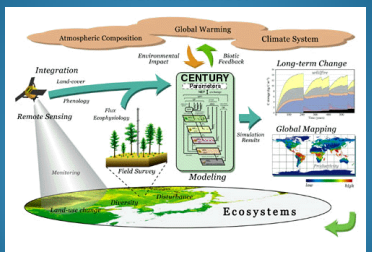
# Chapter 4: Ecosystems and Community Interactions

Section 4.2 Niches and Community Interactions

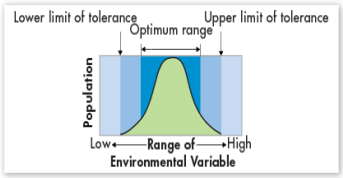
Mrs. Michaelsen






## Tolerance

- Every species has its own range of **tolerance**: The ability to survive and reproduce under a range of environmental circumstances.





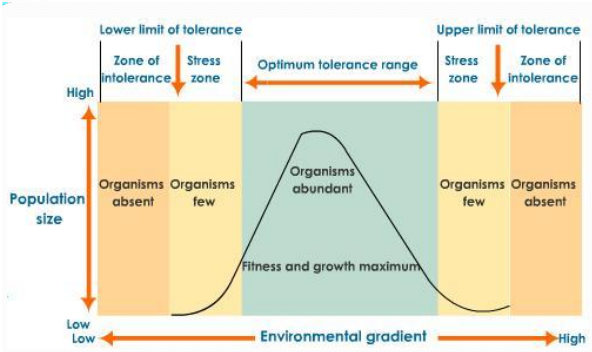

## Tolerance

- Stress can result when an environmental condition, (e.g. temperature), extends in either direction beyond an organism's optimum range.
- The organism must expend more energy to maintain homeostasis, and has less energy left for growth and reproduction.




## Tolerance

- All organisms have an upper and lower limit of tolerance. Beyond those limits, the organism cannot survive.
- A species' tolerance helps determine its **habitat**: The general place where an organism lives.






## Defining the Niche

- **Niche** describes the environment where it lives, but also *how* it interacts with biotic and abiotic factors in the environment.
- Includes the physical and biological aspects of its environment and the way in which the organism uses them to survive and reproduce.
- Remember: ***Habitat is the organism's "address", and the niche is its "profession".***



## Example of Habitat/Niche

- **Oak trees:**
- Habitat (address):
  - Oak woodlands
  - Country Road D, Chetek, WI 54728
- Niche (profession):
  - Absorb sunlight by photosynthesis;
  - Absorb water and mineral salts from the soil;
  - Provide shelter for many animals and other plants;
  - Act as a support for creeping plants;
  - Serve as a source of food for animals;
  - Cover the ground with their dead leaves in the autumn.



## Resources and the Niche

- **Resource** can refer to any necessity of life: water, nutrients, light, food, or space.
  - Plants: Sunlight, water, and soil nutrients.
  - Animals: Nesting space, shelter, types of food, and places to feed.

## Physical Aspects of the Niche

- Part of an organism's niche involves the abiotic factors it requires for survival.

- Example: 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.



## Biological Aspects of the Niche

- Includes the biotic factors an organism requires for survival:
  - When and how it reproduces, the food it eats, and the way in which it obtains that food.
- Example: 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.
  - Each species occupies a distinct niche.



## Competition

- How one organism interacts with other organisms is an important part of defining its niche.
- Competition occurs when organisms attempt to use the same limited ecological resource in the same place at the same time.



## 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.
  - **Intraspecific competition:** Occurs between members of the same species.
  - **Interspecific competition:** Occurs between members of different species.

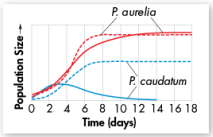
## The Competitive Exclusion Principle

- Direct competition between different species almost always produces a winner and a loser—and the losing species dies out.



## The Competitive Exclusion Principle

- In the experiment shown in the graph, two species of paramecia (*P. aurelia* and *P. caudatum)* were first grown in separate cultures (dashed lines) . In separate cultures, but under the same conditions, both populations grew.
- However, when both species were grown together in the same culture (solid line), one species outcompeted the other, and the less competitive species did not survive.





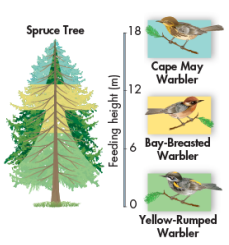

## The Competitive Exclusion Principle

- The **competitive exclusion principle** states that no two species can occupy exactly the same niche in exactly the same habitat at exactly the same time.
- One species will be better at competing for limited resources and will eventually exclude the other species.
- As a result, natural communities rarely have niches that overlap significantly.



## Dividing Resources

- Instead of competing for similar resources, species usually divide them.
- Example: Three species of North American warblers shown all live in the same trees and feed on insects.
- But one species feeds on high branches; another feeds on low branches, and another feeds in the middle.



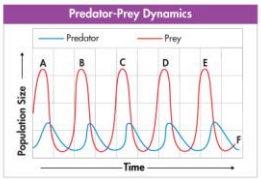
## Predator-Prey Relationships

- **Predation:** An interaction in which one animal (the predator) captures and feeds on another animal (the prey).
  - Predators can affect the size of prey populations in a community and determine the places prey can live and feed.
  - Birds of prey help regulate the population sizes of mice, voles, and other small mammals.



## Predator-Prey Relationships

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






## Herbivore-Plant Relationships

- **Herbivory:** An interaction in which one animal (the herbivore) feeds on producers (such as plants).
  - Example: Dense populations of white-tailed deer are eliminating their favorite food plants from many places across the United States.



## Keystone Species

- Sometimes changes in the population of a single species, often called a **keystone species,** can cause dramatic changes in the structure of a community.
  - Example: Sea otters off the Pacific coast devour large quantities of sea urchins.
  - Urchins are herbivores whose favorite food is kelp, giant algae that grow in undersea "forests."

# Keystone Species

- A century ago, sea otters were nearly eliminated by hunting. Unexpectedly, the kelp forest nearly vanished.
- Without otters as predators, the sea urchin population skyrocketed, and armies of urchins devoured kelp down to bare rock.
- Without kelp to provide habitat, many other animals, including seabirds, disappeared.
- Otters were a keystone species in this community.



# Symbioses

- Any relationship in which two species live closely together is called **symbiosis**, which means "living together."
- The three main classes of symbiotic relationships in nature are mutualism, parasitism, and commensalism.



# Mutualism

- **Mutualism**: Relationship between species in which both benefit.
- Sea anemone and clownfish.
  - 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.



# Parasitism

- **Parasitism:** Relationship in which one organism lives inside or on another organism and harms it.
  - Tapeworms live in the intestines of mammals.
  - Fleas, ticks, lice, and the leech shown, live on the bodies of mammals and feed on their blood and skin.
- Obtains all or part of its nutritional needs from the host.
- Weakens, but does not kill host.

# Commensalism

- **Commensalism:** Relationship in which one organism benefits and the other is neither helped nor harmed.
  - 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.