Competition

Key concepts

- Classification of species interactions
- Ecological niche (barnacles)
- Exploitative competition (diatoms and mud snails)
  - R* Theory
- Interference competition (shore crabs)
  - Lotka-Volterra Theory

Classes of Interspecific Interactions

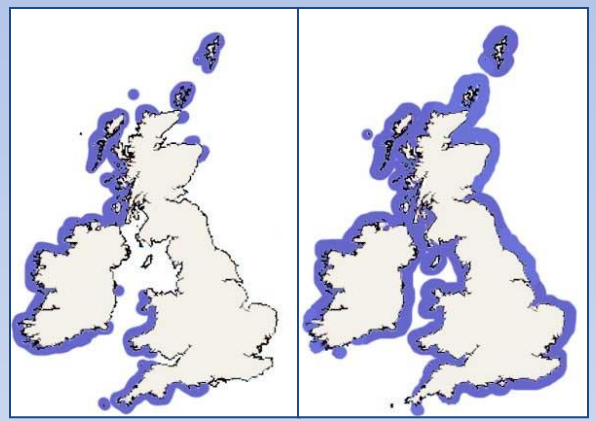
(Species 1/Species 2)	Interaction
(-/-)	Competition
(+/+)	Mutualism
(+/-)	Antagonistic Plant-Herbivore Predator-Prey Host-Parasite

Competition among sedentary, filter-feeding animals

Stellate barnacle *Chthamalus stellatus*

Acorn barnacle *Semibalanus balanoides*

Geographical overlap and spatial segregation



Chthamalus stellatus *Semibalanus balanoides*

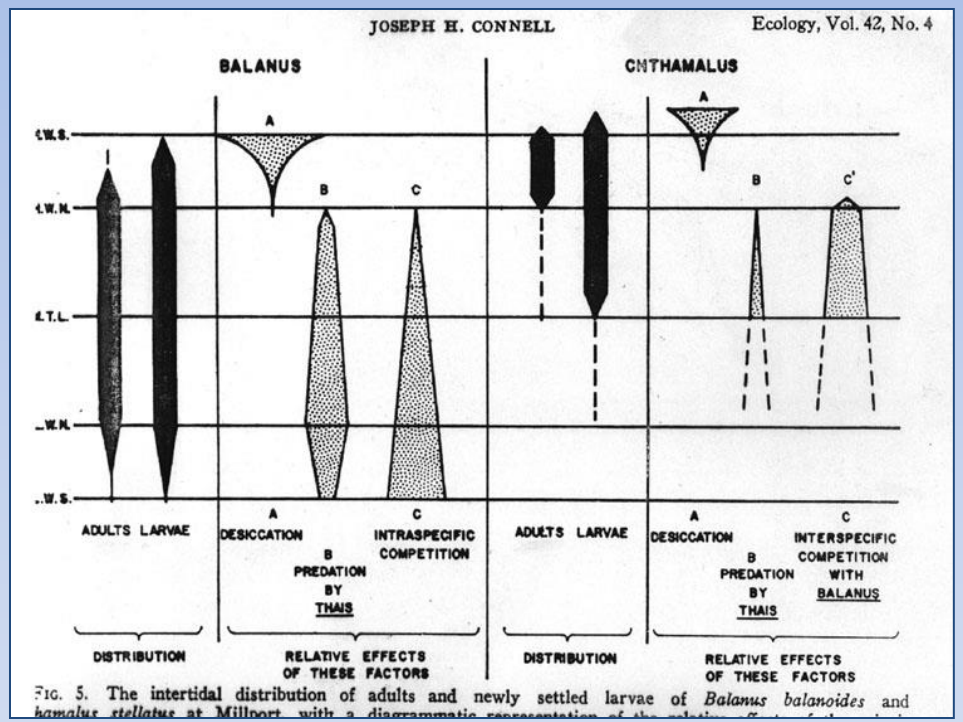
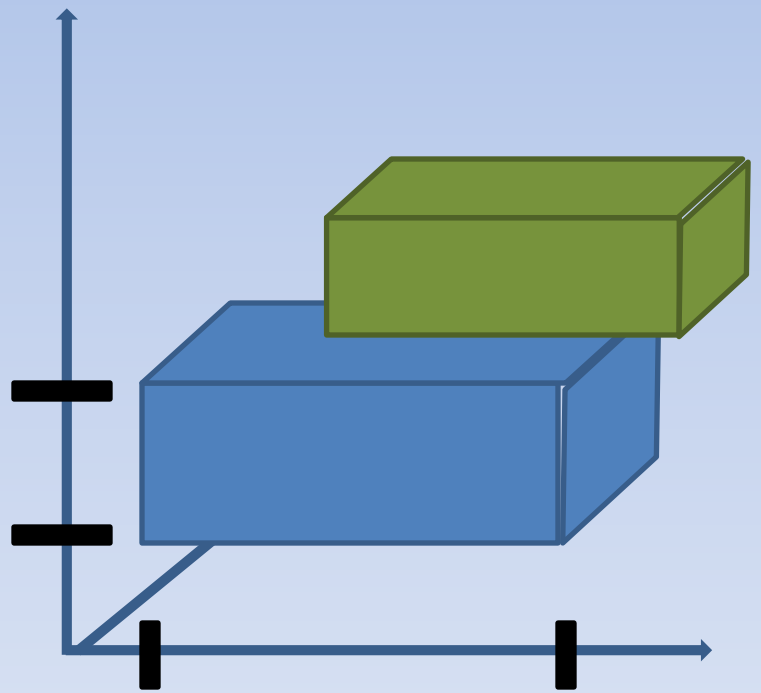


FIG. 5. The intertidal distribution of adults and newly settled larvae of *Balanus balanoides* and *Chthamalus stellatus* at Millport, with a diagrammatic representation of the relative effects of the...

Why do these species spatially segregate?

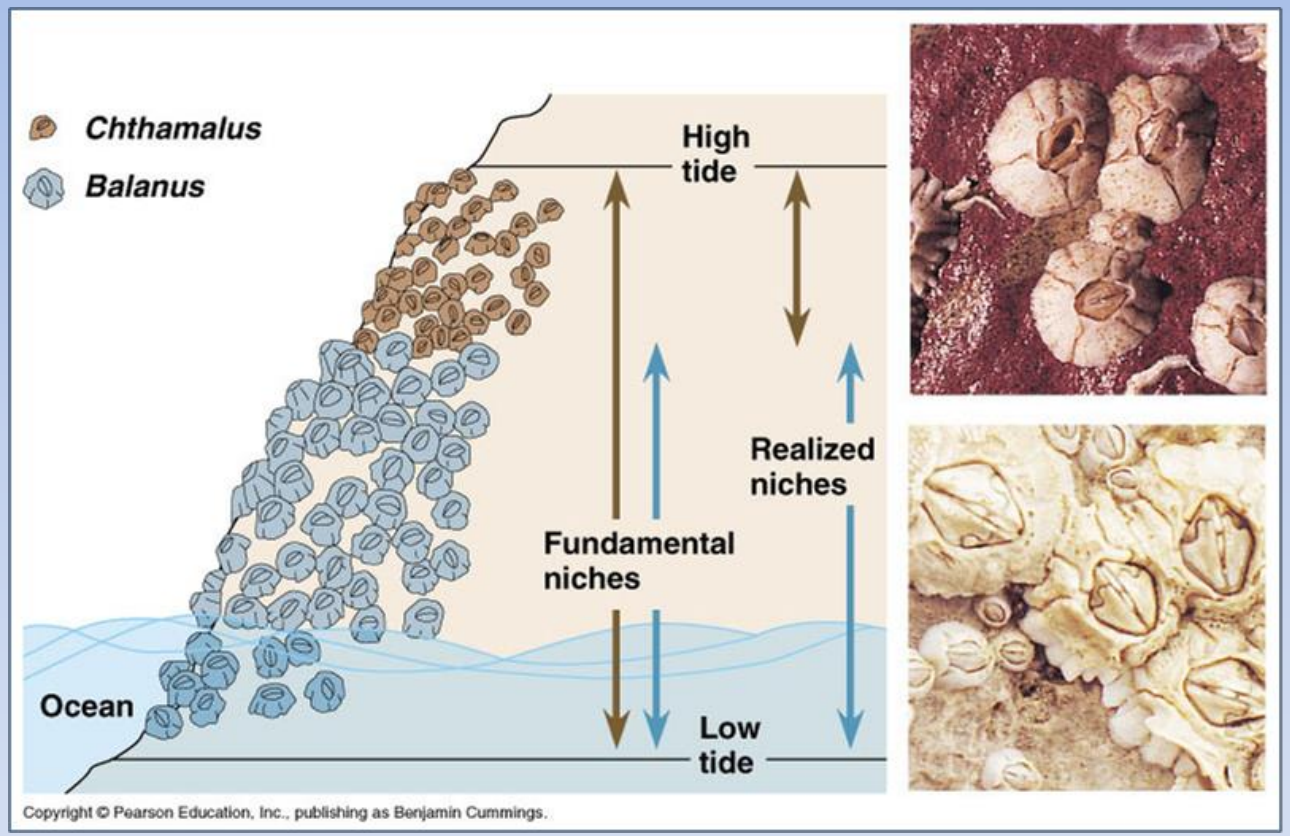
- H_1: Habitat preferences
- H_2: Interactions

Fundamental Niche (def.)
The set of environmental conditions (*n*) under which a population of a species can persist



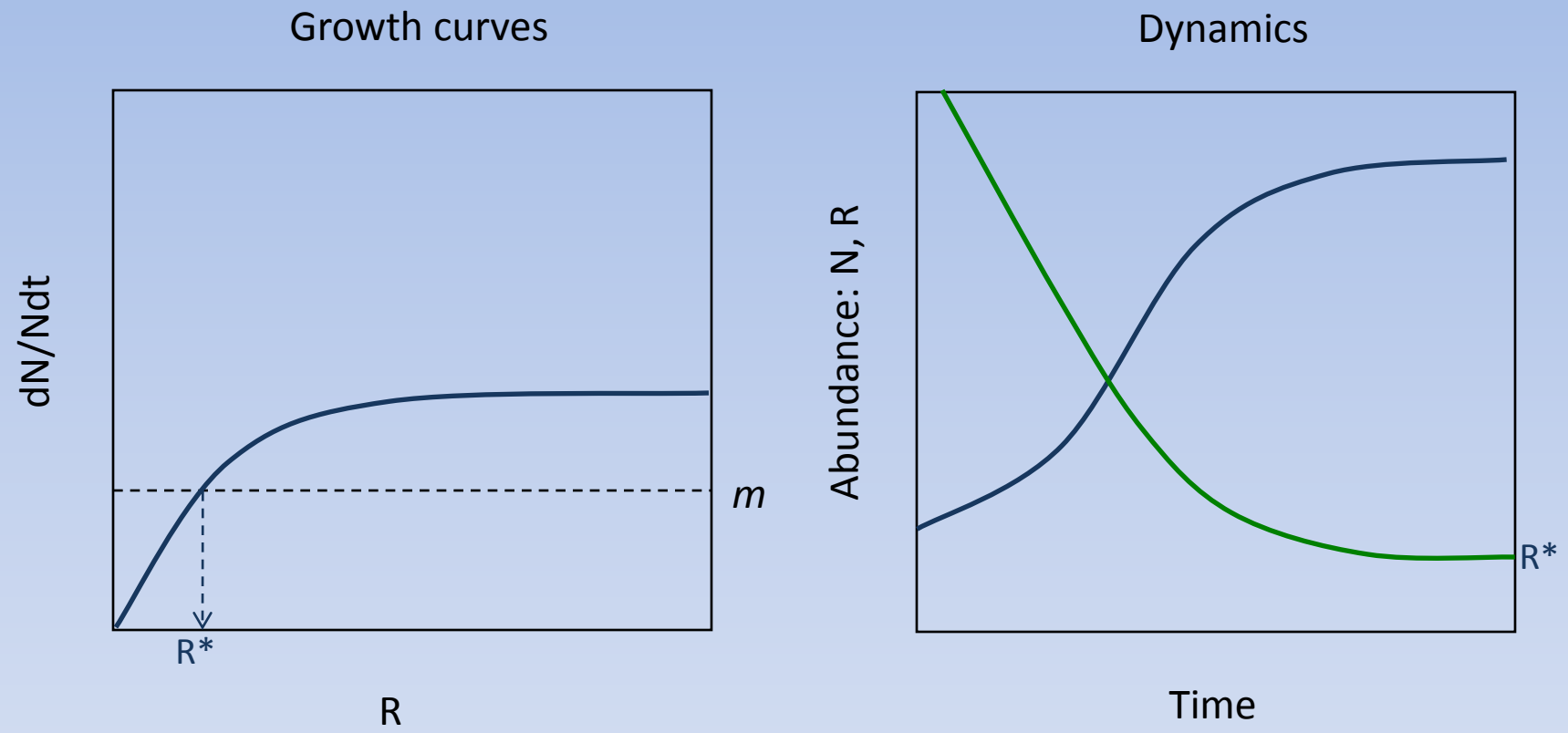
"n-dimensional hypervolume"

Exploitative Competition for Resources



Realized Niche (def.): That portion of the set of environmental conditions in which an organism can survive in the presence of competition, or that portion actually occupied; a subset of the fundamental niche.

Resource Competition Theory



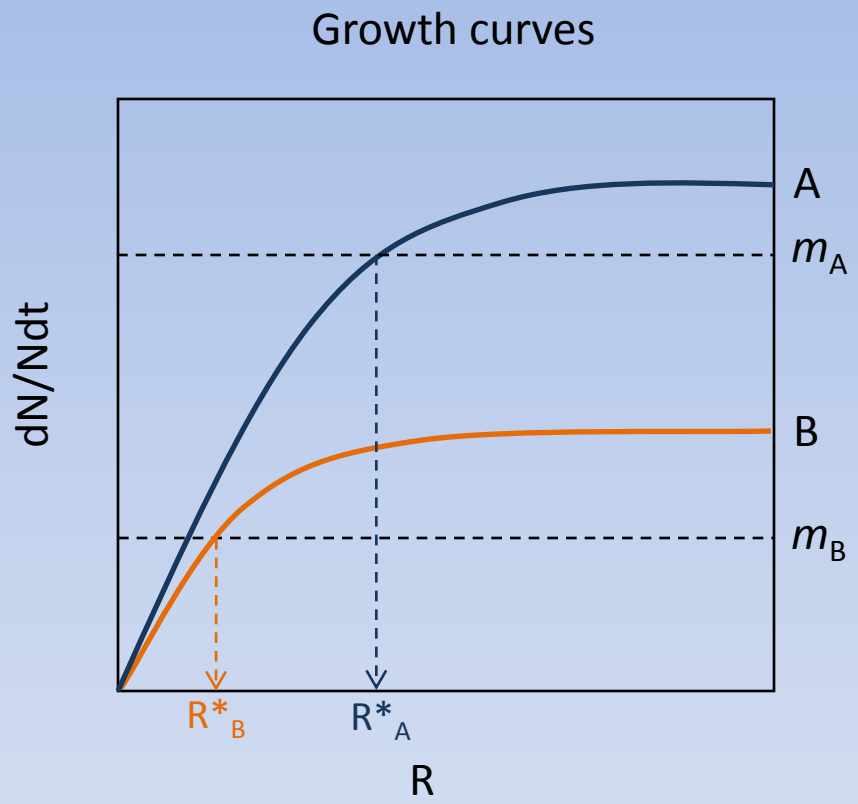
Where R=resource abundance

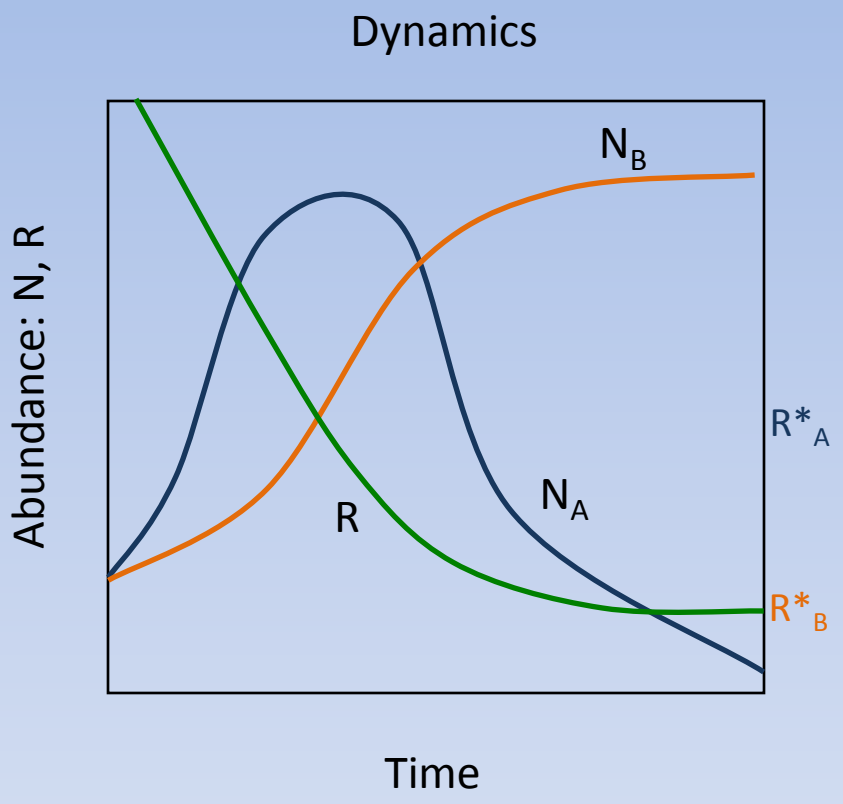
N=abundance of species *i*

m=per capita mortality rate of species *i*

Tilman (1982)

Resource Competition Theory





Where R=resource abundance

N_i=abundance of species i

m_i=per capita mortality rate of species i

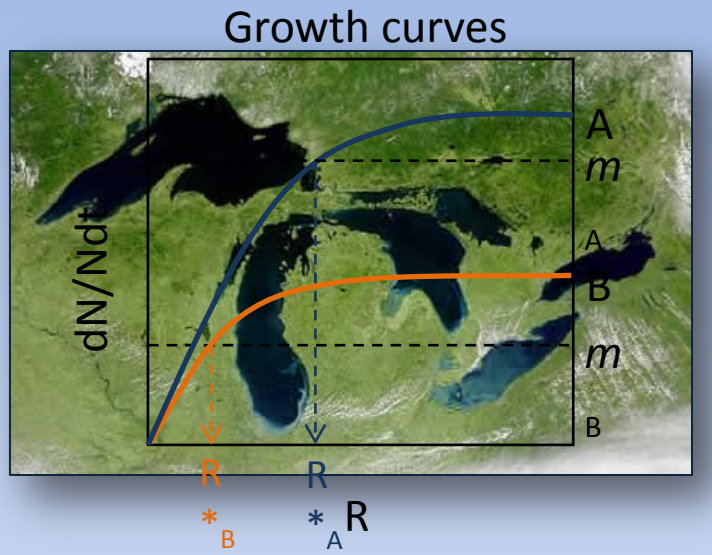
Tilman (1982)

Interspecific competition between diatoms for silicate

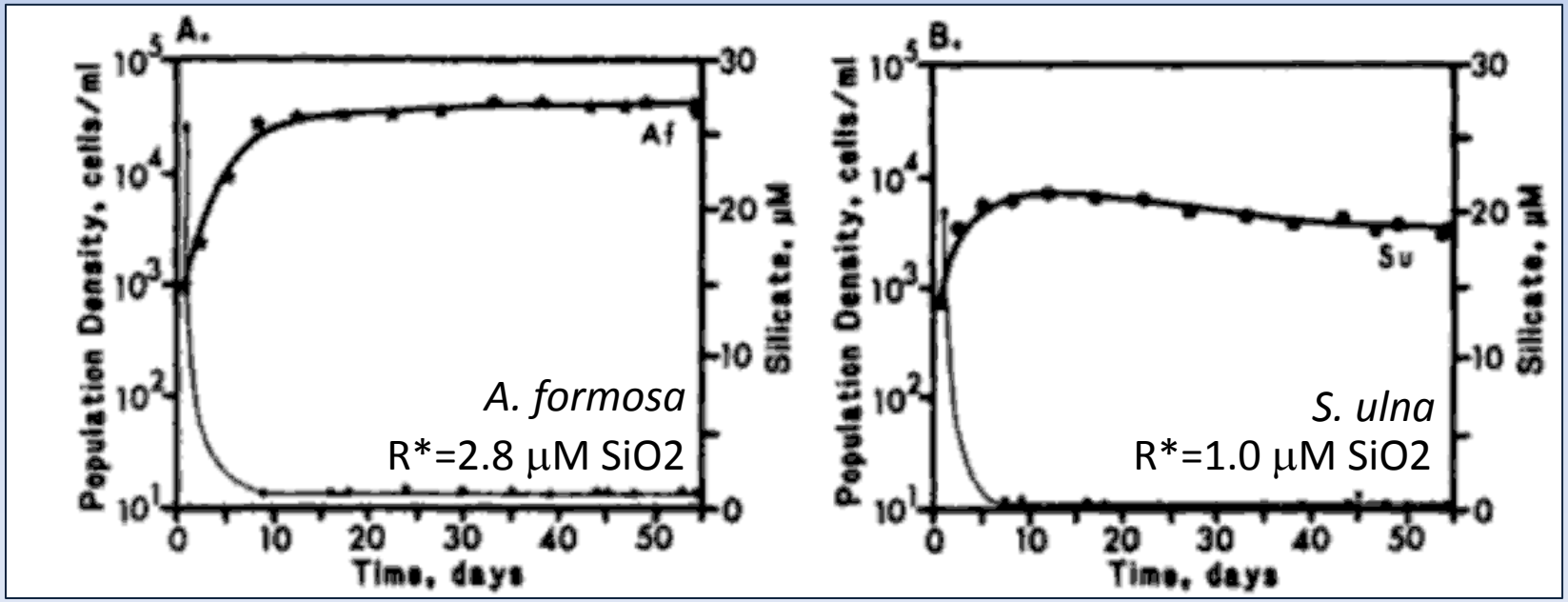
Diatoms are planktonic algae that form the basis of the food web in most mid-latitude mesotrophic lakes

Asterionella formosa is a dominant species throughout Lake Michigan

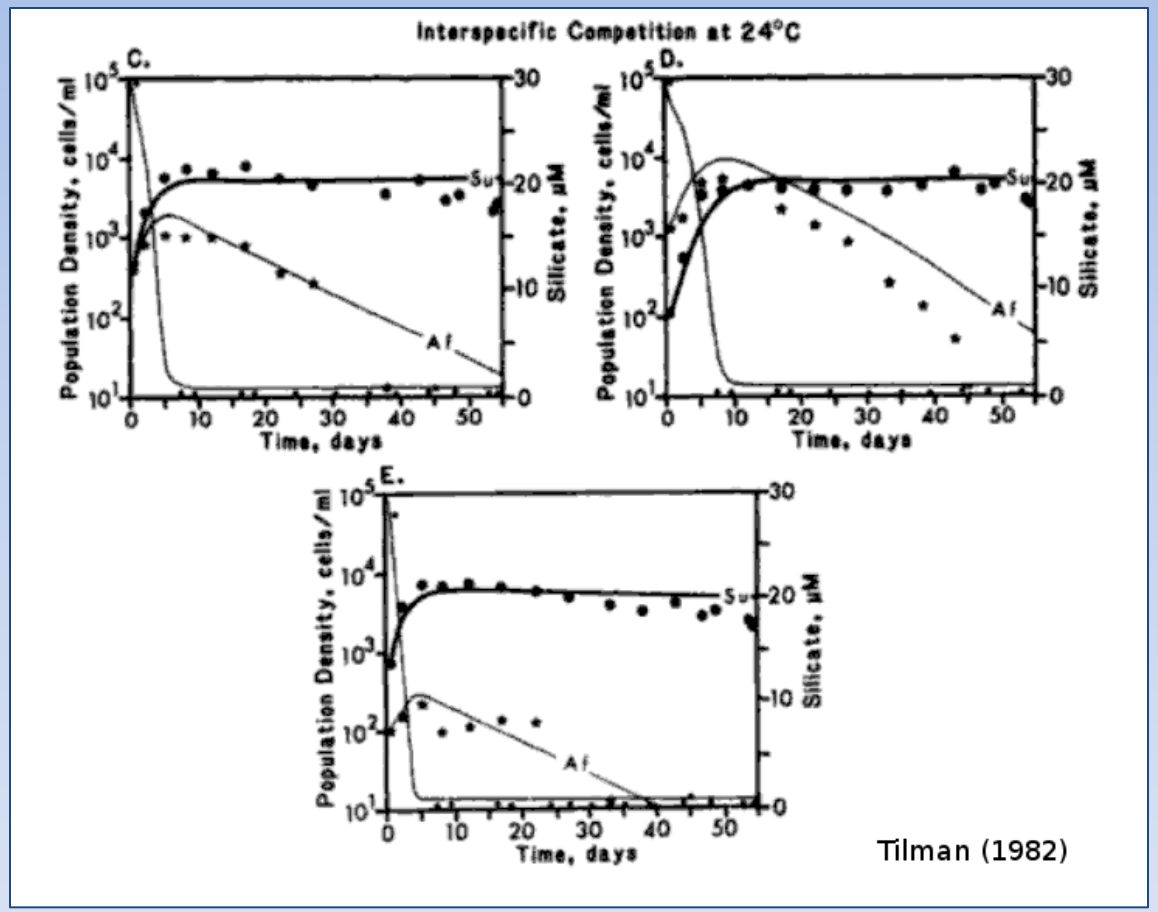
Synedra ulna limited to near shore areas



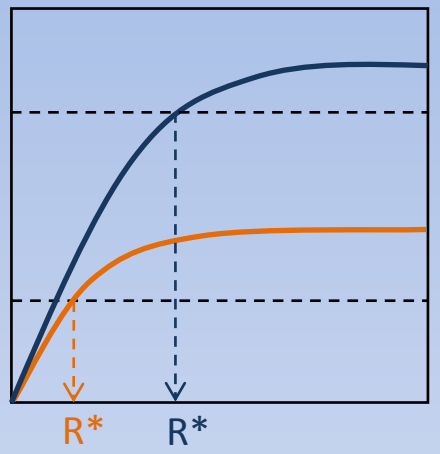
Which species has the lower R*?



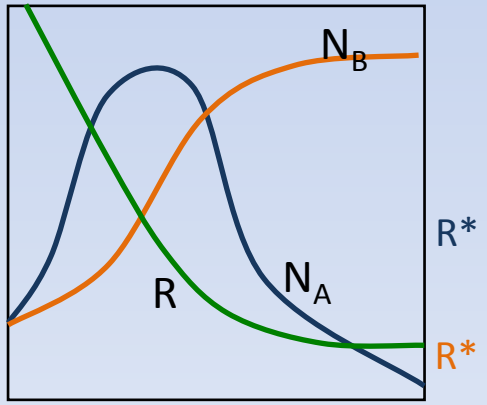
Which species should win in a competition for silicate?



Growth curves



Dynamics



Time

Will the invasive *Batillaria attramentaria* replace the native *Cerithidea californica?*

Batillaria attramentaria

(Non-native)

Cerithidea californica

(Native)

Can we use resource competition theory to answer this question?

$$\frac{dN}{dt} = births - deaths = \alpha_N \varepsilon_N R_N N - m_N N$$

Derivation of R*

$$0 = \alpha_N \varepsilon_N R^*_N N - m_N N$$

$$\alpha_N \varepsilon_N R^*_N N = m_N N$$

$$R^*_N = \frac{m_N}{\alpha_N \varepsilon_N}$$

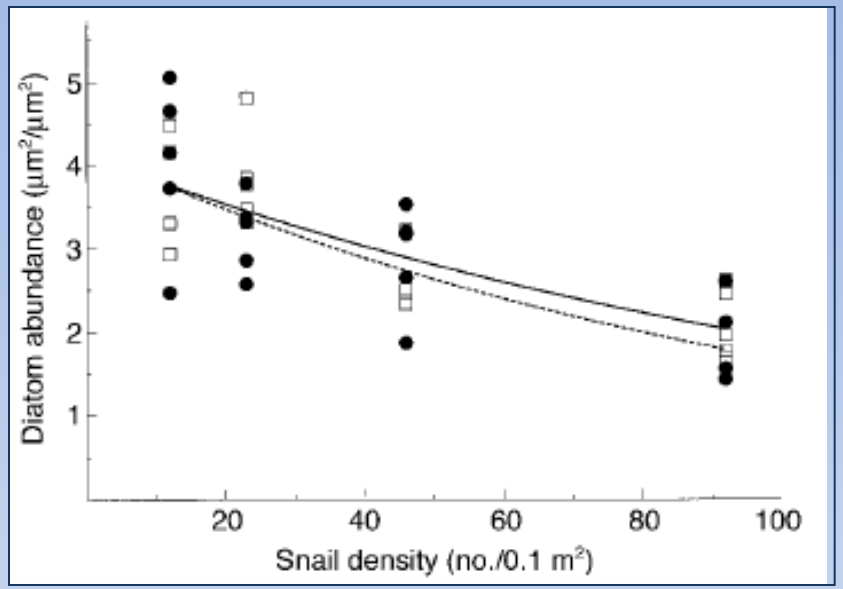
Condition for displacement

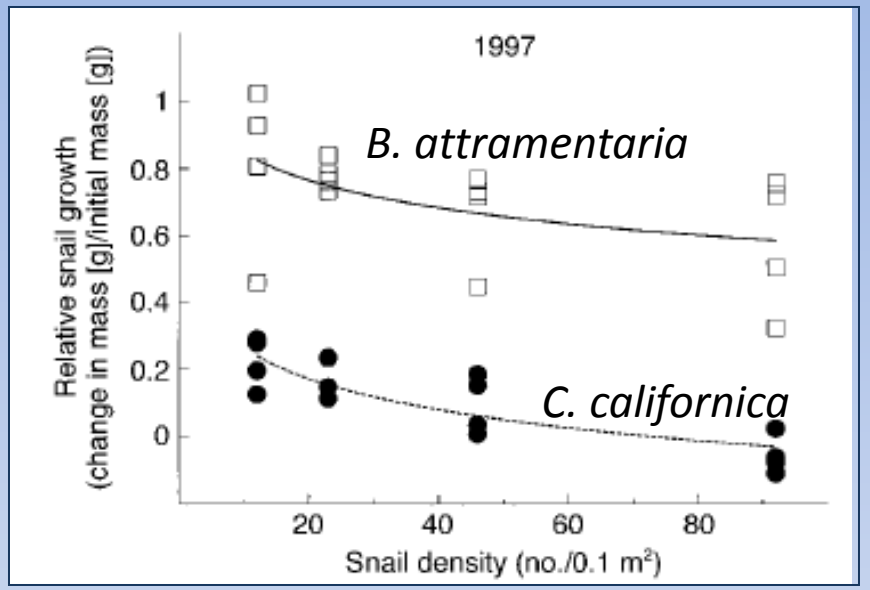
$$R^*_N = \frac{m_N}{\alpha_N \varepsilon_N} \quad R^*_I = \frac{m_I}{\alpha_I \varepsilon_I}$$

$$R^*_N > R^*_I$$

$$\frac{m_N}{\alpha_N \varepsilon_N} > \frac{m_I}{\alpha_I \varepsilon_I}$$

Experimental data test R* theory for invasive snails





Byers (2000)