Topic 1.1
Introduction To Ecosystems

Enduring Understanding: Ecosystems are the result of biotic and abiotic interactions

Learning Objective: Explain how the availability of resources influences species interactions

Components of Ecosystems

- **What makes up an ecosystem and how do its components interact?**
  - Ecosystems are natural units made up of a community of living organisms (***biotic factors***) and the physical conditions (***abiotic factors***) in an area
  - A ***community*** of living organisms and the physical (non-living) components of their environment.
  - The community itself is made up of a number of different ***populations.***
  - **Populations** are organisms of the same species living in the same geographical environment.
  - The type and availability of resources in the environment determine the species distribution and survival and influence how different species interact.

Components of Ecosystems

- Interactions of living organisms with each other and with the physical environment help determine an ecosystems features
- Components of an ecosystem are linked to each other through nutrient cycles and the flow of energy.

Biotic Factors	**Abiotic Factors**		
The **living organisms** in the environment including their interactions	**Hydrosphere** (water)	**Atmosphere** (air)	**Lithosphere** (rock/soil)
• Plants • Animals • Microorganisms (protists, bacteria, archaea) • Fungi	• Dissolved Nutrients • pH • Salinity • Dissolved Oxygen • Precipitation • Temperature	• Wind Speed • Wind Direction • Humidity • Light Intensity/quality • Temperature	• Nutrient Availability • Soil moisture • pH • Texture • Depth • Temperature

Resources and the Interactions Between Species

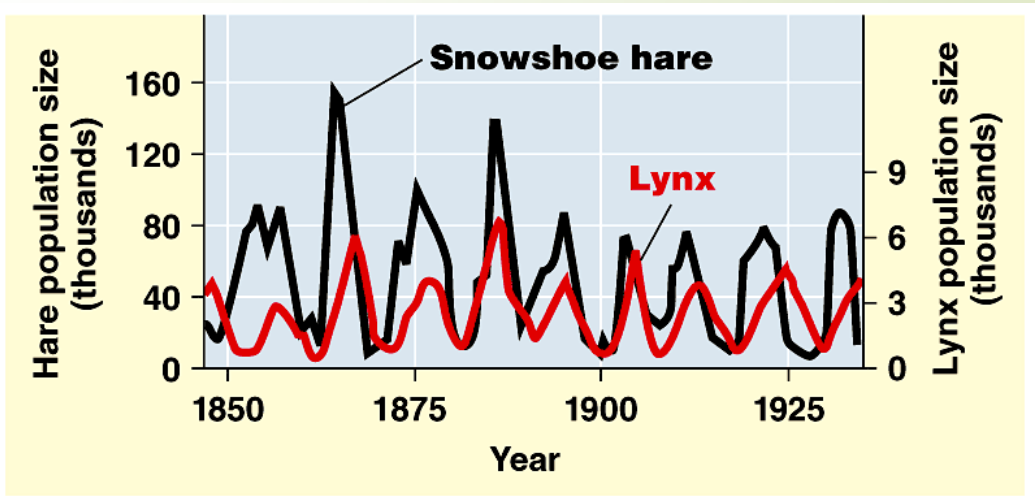
- **How do Species interact within ecosystems and how are their interactions influenced by resources?**
  - Interactions between species are an important component of the biotic factors that structure ecosystems
  - Resource availability within ecosystems often influences the extent to which species interact, especially in ***interspecific competition*** for ***limited resources***
  - Some relationships involve exploitation, e.g. ***predator-prey***, including herbivory
  - Others relationships involve two or more species being reliant on their close ecological relationship (***Symbiosis***)
    - ***Mutualism, commensalism, parasitism***

Type of Interaction Between Species

Mutualism +/+	Commensalism +/Ø	Parasitism +/-	Predation +/-	Competition -/-
A type of symbiosis that may be obligate, meaning both species depend on it for survival. Both species benefit.	A type of symbiosis. One species benefits and the other is unaffected. It is likely that many commensal relationships involve a small effect on the apparently neutral party	A symbiotic relationship in which the parasite lives in or on the host, taking significant nutrition from it. The host is harmed but not usually killed directly.	A predator kills the prey and eats it.	Individuals of the same or different species compete for the same limited resource. Both parties are harmed by getting fewer resources.
Flowering plants and their insect pollinators	Anemone shrimp and anemone (shrimp is protected by barbs of anemone and gets food scraps, anemone is generally unaffected.	Mistletoe is a parasitic plant that taps into the phloem of various tree species; siphoning away water, nutrients and sugars	Cheetah eats a gazelle	Trees (of the same species and of different species) compete for sunlight in a tropical forest
				

Predator-Prey Interactions

- A predator consuming is prey is an obvious ecological interaction between species
- Predator and prey populations influence one another and the structure of the ecosystems they are part of
  - Predators are well adapted to locating and subduing their prey
  - Prey are well adapted to avoiding being eaten and maintaining their population size despite predation
  - Predator populations are heavily influenced by the availability of prey, especially when there is little chance of switching to alternative prey species

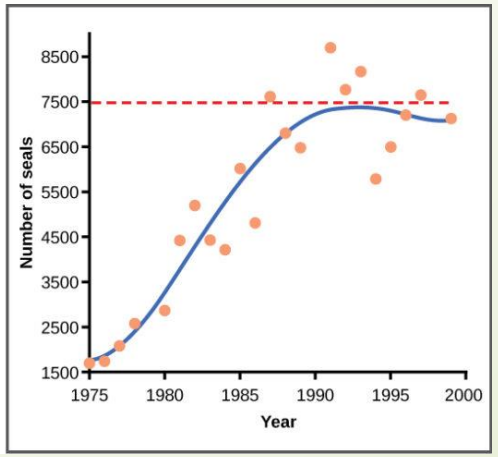


The Nature of Symbiosis

- Resource availability often determines the type of symbiotic relationship
- Mutualistic and commensal relationships result when one or both species obtain increased access to a resource through their relationship
  - **Resource–Resource Relationships**: one resource is traded for another.
  - Termites rely on a mutualism with bacteria in their digestive tract. Termites supply cellulose as food to the bacteria, in turn bacteria digest cellulose into simpler carbohydrates (glucose) that are a more efficient energy source to the termite.
  - **Resource-Service Relationships**: a resource is traded for a service provided
  - Bees and flowering plants, the bee receives nectar (sugar/energy) and the flower is pollinated (gametes transferred from plant to plant.
- Parasites exploit their hosts for the resource they provide, but they usually do not kill their hosts directly
  - Hosts may die from parasitism when combined with other stressors
    - Mistletoe normally does not kill oaks, but may during droughts when the trees face additional stress
  - Evolution favors parasite/host relationships that are mutually tolerable

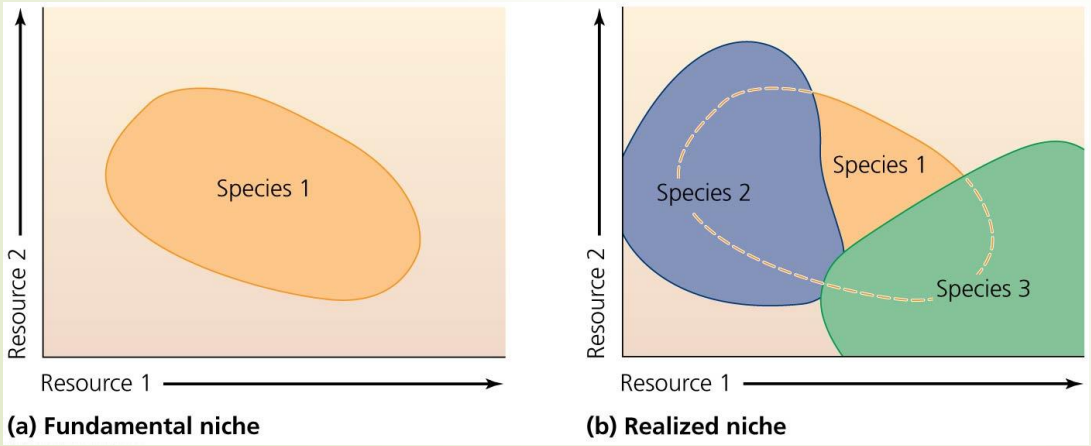
Intraspecific Competition

- ***Intraspecific competition*** describes competition among individuals of the same species.
  - These individuals share the same resource requirements (food, habitat, mates) so competition is often more intense than competition between different species
  - Resource limitations and competition for these limited resources often affects individual size, population size, and population distribution.
- Examples of intraspecific competition:
  - *Scramble competition*: Race to consume a resource
  - *Contest competition*: Males big horn sheep competing with other males for mating privileges
  - *Social competition:* in social species such as wolves individuals compete for a place in the social hierarchy. Individuals of higher rank receive a greater share of available resources
- Intraspecific Competition often determines size of populations (***carrying capacity***)



Interspecific Competition

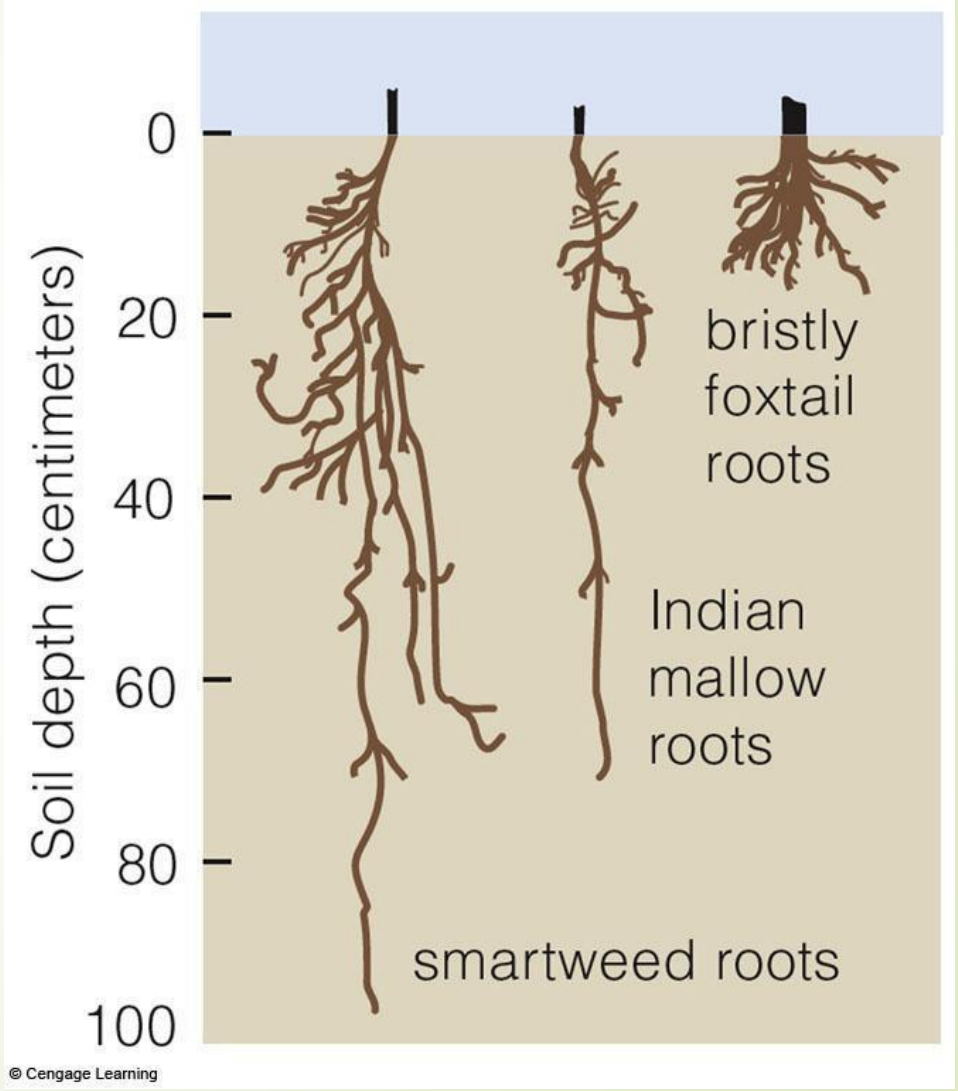
- ***Interspecific competition*** is competition between members of different species for shared resources.
- Generally less intense than intraspecific competition because the two different species competing will not have the exact same ***niche***
  - **Niche**: How an organism uses its environment; its job within its habitat. Functional role in a community (habitat use, food selection, role in energy and nutrient flow, interactions with other individuals)



- Interspecific Competition can result in:
  - ***Competitive exclusion***: One species drives the other to localized extinction.
  - ***Resource Partitioning***: One or both species evolve to utilize resources differently, thus avoiding direct competition for the shared resource
- In resource partitioning, the ***fundamental niche*** of the weaker competitor will be reduced to a smaller, more specialized ***realized niche*** through interspecific competition
  - Fundamental Niche: The full potential niche of a species
  - Realized Niche: The actual niche that is exploited by a species. Smaller than its fundamental niche as a result of interspecific competition or other species interactions

Resource Partitioning

- Resource partitioning allows organisms with similar ecological requirements to minimize interspecific competition and coexist by exploiting resources in different areas of an ecosystem or at different times of the day or year within the ecosystem
- Resource partitioning allows these three different species of prairie plants to coexist in the same ecosystem
  - Resources of water and nutrients are obtained at different soil depths by the various plants.
  - Different depths of roots minimizes competition for the shared resources of water and nutrients at any one depth in the soil profile.



Interspecific Competition

- **Character displacement**
  - competing species diverge in their physical characteristics due to the evolution of traits best suited to the resources they use
  - Results from resource partitioning

➡ *Competition is reduced when two species become more different*