Quiz

Our model organism for understanding resource competition is

a) An alga (diatom)
b) An animal (ungulate)
c) A plant (shrub)
d) A bacterium (E. coli)

Resource Competition

Key concepts

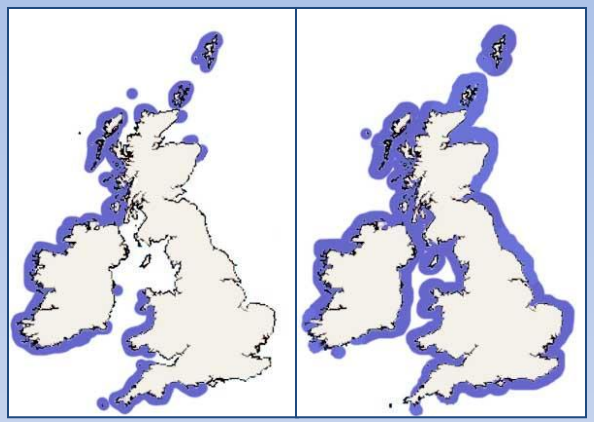
- Ecological niche (barnacles)
- Exploitative competition (diatoms and mud snails)
  - R* Theory
- Zero net-growth isoclines

Competition among sedentary, filter-feeding animals

Acorn barnacle *Semibalanus balanoides*

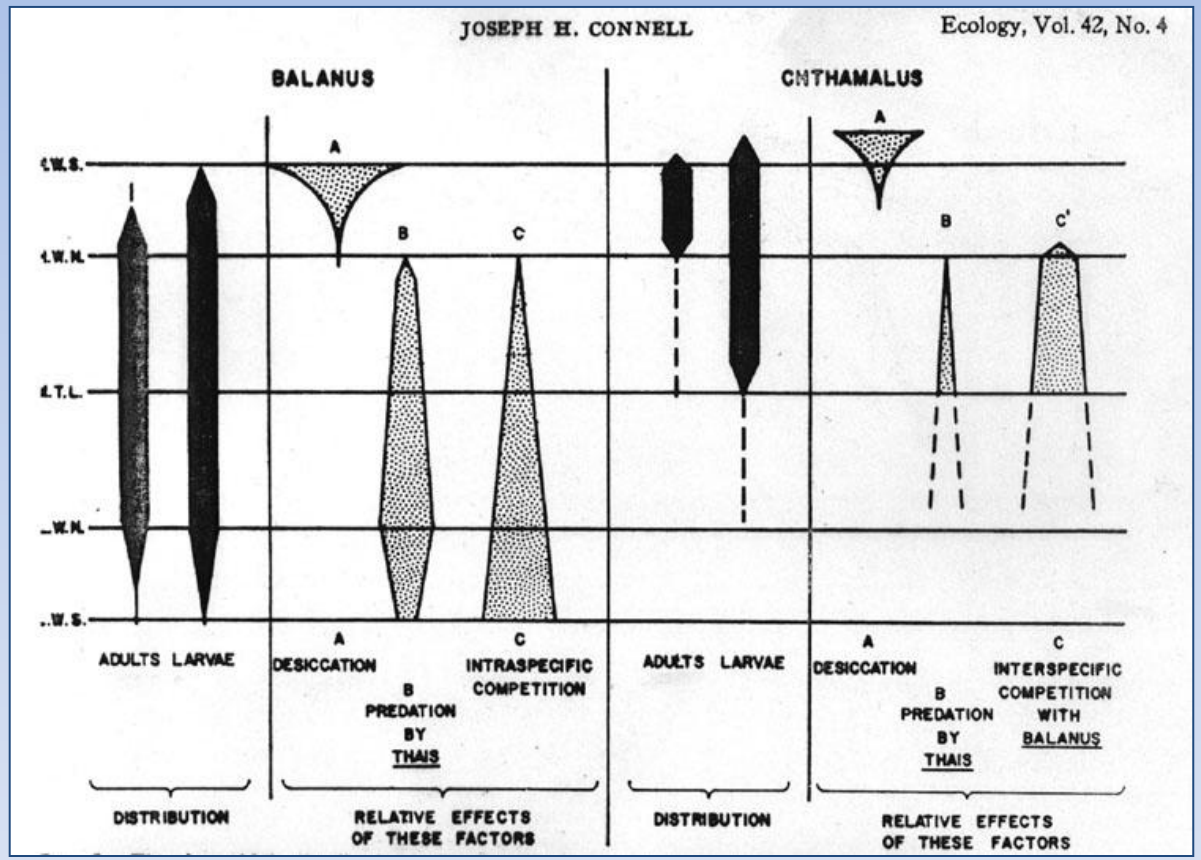
Stellate barnacle *Chthamalus stellatus*

Geographical overlap and spatial segregation



Chthamalus stellatus *Semibalanus balanoides*

Dog whelk *Nucella lapillus*



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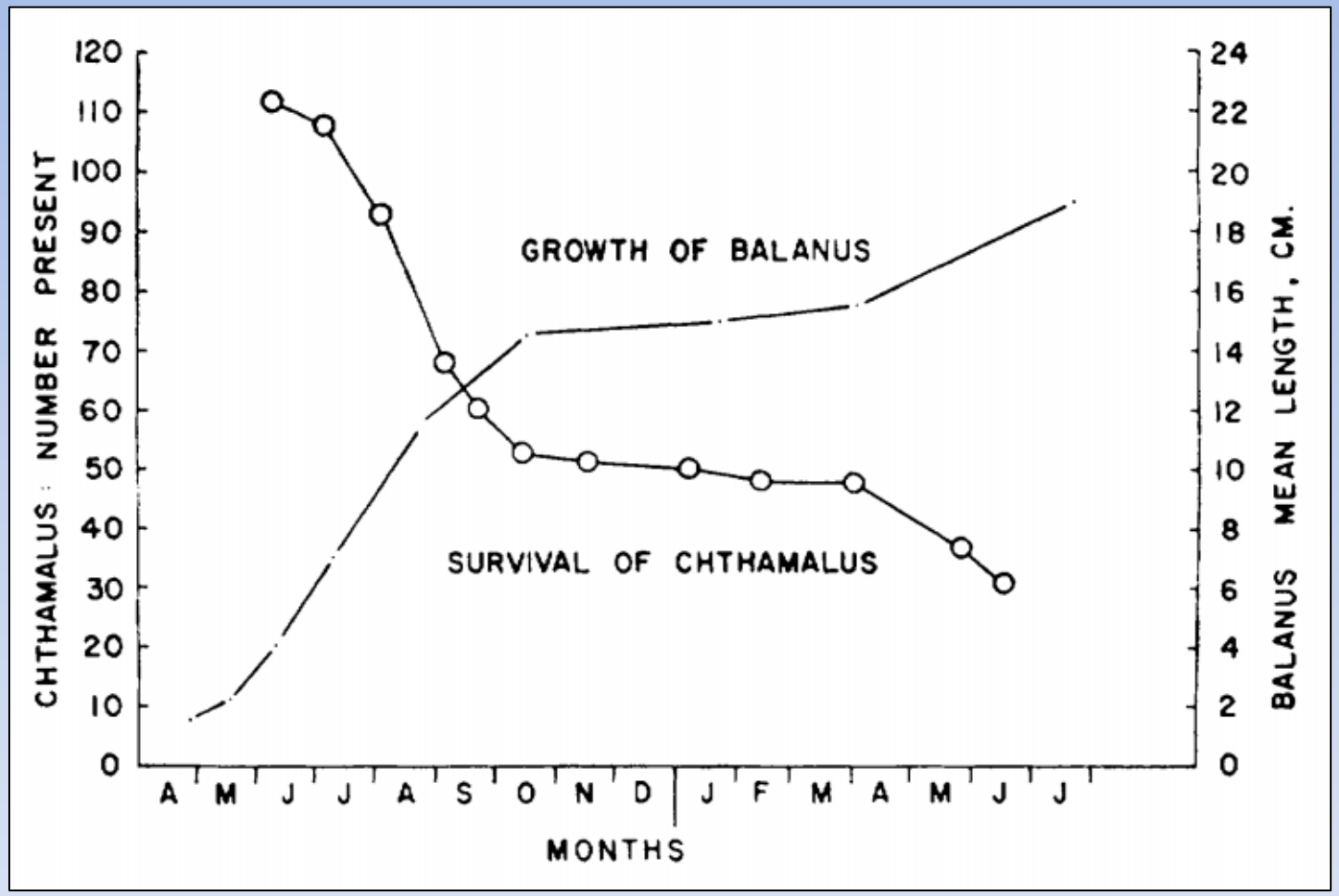

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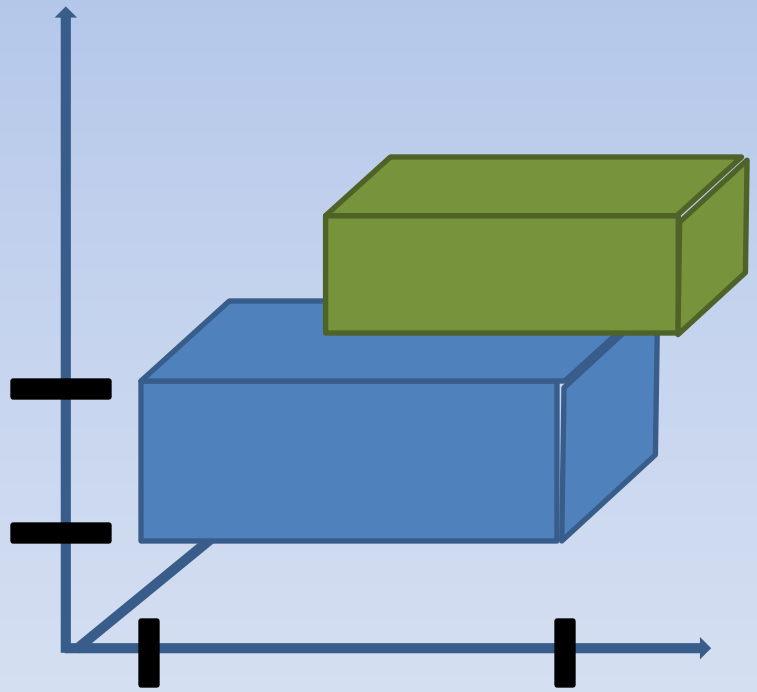
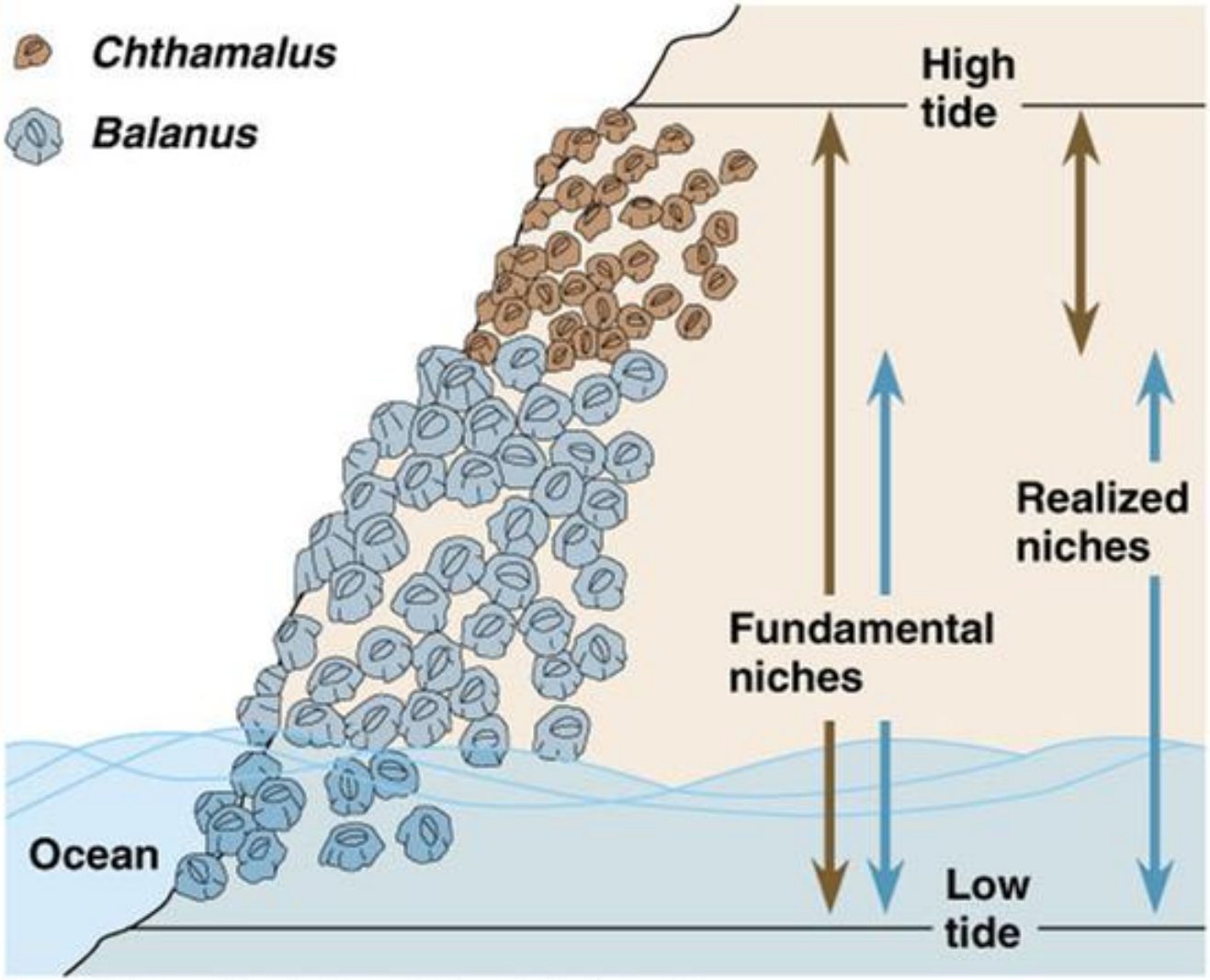
Why do these species spatially segregate?

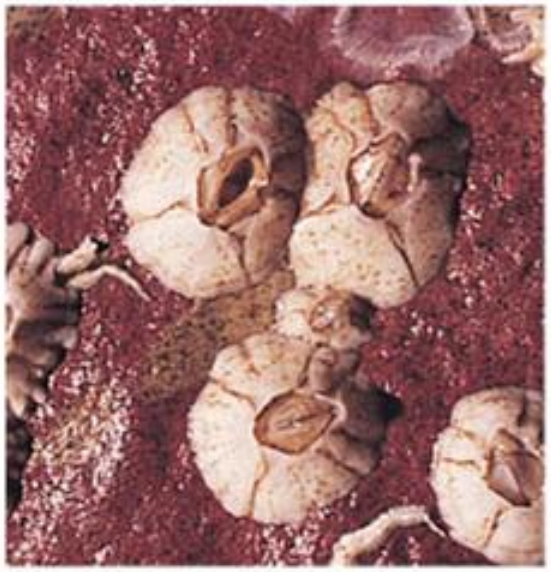
- H_1: Habitat preferences
- H_2: Interactions

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



"n-dimensional hypervolume"



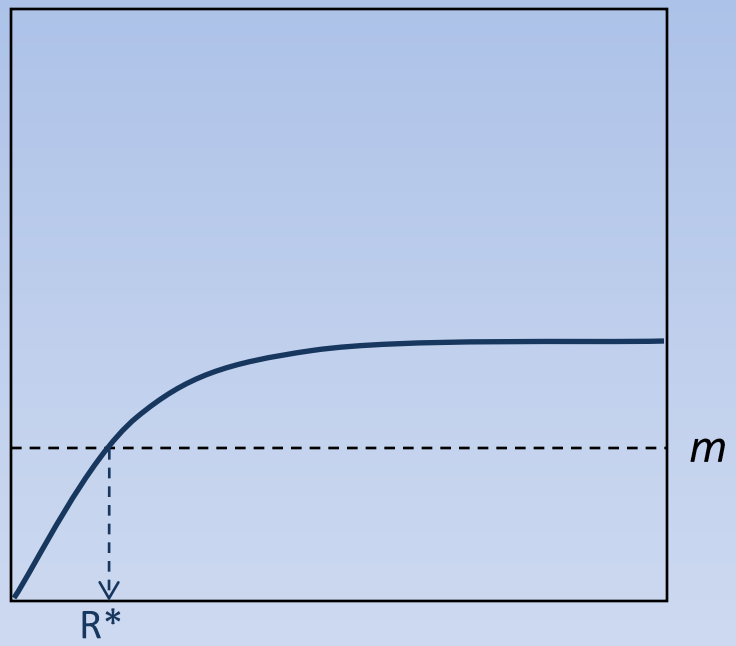


Realized Niche (def.)

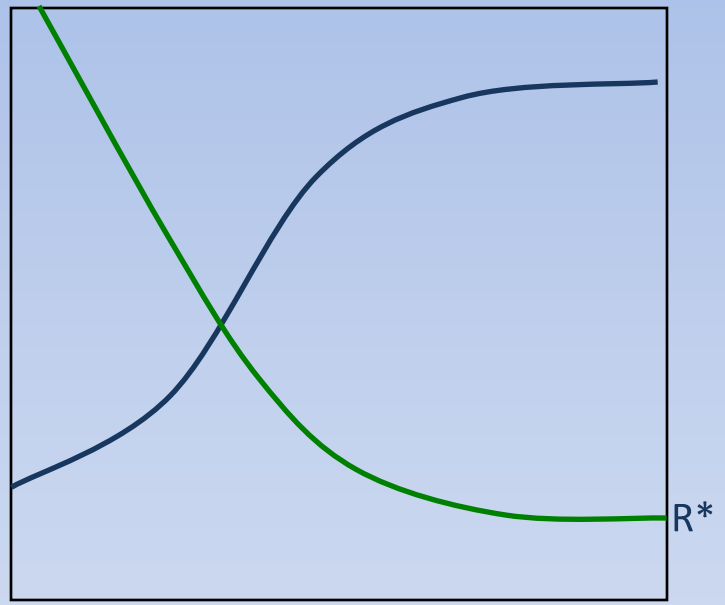
That portion of the set of environmental conditions in which an organism can survive in the presence of competition, or that portion actually occupied; a subset of the fundamental niche.

Resource Competition Theory

Growth curves



Dynamics



Where R=resource abundance

N=abundance of species *i*

m=per capita mortality rate of species *i*

Tilman (1982)

Resource Competition Theory

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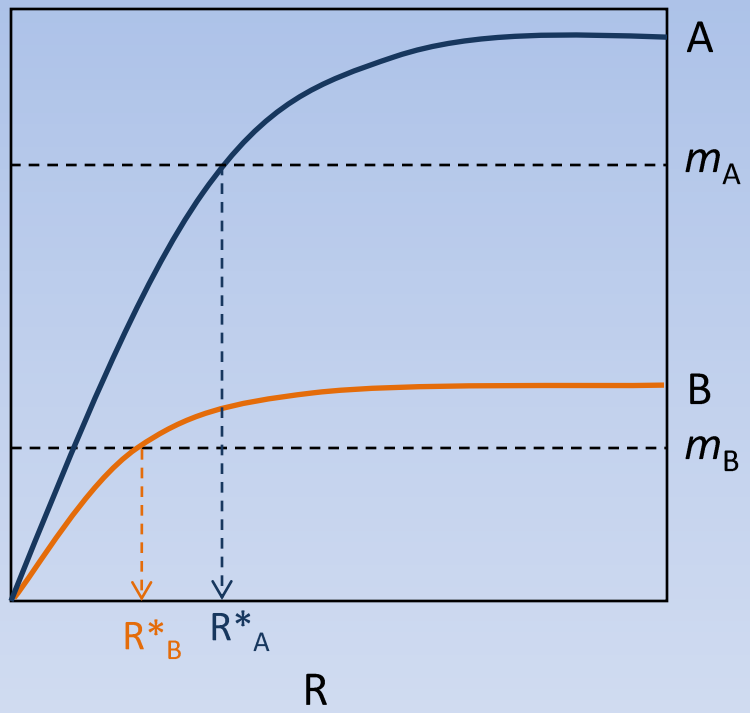

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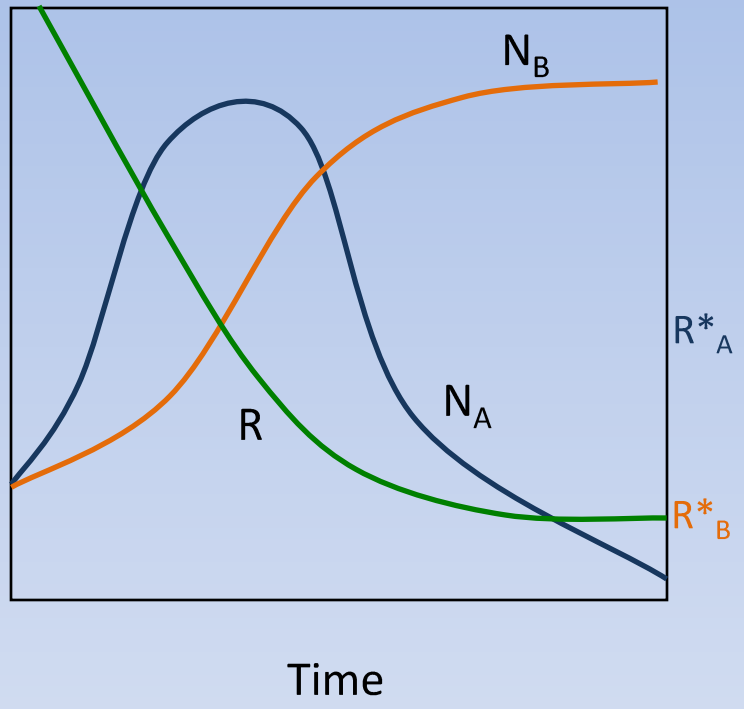

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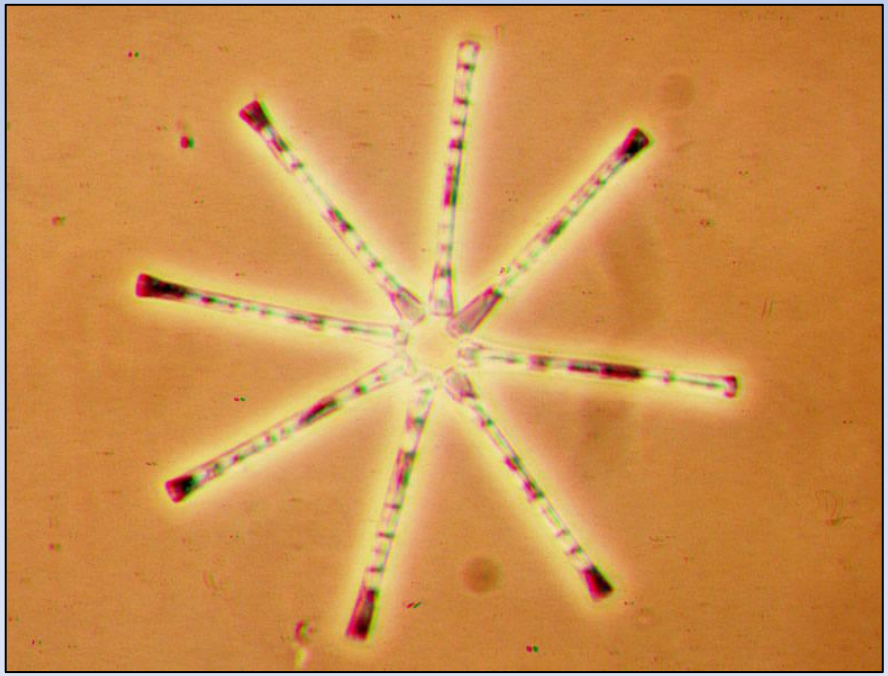
Tilman (1982)

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 nearshore areas



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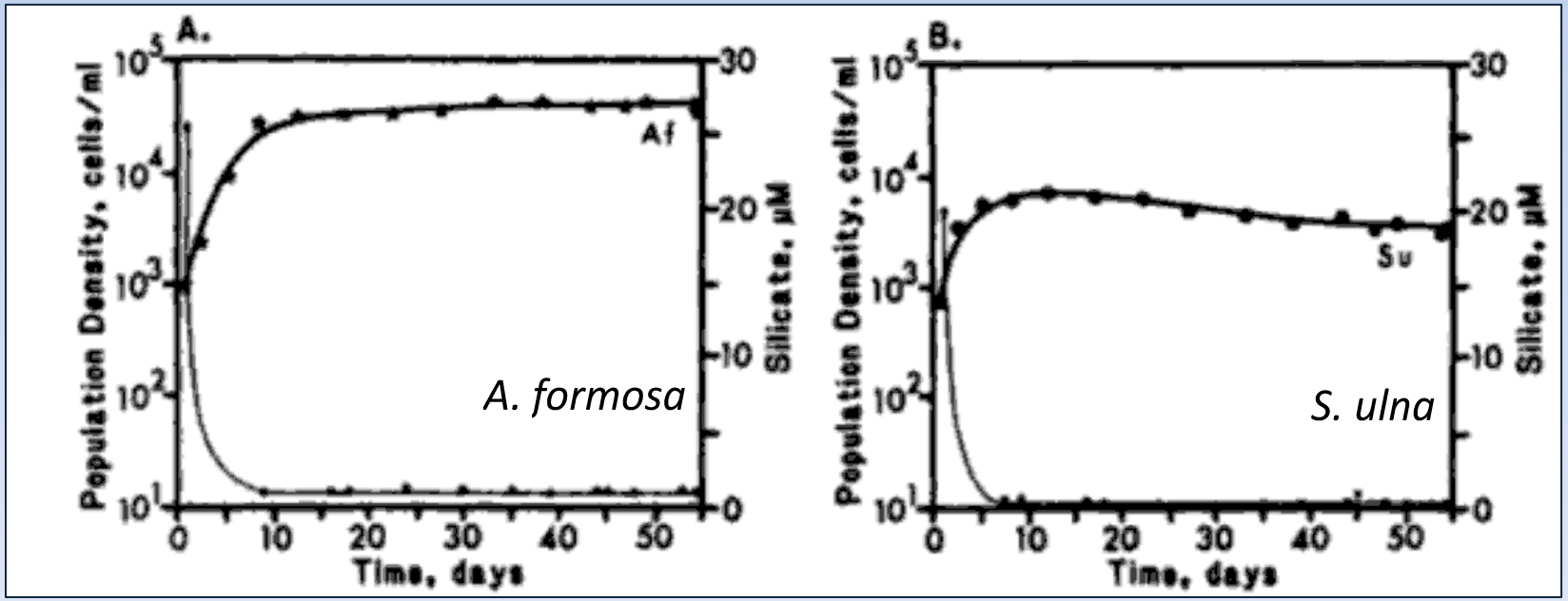

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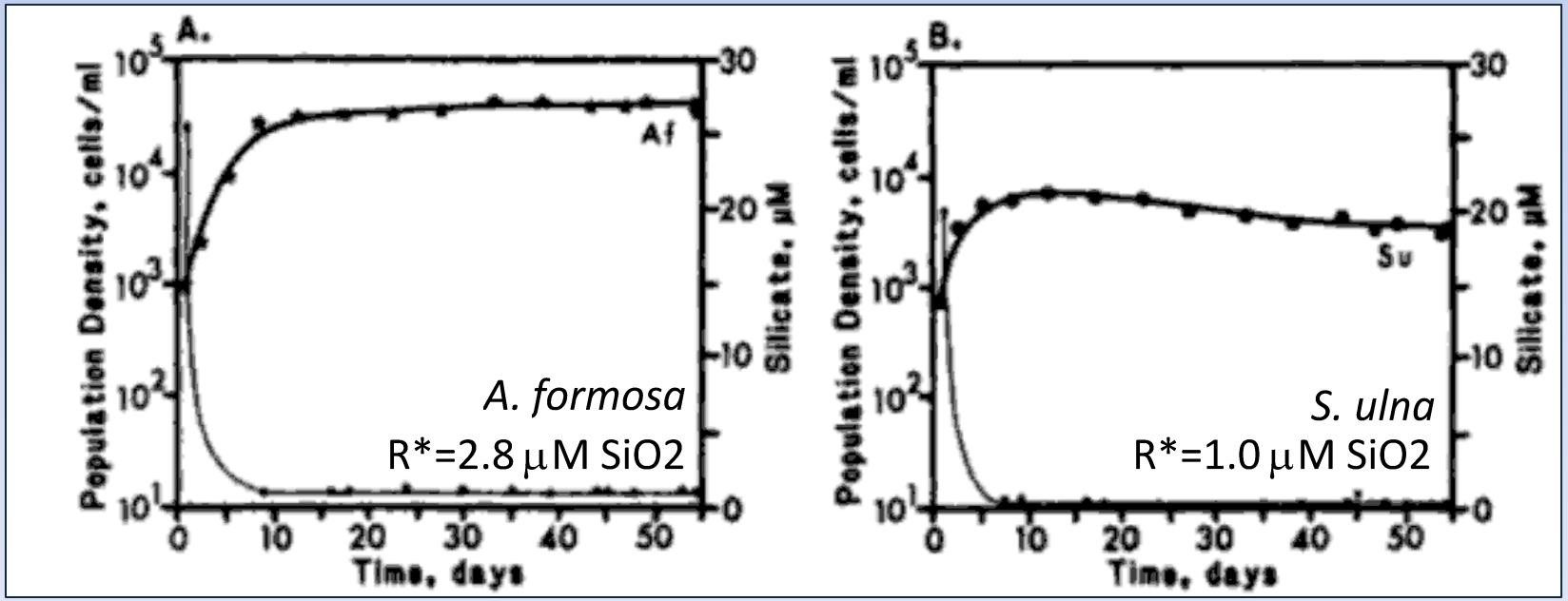
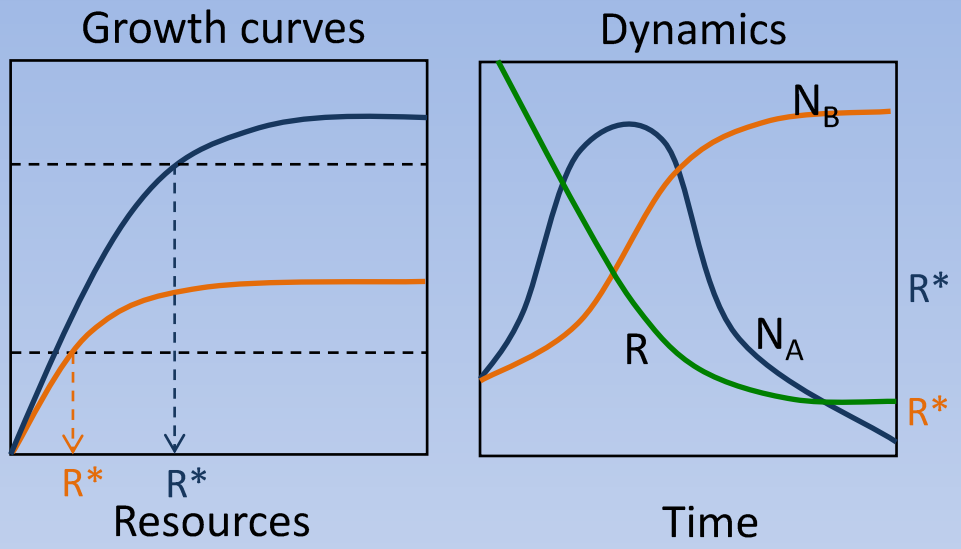
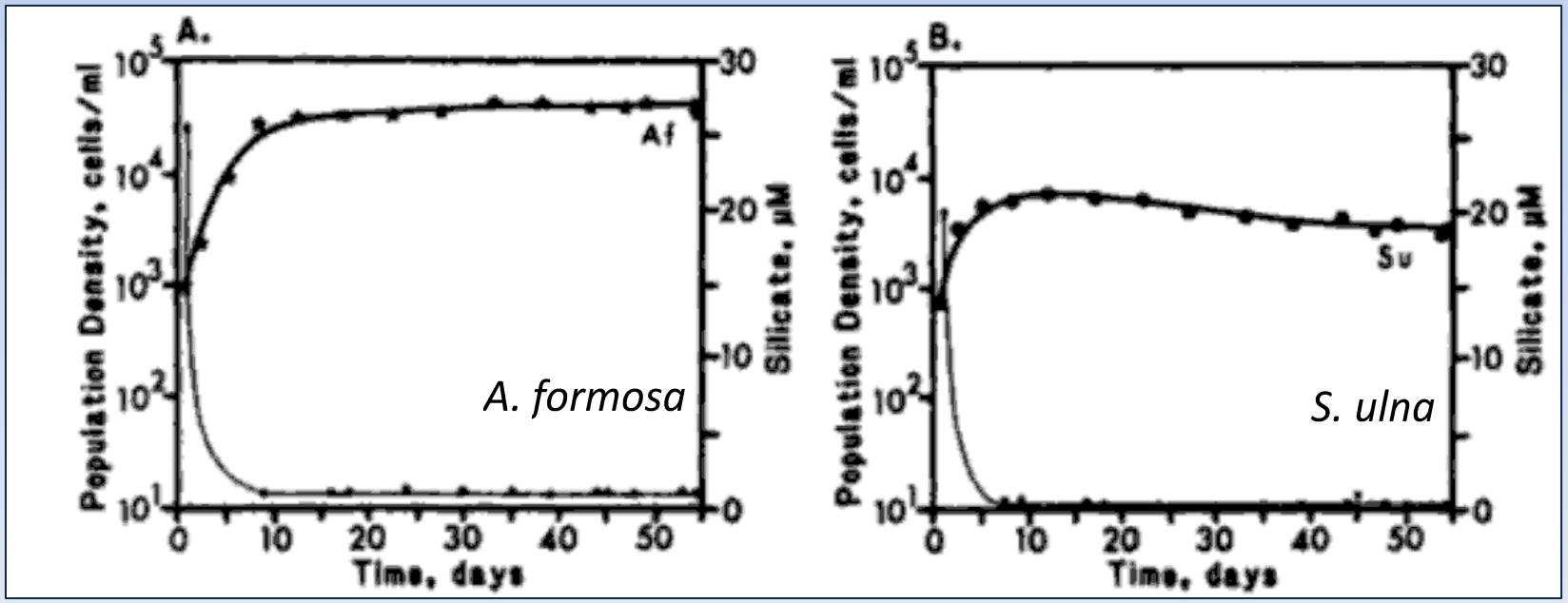




Which species should win in a competition for silicate?



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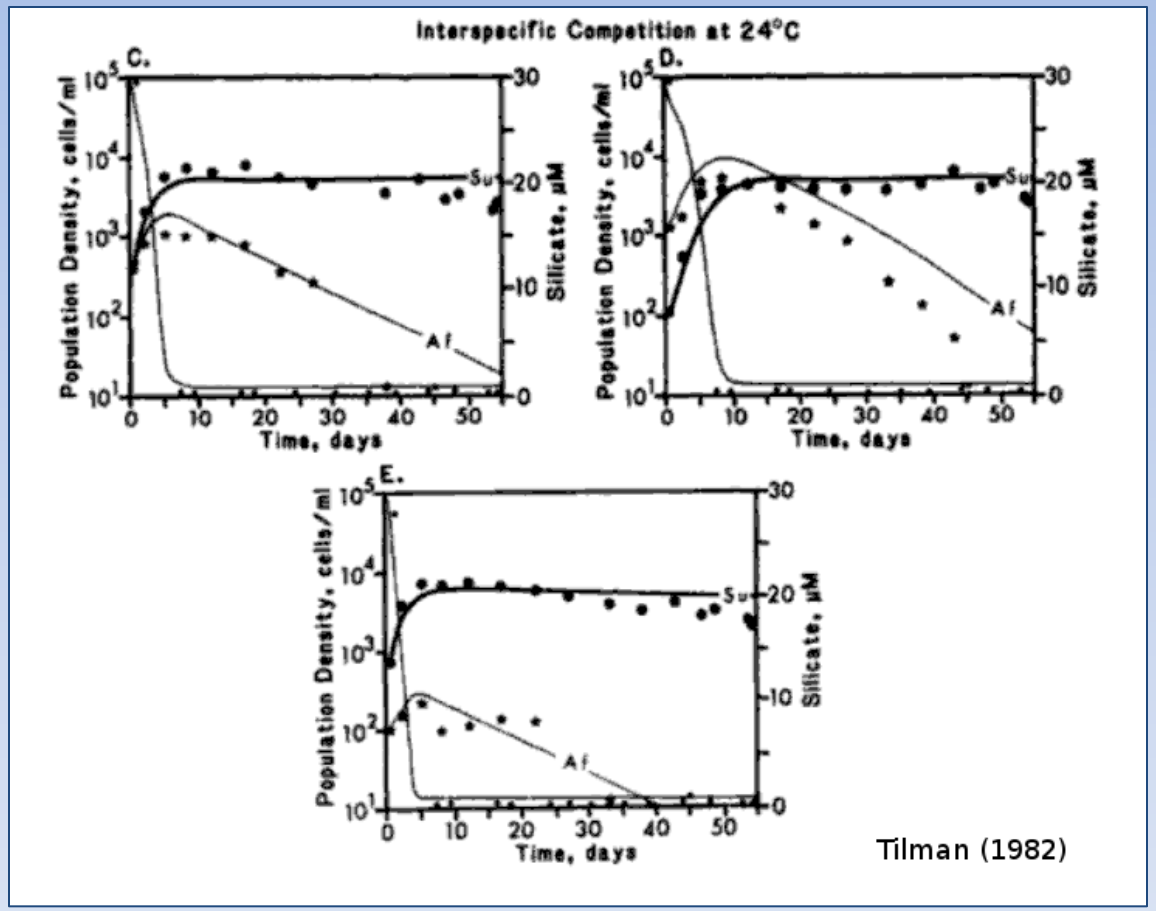

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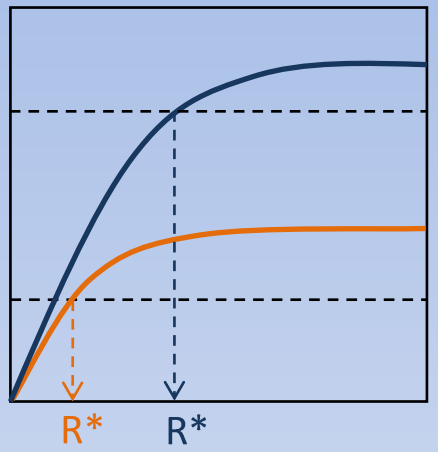

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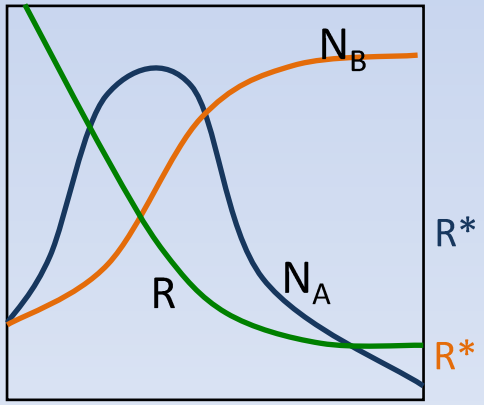


Time

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*

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

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

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

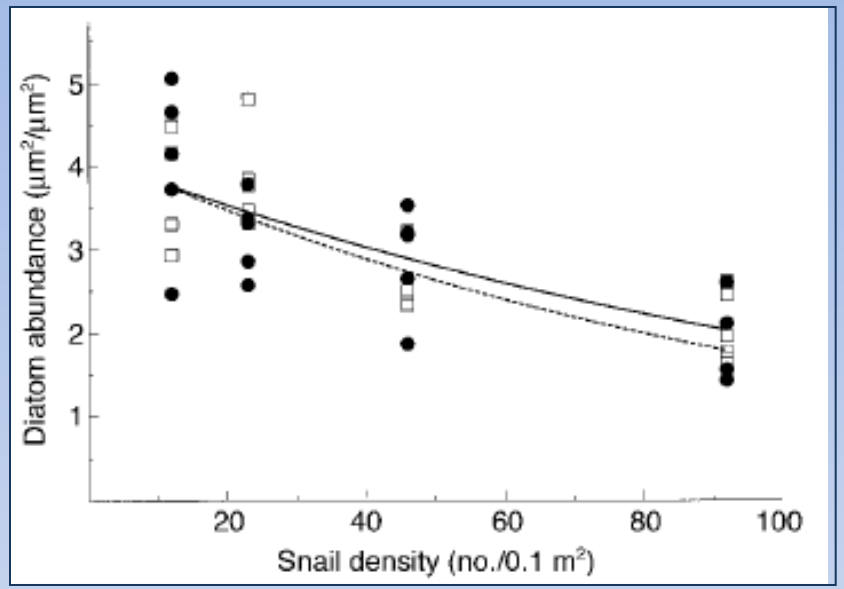
Condition for displacement

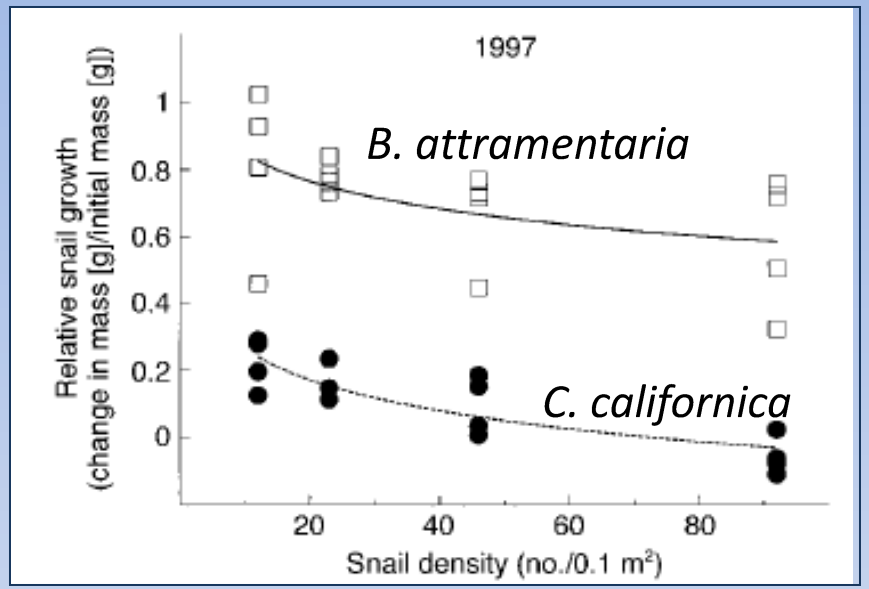
$$R^*_N = \frac{m_N}{\alpha_N \varepsilon_N} \quad R^*_I = \frac{m_I}{\alpha_I \varepsilon_I}$$

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

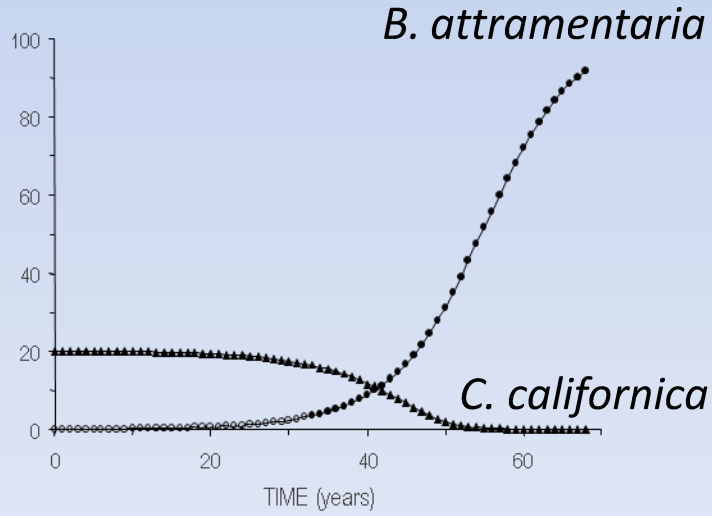
$$\frac{m_N}{\alpha_N \varepsilon_N} > \frac{m_I}{\alpha_I \varepsilon_I}$$

Experimental data test R* theory for invasive snails





Byers (2000)



Key points

- Niche as an n-dimensional hypervolume
- Fundamental vs. realized niche
- R* theory for resource competition