Community Ecology: Interactions

---

The Realm of Ecology

- Community Ecology: Interactions among members of all species in a given habitat.

---

Community Ecology

Community: All the populations of organisms living together in a given place

Characteristics:
- **Biodiversity**
  - Species richness
  - Relative abundance
- **Dominant vegetation**
- **Stability/disturbance**

---

The Niche Concept

- A population’s **Habitat** is the area in which it lives - “address”
- **Niche** is a population’s total use of biotic and abiotic resources - “profession”
- Multiple species within a community share habitat, but have different niches
  - The **competitive exclusion principle** states that two species competing for the same limiting resources cannot coexist in the same place

---

Interspecific Interactions

<table>
<thead>
<tr>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
</table>
| -  | -  | competition
| +  | -  | trophic — parasites / predators
| +  | o  | commensalism / facillitation
| +  | +  | mutualism
| o  | -  | amensalism

---

Why do species Y & Z coexist?

- **Individualistic Hypothesis**
  - Y & Z need similar physical environment
- **Interactive Hypothesis**
  - Y needs Z

---

Community Ecology

Interactions among members of all of the species in a given habitat.

A. Competitive Interactions
B. Trophic Interactions
C. Symbiotic Interactions
D. Amensal Interactions
E. Facilitative Interactions

---
A. Competition

- **Interspecific Competition** = when two species compete for the same limited resource
- **Competitive Exclusion** = the elimination of a population due to competition

Gause’s experiment with *Paramecium*

Example of Competitive Exclusion

- Two barnacle populations require the same resource: space
- When *Balanus* is removed *Chthamalus* spreads lower
- *Fundamental niche*
- When both species compete *Balanus* displaces *Chthamalus*
- *Realized niche*

Competition & Resource Partitioning

- In *Anolis* lizards

Competition & Character Displacement

- *Geospiza* spp. on islands of the Galapagos
  - allopatry
  - sympatry

**B. Trophic (Feeding) Interactions**

- Quaternary consumers
- Tertiary consumers
- Secondary consumers
- Primary consumers
- Zooplankton
- Phytoplankton

Figure 53.3

Figure 54.11

A terrestrial food chain
A marine food chain
Community Ecology: Interactions

**B. Trophic (Feeding) Interactions**

- A very localized food chain:
  Tomatoe snail → homewasp → caterpillar → parasitoid wasp

**Primary producers**
- **Autotrophs** ("self feeder")
  - Photosynthetic plants, protists, bacteria
  - Chemoautotrophic bacteria
- Obtain nutrients from nonliving materials
  - Inorganic compounds, minerals
  - CO₂ to make organic backbones
  - Carbon fixation

**Consumers**
- **Heterotrophs** ("feed on others")
  - **Herbivores** ("plant eater")
    - Primary consumers: eat producers
  - **Carnivores** ("meat eater")
    - Secondary consumers: eat other consumers

**Decomposition is an important part of an ecosystem**
- **Detritivores** (*detritus* = decaying matter)
  - Another level of consumer
  - Recycle matter back into the abiotic world

**A food web**
- Trophic patterns are rarely linear
- Typically ~10% [5–20%] efficiency of transfer between levels
- I.e., to grow or reproduce, 10x the added energy & mass must be consumed.
- Thus there must be a lot of primary production to support long food chains.

**Biomagnification**
- Efficiency of transfer creates a food pyramid.
- Pyramid effect may result in biomagnification of environmental contaminants.
  - E.g., compounds sequestered in fat or skeleton.
Community Ecology: Interactions

**Predation and Adaptations**
- Mechanisms of defense have evolved in every species (size, flee, hide, venom)
- **Coevolution** = a series of reciprocal adaptations in two species (a type of “arms race”)

**Coevolution: caterpillar and passionflower vine**

**Consumers**
- **Herbivory**
  - One species (herbivore) eats part of a producer (prey)

**Herbivory**
- Specialist herbivores acquire resistance to chemical defense of specific prey

**Predation**
- One species (predator) kills & consumes another species (prey)

**Consumers**
- **Herbivory**
  - One species (herbivore) eats part of a producer (prey)

**Herbivory**
- Specialist herbivores acquire resistance to chemical defense of specific prey

**Predation**
- One species (predator) kills & consumes another species (prey)
**Community Ecology: Interactions**

**Cryptic Coloration (Camouflage)**
- Works for both predator and prey

**Physical (Mechanical) defenses**
- Spines, bristles, shells
- Repels predator
- Makes hard to swallow/digest
- Makes it too energetically expensive
  - Cost > benefit for the predator

**Chemical defenses**
- Chemical warfare
  - Predator learns to avoid species
  - Examples
    - Eucalyptus oil, oleander shrubs, stinkbugs, skunks, cane toads

**Sometimes defenses don’t work!**
- Grasshopper mouse sticks stinky end into ground to munch head
Mimicry
- Color and patterns of warning coloration are copied

Mimicry
- In Müllerian mimicry, multiple noxious or unpalatable species resemble each other.

Mimicry
- Color and patterns of warning coloration are copied

• In Batesian mimicry, harmless species mimic dangerous or toxic species.

Mimicry
- Color and patterns of warning coloration are copied

• In Batesian mimicry, harmless species mimic dangerous or toxic species.

• Only works if predators learn to avoid real danger!

Mimicry
- Color and patterns of warning coloration are copied

• In Batesian mimicry, harmless species mimic dangerous or toxic species.

Figs. 1.25–1.27
Community Ecology: Interactions

**Mimic Octopus**

- Master of Batesian mimicry
- Rapidly changes coloration, morphology & behavior

**Avoiding Predation**

- Startle Coloration

**Preation and Diversity**

- **Keystone Predator**
  - A species that reduces the population density of the strongest competitors
  - Predation can help maintain species diversity

**Partivory**

- One species (partivore) consumes part of another species (host) without killing or consuming all of it

**C. Symbiosis**

- **Sym-** : “together”; **-bios**: “living”
- One species living in, on, or in tight association with another species
- **Symbiont** and **Host**
- Three types of symbiosis
  - **Parasitism** + –
  - **Commensalism** + 0
  - **Mutualism** + +

---

Aedes aegypti feeding on human

Pisaster sea star eating a mussel

Predation and Diversity
Parasitism

- Symbiont benefits at the expense of the host
- Other kinds of parasite cost their host something else
  - E.g., “brood parasite”: Cuckoo “foster” their young in other species nests

Parasitoid

- Parasite or slow predator?
  - A “good” parasite does not kill its host
- Parasitoid wasp stings & paralyzes spider — but does not kill it
- Lays eggs inside spider
- Wasp larvae hatch & consume living spider
- Spider killed when larva metamorphose & emerge

Commensalism

- Symbiont has no significant effect on host
- Eagles nesting in conifers

Commensalism or Parasitism?

- Manta & remoras
- Is the effect of the symbiont on the host really insignificant?

Mutualism

- Both symbiont & host benefit from the relationship
- Acacias & ants
  - S. Am. Acacias provide shelter, nectar & antfood to harbor Pseudomyrmex ants
  - Ants defend the acacias from herbivores, pathogenic fungi & competing vegetation
Commensalism or Mutualism?
Is the benefit to the host significant?

Commensalism:
A species is neither benefited nor harmed by another species, but the activity, metabolism or defenses of the first species inhibits or eliminates the second species

Harmful algal blooms (HAB)
- Overgrowth of photosynthetic cyanobacteria or protists
- Consumption of $dO_2$, decreased light penetration, and/or production of toxic metabolites impacts other aquatic spp.

Amensalism:
A species is neither benefited nor harmed by another species, but the activity, metabolism or defenses of the first species inhibits or eliminates the second species

Human amensalism
- Agricultural & urban development, and waste production
- Negatively impact many species

Burrowing owls
- Inhabit old tunnels of prairie dogs or ground squirrels in dry grasslands
- Populations nation-wide threatened by habitat loss
- Listed as endangered & CA Species of Special Interest

Competition or Amensalism?

- If Balanus distribution is the same whether or not Chthalamus is present, should it be called a competitive or amensal interaction?

Barnacle populations illustrating competitive exclusion

Pathogens
- Microorganisms that cause disease
- May be trophic or amensal
  - Sudden Oak Death (SOD)