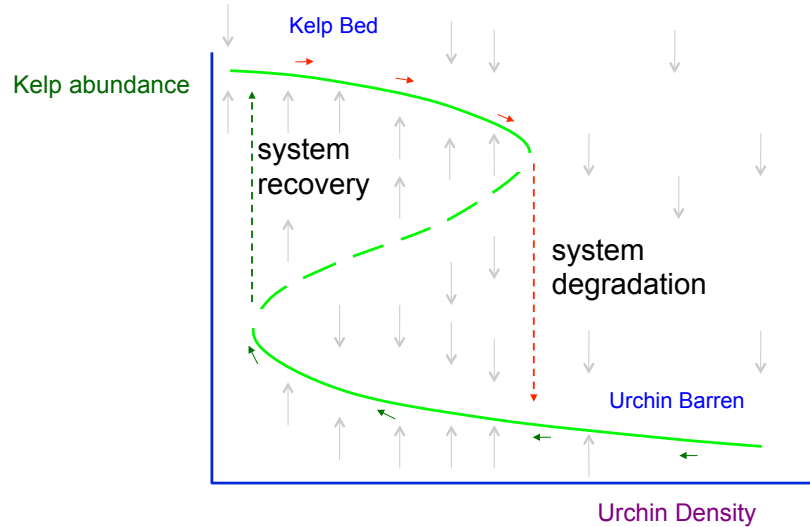




The Classic Marine Trophic Cascade

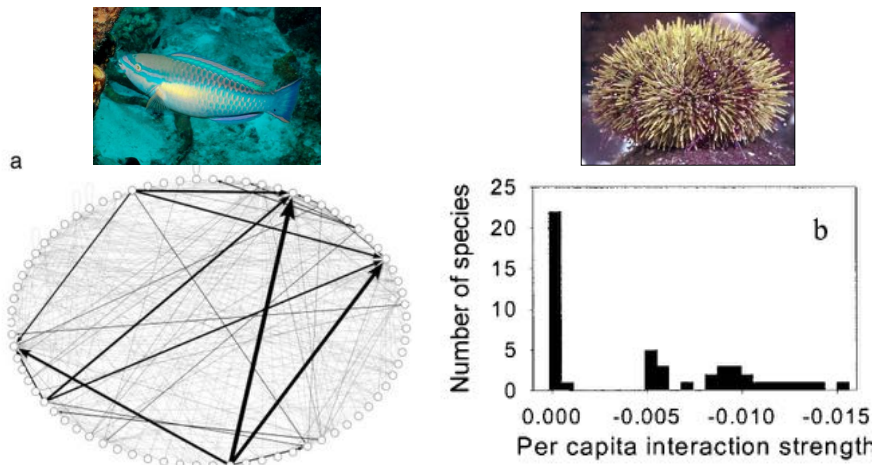


Phase shift & hysteresis



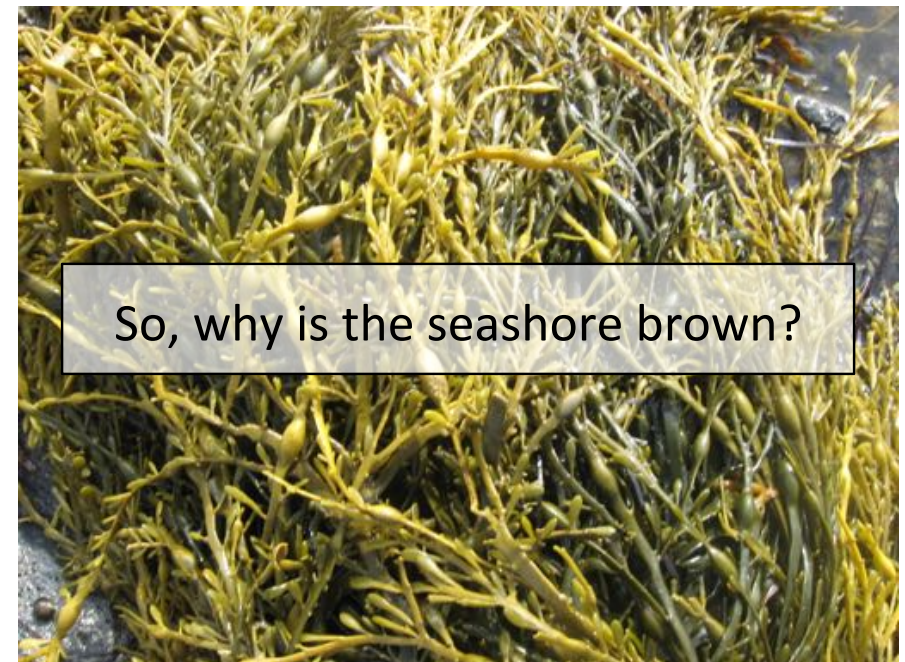
Levinton
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But...Most Species are Not Strong Interactors



Bascompte et al. 2005 PNAS

Sala and Graham 2008 PNAS



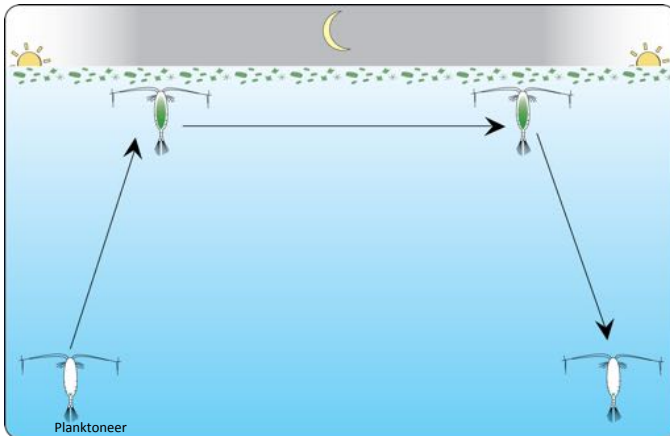
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Mechanisms of Predator Avoidance

- Escape
- Camouflage
- Associational Defense
- Physical Defenses
- Chemical Defense

Escape: Zooplankton Vertical Migration



Consequences?

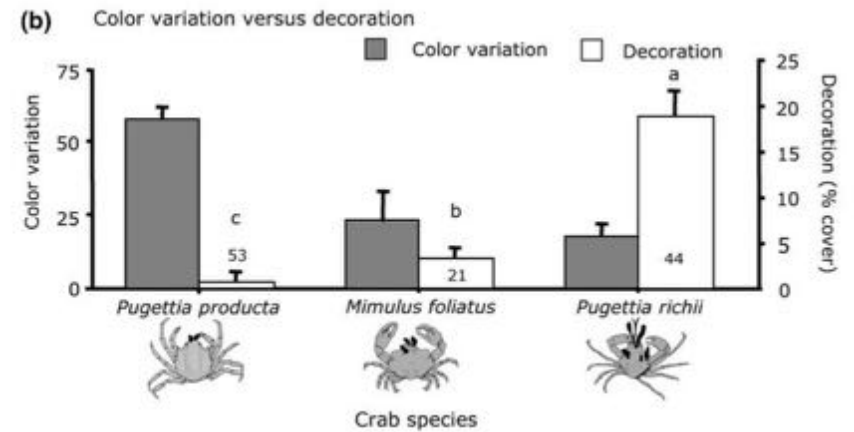
Camo-Crabs!



Adaptation Matters

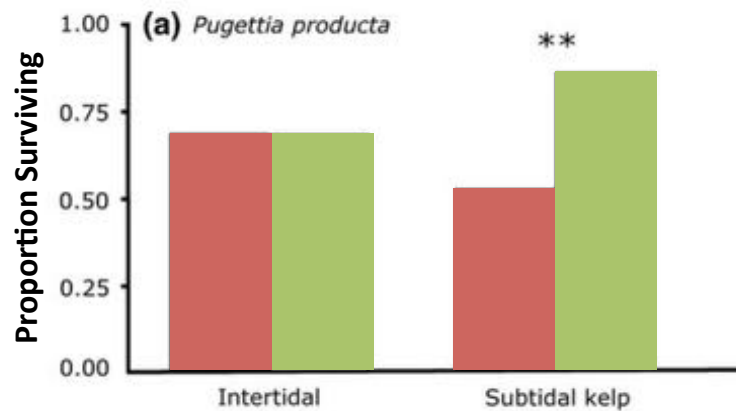


Multiple Strategies Possible



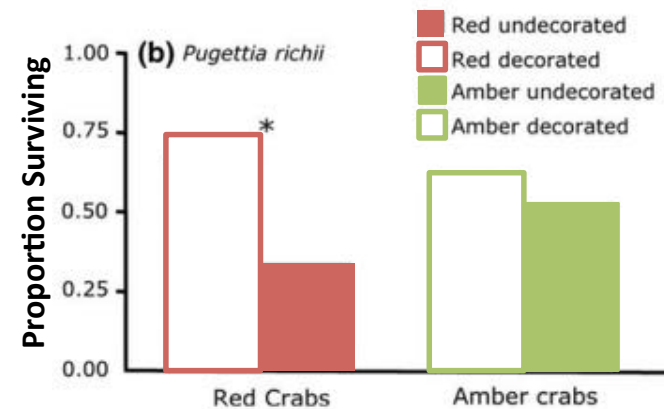
Hultgren and Stachowicz 2008

Strategies are Adaptive: Color Changer



Hultgren and Stachowicz 2008

Strategies are Adaptive: Decorator



Hultgren and Stachowicz 2008

The Enemy of your Enemy is your Friend

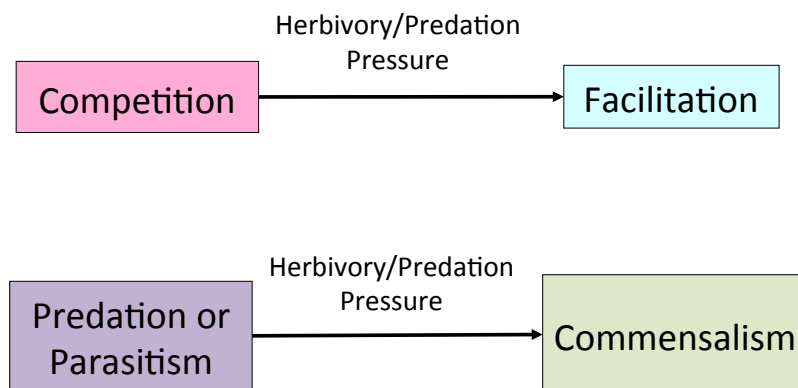


Gagnon et al. 2006

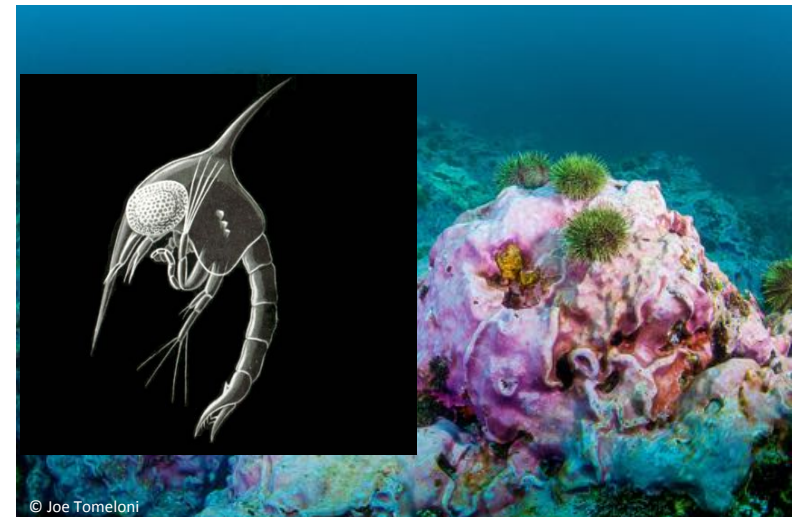
Corals and the Crabs that Love Them

https://www.youtube.com/watch?v=9gpEcFrgE_U

The Enemy of your Enemy is your Friend



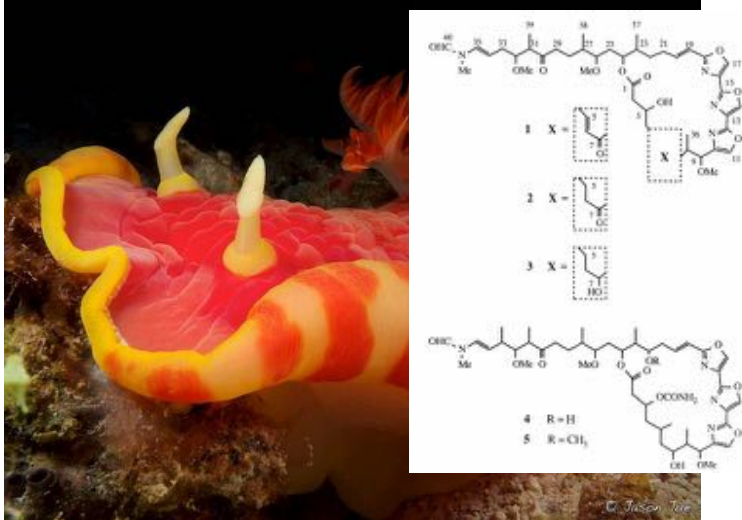
Physical Defense: Structure



© Joe Tomeloni

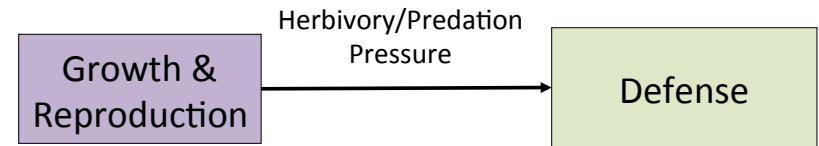
Costs versus Benefits?

Better Living through Chemistry



Pawlik et al 1988

Why isn't everyone defended?



Life or Dinner

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Inducible Defenses: Cost-Savings!



Ungrazed: Few spines, solitary

Grazed: More spines, forms a colony

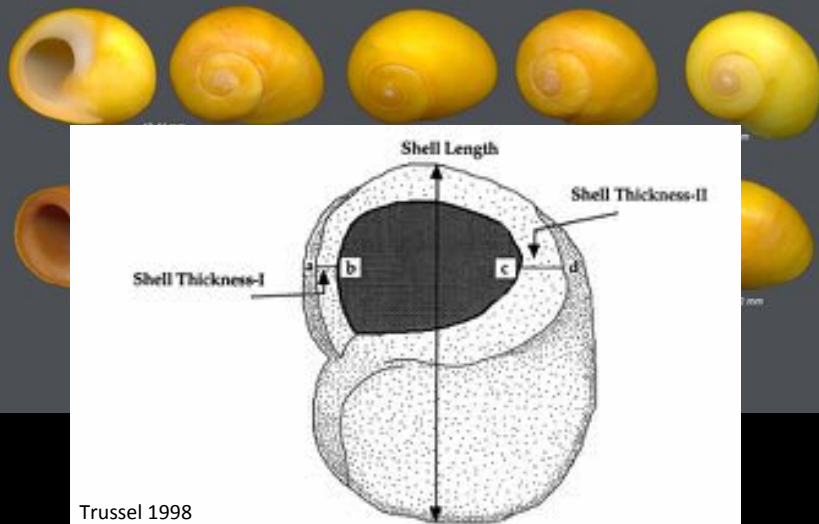
Nature Reviews | Genetics

Spaulding et al 2001



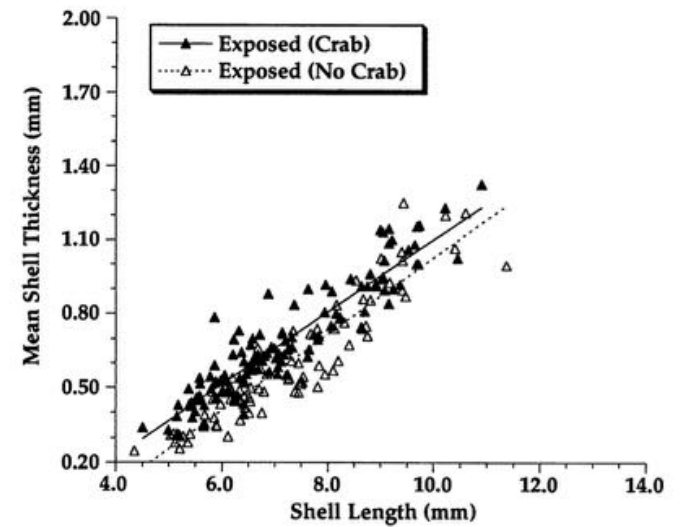
Trussell Lab

Littorina obtusata



Trussell 1998

Crabs Necessary to Induce Growth Changes



Trussell 1996

Bryozoan Spines

<https://www.youtube.com/watch?v=zRWVaKsPLvA>



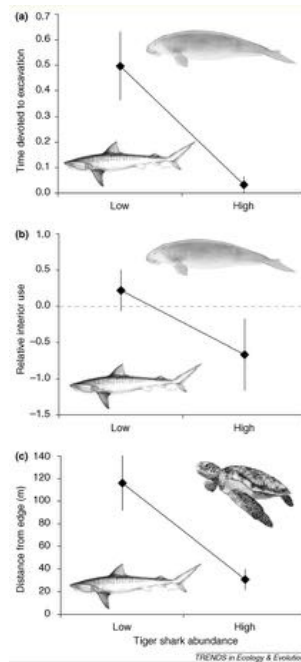
Fortin et al. 2005

Trait Mediated Indirect Interaction

- Change in foraging strategy (BMII)
- Change in foraging rate
- Change in habitat use
- Change in morphology to protect against predation



Heithaus Lab



Heithaus et al. 2008

Change in Grazing from Just Cue

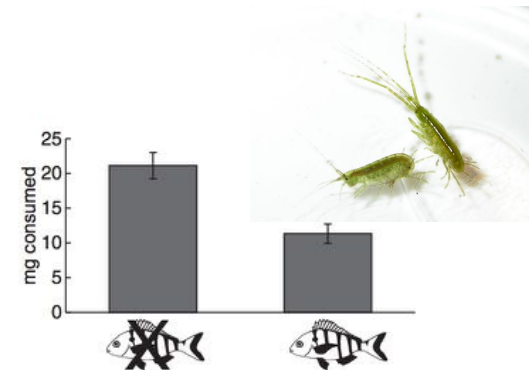
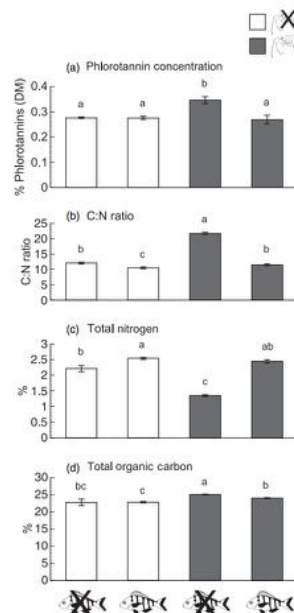


Fig. 1. Amphipod grazing rates over 7 days in the presence (+) and absence (-) of olfactory cues from fish (fish icon). ($T = -4.18$, $P < 0.001$) Mean consumption (mg) \pm SE are shown.

Reynolds and Psotka 2011

Effects go Beyond Biomass of Algae

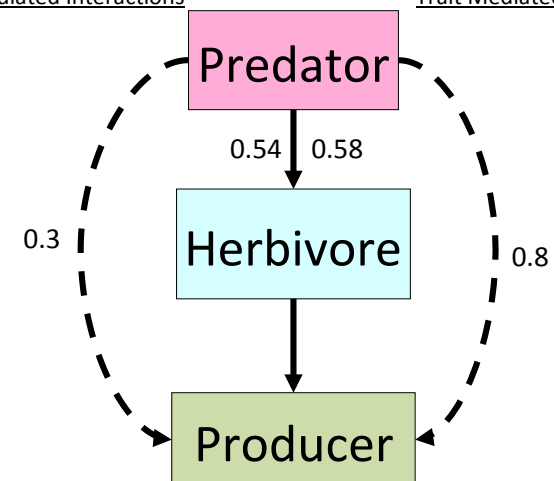


Reynolds and Psotka 2011

TMIIs Amplify As Opposed to DMIs

Density Mediated Interactions

Trait Mediated Interactions

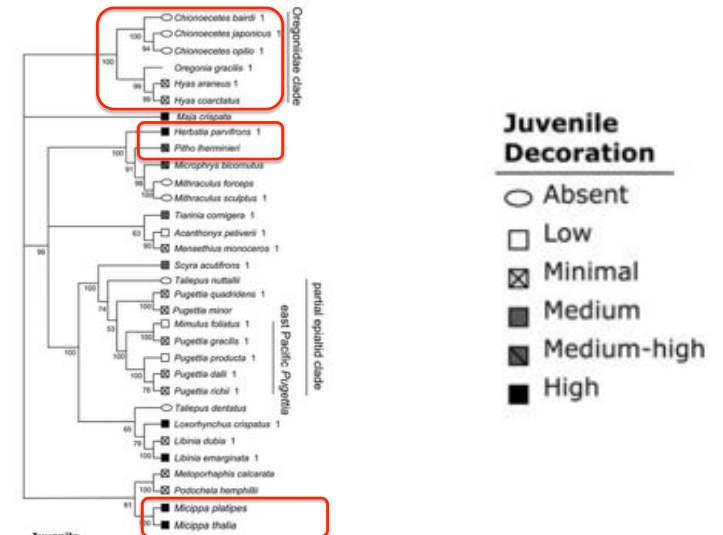


Preisser et al. 2005

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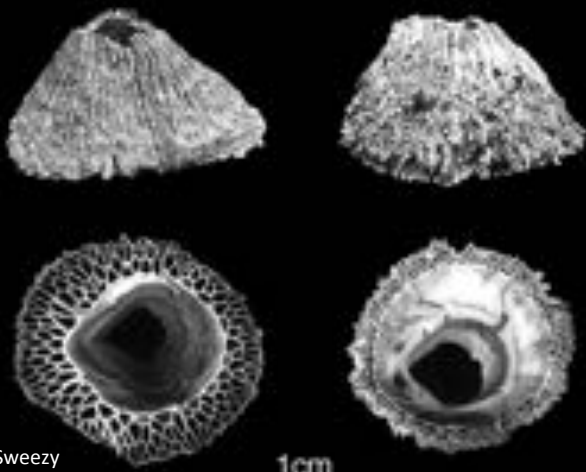
Defenses Evolutionarily Conserved



Hultgren and Stachowicz 2009 Am. Nat.

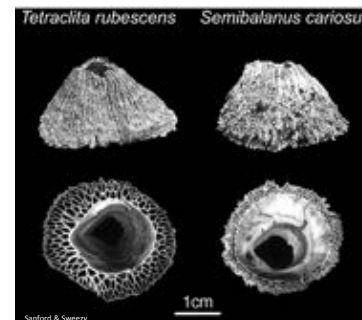
Variation Across Taxa in Traits of Vulnerability

Tetracita rubescens *Semibalanus cariosus*



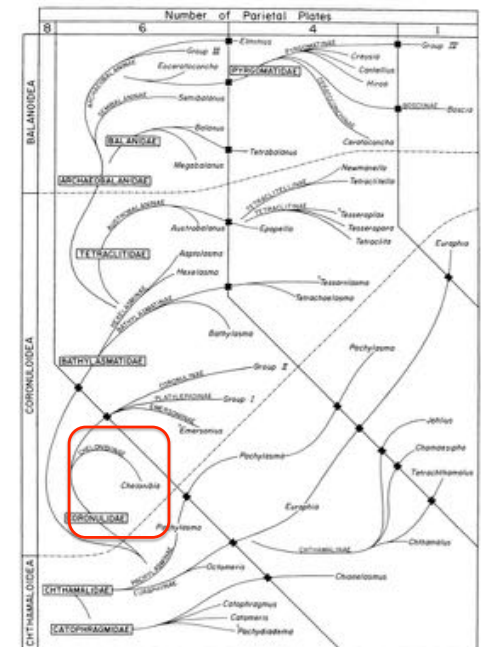
Sanford and Swezey

Barnacles Tend towards Plate Reduction

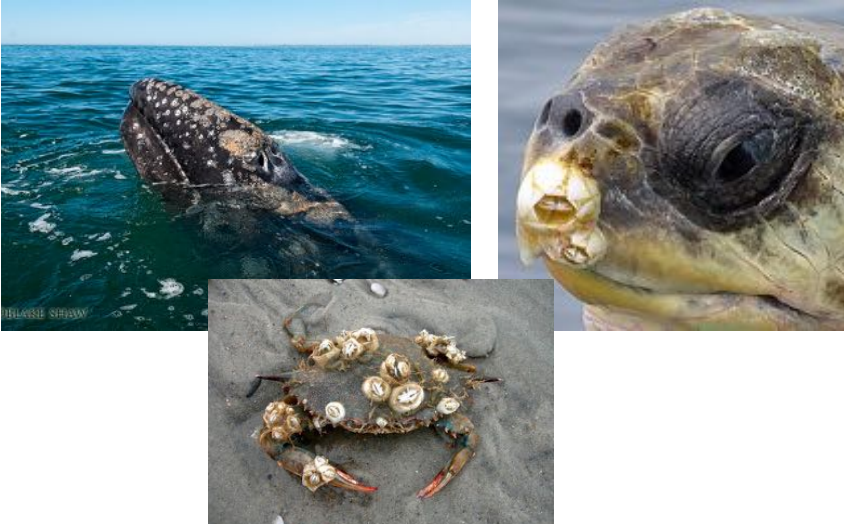


Sanford & Swezey

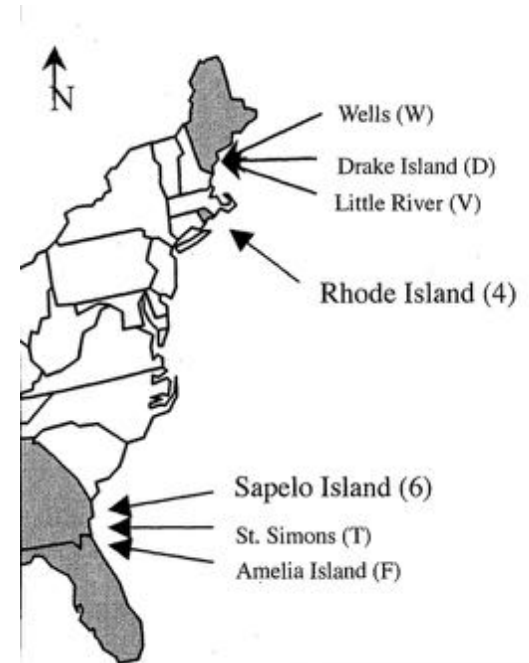
Palmer 1982



Exception Proves the Rule



Evolutionary Signal
in Geographic
Gradients: Local
Adaptation

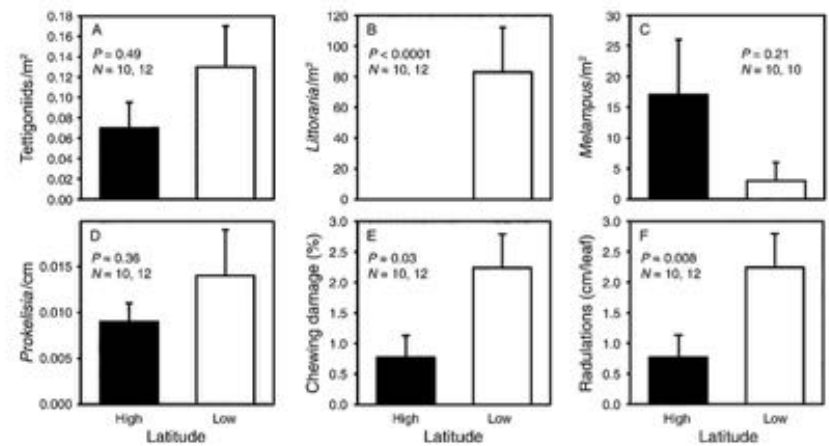


Pennings et al. 2001

Geographic Variation in Marsh Herbivores



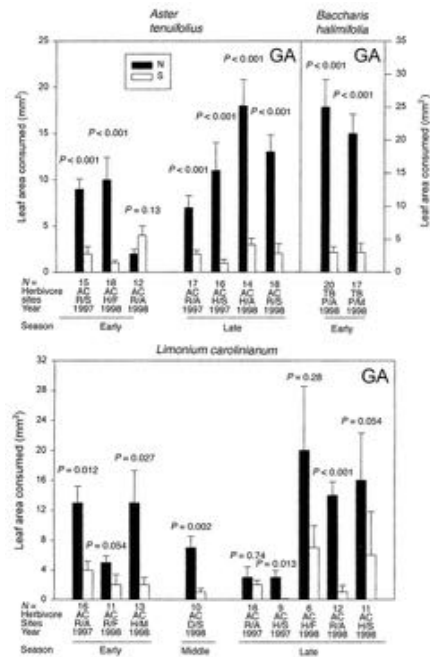
Latitudinal Gradients



Pennings et al. 2009

Herbivory Consistently Higher on Northern Samples

Pennings et al. 2001



What does playing defense matter?

