Competition

Species Interactions

Species A

Species B	Harmed -	No-effect 0	
Benefitted +	Competition	Competition	
Predation / Parasitism / Herbivory	Harmed		
No effect / Commensalism (facilitation)	Benefitted		
Mutualism (facilitation)			

Competition

- Competition occurs when animals utilize common resources that are in short supply; or if resources are not in short supply, competition occurs when the animals seeking those resources nevertheless harm one another in the process. - Birch 1957

Competition

- Interspecific competition occurs when two or more species experience depressed growth rate or equilibrium population level attributed to their mutual presence in an area. - Emlen 1973

3 key points of definitions

1. Reciprocal reduction in fitness
2. Resource is limited
3. Density dependent

Types of Competition

- Passive (utilize resource w/o intefering)
- Active
- Scramble
- Contest
- Interference
- Exploitation

Passive Competition

- The 2 species (or individuals of same species) utilize the limited resource without interfering with one another in any way.

Active Competition

- Results from passive competition
- If r or K is depressed due to passive competition, it may be advantageous to exclude the other species or individual from the resource;
- It may not though if it is too costly.

Territoriality

- *Intraspecific*
  - *Possessing and defending a territory insures breeding site, food supply, etc.*
- *Interspecific*
  - *Redwing and yellow-headed blackbirds*
  - *Hummingbirds*

Scramble Competition

- *A scramble for the resources and no single individual necessarily obtains a sufficient amount.*

Contest Competition

- *Each individual possesses its own supply of the resources so that some always have sufficient and otherss may not.*
  - *Territoies*
  - *Social hierarchies*

Interference

- *Behavior patterns of one species harms the other species.*
- *Example: Mus and Microtus*

Exploitation

- *Passive Competition*
- *Scramble*

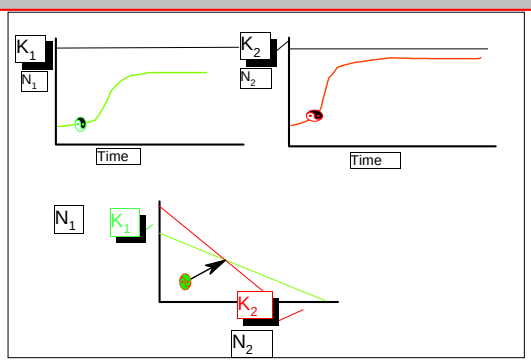
Examples

- *Gause's Yeast and Paramecium*
- *Parks's Flour beetles*
- *Brown and Munger's desert rodents*

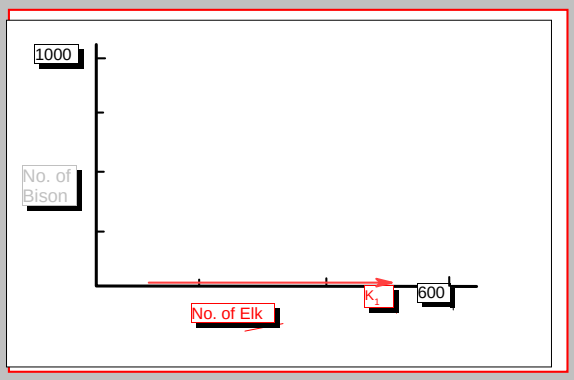
Theory of Competition

- *1926 - Italian Mathematician Volterra*
- *1932 - American Mathematician Lotka*
- *Started with logistic pattern of growth*
- *Extended it to include 2 species*

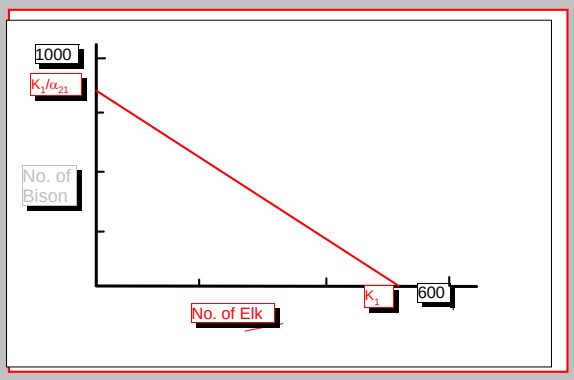
Phase Plane



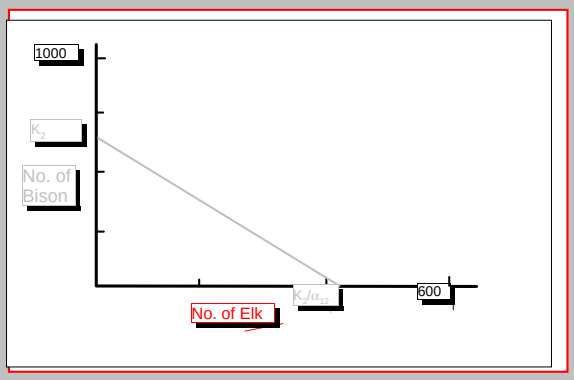
Elk at National Bison Range



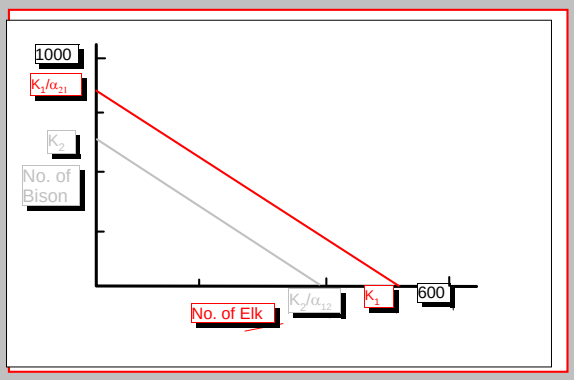
Elk at National Bison Range



Bison at National Bison Range



Elk and Bison at NBR



Competitive Exclusion

- *Gause (1934) in his book The Struggle for Existence stated:*
- *"Complete competitors cannot coexist."*
- *"Gause's competitive exclusion principle."*

Competitive Exclusion

- *Miller (1967) study of gophers*

Evaluation

- *How do we evaluate the potential for competition?*
- *Compare resource use-distributions in presence and absence of the other species.*
- *Evaluate the similarity of the species.*
- *Best would be to compare growth rates and equilibria in presence and absence of other species.*

Similarity of 2 bird species

- *Are they together geographically?*
- *Elevations*
- *Habitats (plant communities, seral stages)*
- *Where do they feed?*
- *What do they eat?*
- *What size of insects?*
- *Where do they nest?*

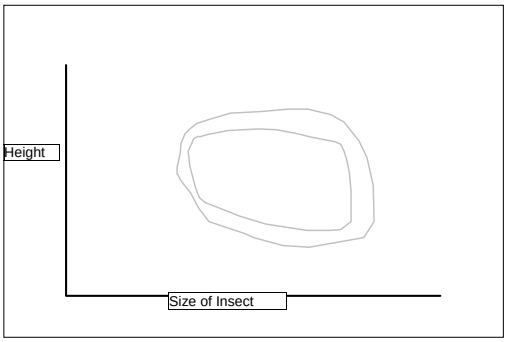
Niche

- *Grinnell (1914) used the term niche or ecological niche to express the species position in the community in terms of habitat.*
- *Elton (1927) : role that species plays in a community*
- *G. E. Hutchinson (1957) expanded the concept to include both aspects*

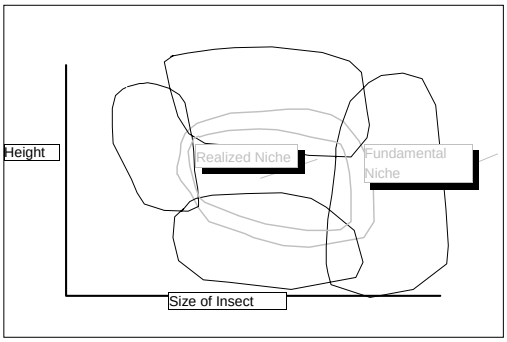
Niche

- *Hutchinson (1957) suggested defining niche in terms of an abstract space in which the axes represent habitat or resource factors.*
- *Example: Blue-gray gnatcatcher*
- *Fundamental niche = The range of conditions in which the species could potentially survive.*
- *Realized niche = The actual range of conditions occupied.*

Niche of Blue-gray Gnatcatcher - Root 1967



Niche



Niche

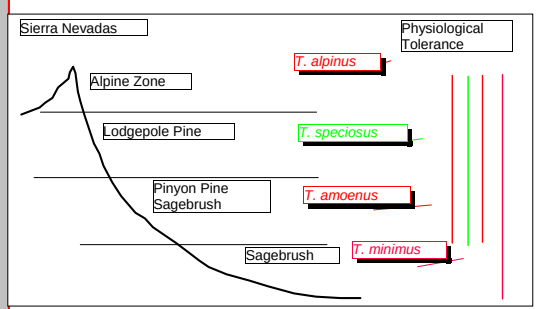
- *Example: Planaria*
- *Anolis lizards*
- *Character displacement*
- *Galapagos Finches*
  - *Darwin, Lack and most recently Peter Grant (1986, Ecology and Evolution of Darwin's Finches. Princeton Univ. Press) have inferred the adaptive radiation of finches on Galapagos Islands driven by competition.*

Galapagos Finches

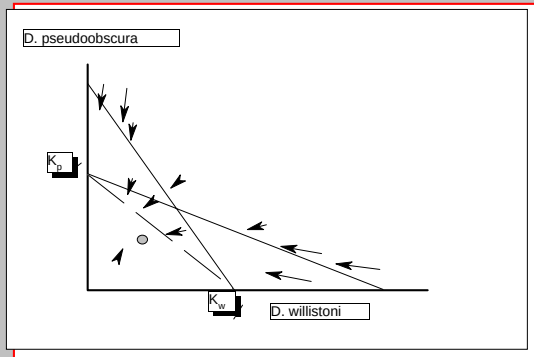
Structuring communities

- *Does competition structure communities?*
- *Simberloff, Strong and others argue that the evidence is very weak.*
- *Same patterns without competition*
- *Species kept well below K*
- *Alternate hypotheses*

Chipmunks (Eutamias* now *Tamias) Classic study by Heller (1971)



Ayala's fruit flies (1970)



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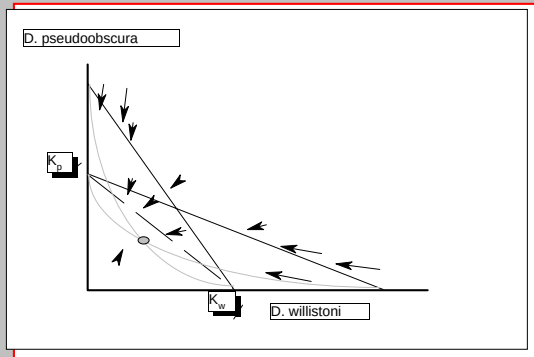


Resource Competition

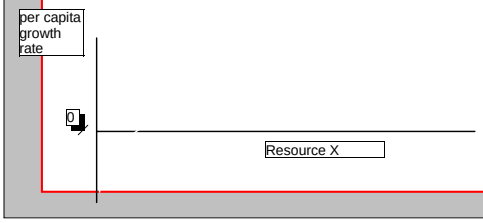
- *Tilman (1982) Resource Competition and Community Structure*
- *Experimental studies of relationship between species richness (diversity) and resource richness (productivity)*

Diversity and Productivity

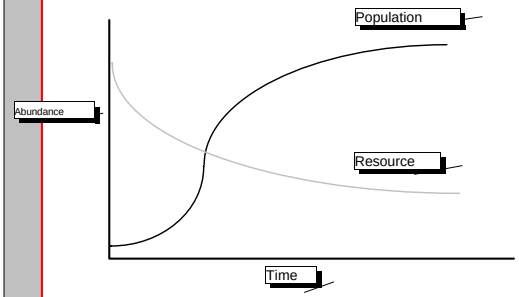
- *Is diversity higher in richer (more productive) places?*
- Desert to grassland to forest to tropical rainforest?
- *What happens if we fertilize an area? Does the species diversity increase?*
- *Let's look at what Tilman found.*

Tilman - Resource Competition

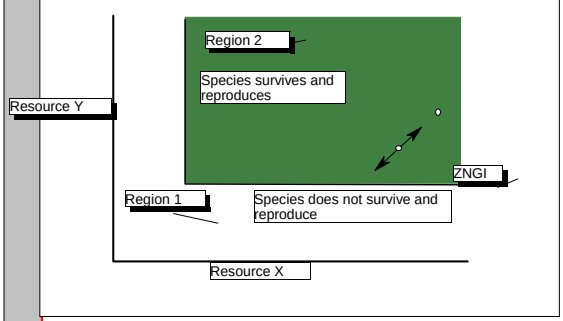
- *"Monod equation" relating resource availability to per capita growth rate*



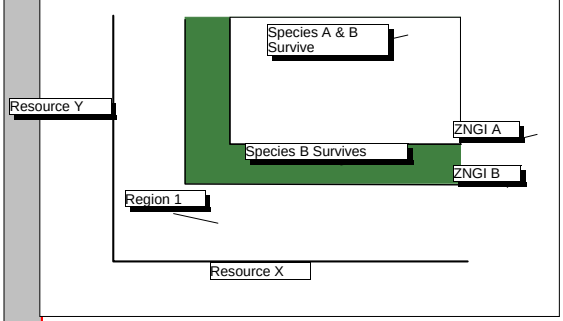
Monod equation



Tilman's theory



2-Species Exclusion



2 Species - Coexistence