Ecology

• Autecology
• Synecology
• Intraspecific interactions
  – Natural selection
• Interspecific interactions

Interspecific Interactions

<table>
<thead>
<tr>
<th>Type of Interaction</th>
<th>Species 1</th>
<th>Species 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competition</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mutualism</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Predation</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Parasitism</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Commensalism</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Amensalism</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Cooperation</td>
<td>0</td>
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</tr>
</tbody>
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Competition

• Competition
  – Requires a limiting resource
  – Change the resources -> population response?
• Intraspecific Competition
  – Within a species
  – Among individuals
  – For mates and resources
  – Leads to logistic growth
  – Leads to natural selection

Interspecific Competition

• Conditions
  – Sympatric
  – Use the same limiting resource
    • Space, nutrients, light, water, prey
• Mutually detrimental for both species (-,-)
  – Detrimental in what way?

Competition

• Interference inhibition/competition
  – One species physically interferes with another
• Exploitation inhibition/competition
  – Indirect
  – One species reduces a resource for others

Competition

• Competition is asymmetrical
  – One species is affected more negatively more than the other
Tilman et. al’s competition experiment

Silica use and population density

Competition for silica

Competitive Exclusion Principle

• G.F. Gause, Russian ecologist
• 1930’s
• Two species with the same limiting resource cannot coexist in sympatry
• Experiments with paramecia

Coexistence Is Possible

• Unstable environment
• Populations of superior competitor are kept below K
  - Disease
  - Herbivores
  - Predators
Coexistence

- Diffuse Competition
- Coexistence may evolve
  - Character displacement

Predation and Herbivory

- Predation and herbivory represent +/- relationships
- Predators
- Prey
- Herbivores
- Parasites
  - Pathogens
- Scavengers
- Detritivores

Specialization

- Predators
  - Few specialists
  - Specialists are vulnerable
  - Most focus on the most abundant prey
- Herbivores
  - Grazers: low quality, high volume: grasses
  - Browsers: high variety of leaves
  - Specialists: single species of plant

The coevolutionary history of leaf beetles (Ophraella) and their host plants presented by Knowles et al. (1999) provides an excellent illustration of all three categories of evolutionary transitions (see Figure and for further details, see Brooks and McLennan, 2002).

Effects of herbivory on abundance

- Example: Prickly pear cactus (Opuntia stricta) and cactus moth
  - Introduced to Australia in 1839, came to cover large areas by 1925, destroying rangeland.
  - Several herbivores were introduced to try to control the plant
  - In 1925, cactus moth (Cactodiasis cactorum—moth larva) was introduced from South America, with great success controlling the prickly pear
Effect of herbivory on species richness

- If herbivores eat the dominant plant then higher species richness is promoted

The world is green!

Plants fight back!

Plant Defenses

- Crypsis
- Toxicity
  - Aposomatism
- Mimicry
- Run away.... Run away.... Run away

Prey Defenses
Parasites

- Parasite
  - Ectoparasite
  - Endoparasite
- Host
- Generalists
- Specialists
  - Host range
- 50% of species are parasites
- Zoonoses
- Spill over

Parasite Life Cycles

- Direct
  - Parasite is transmitted host to host
  - e.g., pin worms
- Indirect
  - Parasite is carried between hosts through another organism
  - e.g., malaria, *Plasmodium*

Effects on Parasites on Hosts and Communities

- Reduce abundance
- Alter distributions
- Change the outcome of competition

Effect of Host on Parasite

- Hosts must have a minimum density (threshold density) for the parasite to persist

Mutualisms

- Mutually beneficial
  - Organisms still act in their own best interest

Trophic Mutualisms

- Typically involve food producer + housing provider
- Endosymbiotic symbiosis between prokaryotes and eukaryotes: mitochondria and chloroplasts
- Mycorhizae, N-fixing bacteria
- Corals, lichens, protozoans + algae
Pollination and Dispersal

• Pollination
  – Movement of the male gamete
  – Specialization

• Frugivory
  – Birds, mammals, turtles, ants
  – Specialization

• Networks

Defense

• Ant-plants