Chapter 8
Understanding Populations

Section 2:
How Species Interact with Each Other

Key Terms:
- Niche
- Competition
- Predation
- Parasitism
- Mutualism
- Commensalism
- Symbiosis
How Species Interact with Each Other

Objectives:

• Explain the difference between niche and habitat.
• Give examples of parts of a niche.
• Describe the five major types of interactions between species.
• Explain the difference between parasitism and predation.
• Explain how symbiotic relationships may evolve.
An Organism’s Niche

• An organism’s **niche** describes not only the environment where it lives, but *how* it interacts with biotic and abiotic factors in the environment.

• Habitat is an organism’s location, **niche** is the pattern of use of the habitat.

• How one organism interacts with other organisms is an important part of defining its **niche**.
An Organism’s Niche

Full range of biotic and abiotic factors in which an organism lives and the way in which the organism uses its habitat.

- An organism’s job or role (the type of food eaten, how it gets it, and what it does)
- Example: Bullfrog niches - eats insects, worms, spiders, small fish; preyed on by herons, raccoons, snakes
An Organism’s Niche

- **Abitoc factors** include weather, soil, water, and other non-living things.

  Ex: Most amphibians lose and absorb water through their skin, so they must live in moist places. If an area is too hot and dry, or too cold for too long, most amphibians cannot survive.

- **Biotic factors** include factors an organism requires for survival, such as when and how it reproduces, the food it eats, and the way in which it obtains that food.

  Ex: Birds on Christmas Island in the Indian Ocean all live in the same habitat but they prey on fish of different sizes and feed in different places. Thus, each species occupies a distinct niche.
Ways in Which Species Interact

Ecologists call relationships between species in a community **interspecific** interactions

- Competition
- Predation
- Symbiosis (**Parasitism**, **Mutualism**, and **Commensalism**)

Community interactions are classified by whether they help (+), harm (-), or have no effect (0) on the species involved.
Competition

• Competition occurs when organisms attempt to use the same limited ecological resource in the same place at the same time.

• Competition can occur both between members of the same species (known as **intraspecific** competition) and between members of different species (known as **interspecific** competition).

• Competition within a population is part of the pressure of natural selection.
Competition

- Plant roots compete for resources such as water and nutrients in the soil.
- Animals compete for resources such as food, mates, and places to live and raise their young.
Competition

How does competition shape communities?

By causing species to divide resources, competition helps determine the number and kinds of species in a community and the niche each species occupies.
Competition between species with identical niches has two possible outcomes

- One of the species, using resources more efficiently and having a reproductive advantage, will eventually eliminate the other, called **competitive exclusion**.

- Natural selection may lead to **resource partitioning**. Instead of competing for similar resources, species usually divide them.
Competitive Exclusion Principle

- No two species can occupy the same niche in the same habitat at the same time.

- Direct competition between different species almost always produces a **winner** and a **loser** – and the losing species dies out.
Resource partitioning is differentiation of ecological niches, enabling similar species to coexist in a community.
Resource Partitioning

- Three species of North American warblers all live in the same trees and feed on insects.
- One species feeds on high branches; another feeds on low branches, and another feeds in the middle.
- By causing species to divide resources, competition helps determine the number and kinds of species in a community and the niche each species occupies.
Predation

Species Interaction when one organism captures and feeds on another organism.

- **Predator** (consumer) - does the killing & eating
- **Prey** (food) - gets eaten
Predation (+,-)

Predators can affect the size of prey populations in a community and determine the places prey can live and feed.

Birds of prey, for example, can play an important role in regulating the population sizes of mice, voles, and other small mammals.
Predation (+,-)

Predation leads to diverse adaptations in both predator and prey.

- Some feeding adaptations of predators are claws, teeth, fangs, stingers, and poison.
- Behavioral defenses include hiding, fleeing, forming herds or schools, self-defense, and alarm calls.
Predator-Prey Relationships

This graph shows an idealized computer model of changes in predator and prey populations over time.
Predator-Prey Relationships

![Graph showing the population dynamics of Snowshoe hare and Lynx over time.](image-url)
Symbiosis and Coevolution

Symbiosis -- relationships in which two species live closely together. “Symbiosis” means “living together.”

The three main classes of symbiotic relationships in nature are:

- **Parasitism** (+, -)
- **Mutualism** (+,+)  
- **Commensalism** (+,0)
Symbiosis and Coevolution

• Species may evolve adaptations that reduce the harm or improve the benefit of the relationship.
• Coevolution simply put: evolution together.
• Example: specialized bills of hummingbirds for the Hawaiian honeycreeper flower.
Parasitism (+,-)

• One organism (parasite) lives on or inside another organism (host) and benefits but the host is harmed.

• Parasite obtains all or part of its nutritional needs from another organism.
Parasitism (+,-)

- Generally, parasites weaken but do not kill their host, which is usually larger than the parasite.
- Evolutionary advantage if the host lives.
- Parasitism can be considered a form of predation except that parasite spends some or all of life in or on host and parasites usually don’t kill host.
Hornworm caterpillar
Tomato Plant
Parasitic wasp
Parasitism (+,-)

- Tapeworms live in the intestines of mammals where they absorb large amounts of their hosts’ food.

- Fleas, ticks, lice, and leeches, live on the bodies of mammals and feed on their blood and skin.
Mutualism (+,+)

- Mutualism is an interspecific interaction that benefits both species.
- Mutualism can be:
  - obligate, where one species cannot survive without the other, or
  - facultative, where both species can survive alone.
Hollow thorns house stinging ants – the ants get the nectar and the tree is kept free of anything that touches the tree such as fungal spores, herbivores and debris.
Mutualism (+,+)

- The sea anemone’s sting has two functions: to capture prey and to protect the anemone from predators. Even so, certain fish manage to snack on anemone tentacles.

- The clownfish is immune to anemone stings. When threatened by a predator, clownfish seek shelter by snuggling deep into an anemone’s tentacles.

- If an anemone-eating species tries to attack the anemone, the clownfish dart out and chase away the predators.
Mutualism - *Rhizobium* (bacteria are red, false-color image in right figure) in soybean root nodules.
Mutualism between “cleaner organism”, in this case a prawn (Lysmata amboiensis, a shrimp relative), and moray eel: prawn gets food, eel gets parasites removed (from Ricklefs, 2001)
**Mutualism**: Flowers of *Penstemon* sp. in the Sonoran Desert pollinated by the rufous hummingbird (Photo from www.desertmuseum.org)

Below is another *Penstemon* sp. being pollinated by a bee (from helios.bto.ed.ac.uk/bto/desertecology/bees.htm)

Pollination is an extraordinarily important mutualism
Commensalism (+,0)
One organism **benefits** and the other is neither **helped nor harmed**.

Remora and shark
Commensalism (+,0)

Barnacles often attach themselves to a whale’s skin. They perform no known service to the whale, nor do they harm it. Yet the barnacles benefit from the constant movement of water that is full of food particles past the swimming whale.
Commensalism (+,0)

Examples of commensalism:

• Algae that grow on the shells of sea turtles

• Birds that feed on insects flushed out of the grass by grazing cattle
Commensalism (+,0): Cactus wren
Ways in Which Species Interact

Types of Species Interactions

<table>
<thead>
<tr>
<th>Interaction</th>
<th>Species A</th>
<th>Species B</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competition</td>
<td>harmed</td>
<td>harmed</td>
<td>Each species negatively affects the other.</td>
</tr>
<tr>
<td>Predation and parasitism</td>
<td>benefited</td>
<td>harmed</td>
<td>Species A feeds on species B.</td>
</tr>
<tr>
<td>Mutualism</td>
<td>benefited</td>
<td>benefited</td>
<td>Each species is helpful to the other.</td>
</tr>
<tr>
<td>Commensalism</td>
<td>benefited</td>
<td>unaffected</td>
<td>Species A benefits from species B, but B is unaffected.</td>
</tr>
</tbody>
</table>

**COMMENSALISM** Wren makes nest without affecting cactus

**MUTUALISM** Yucca moth pollinates and lays eggs on yucca flowers; moth larvae spread yucca seeds

**PREDATION** Kit fox hunts and feeds on kangaroo rat

**COMPETITION** Fox and coyote are predators of same prey