Science of Ecology

Big Picture

Ecology is the study of how living organisms interact with each other and their surrounding environment. Ecosystems are umbrellas of organisms and their interactions with each other and the environment. Ecosystems can describe the entire Amazon Rainforest or simply a rotting log on the forest ground. Because an ecosystem is shaped by abiotic and biotic factors, the world with its wide diversity of physical conditions creates a variety of environments. Within an ecosystem, producers provide food for consumers, and both of their carcasses are then broken down by decomposers. This simple food chain makes up intricate food webs within an ecosystem.

Key Terms

Ecology: The study of how living organisms interact with each other and their environment.

Abiotic Factor: A physical aspect an environment, also known as a non-living factor.

Biotic Factor: A living aspect of the environment.

Ecosystem: An ecosystem is a complex system that consists of all the biotic (living) and abiotic (physical) aspects of the environment.

Niche: The role of a species in its ecosystem, which includes the way that the species interacts with the abiotic and biotic factors in its environment.

Habitat: A location where a specific population of a species lives.

Competitive Exclusion Principle: The idea that two species cannot occupy the same niche in the same place for a long period of time.

Food Chain: A diagram showing a single pathway through which energy and matter flow through an ecosystem.

Food Web: A diagram that represents multiple pathways through which energy and matter flow through an ecosystem.

Trophic Level: The feeding positions in a food chain or food web.

Biomass: The total mass of organisms at a specific trophic level.

Producer (or autotroph): An organism that creates its own food. Can be divided into photoautotrophs and chemoautotrophs.

Consumer (or heterotroph): An organism that consumes other organisms for energy. Can be classified as a herbivore, carnivore, or omnivore.

Decomposer: An organism that breaks down the remains of producers and consumers and releases simple inorganic molecules back into the environment. Can be classified as a scavenger, detritivore, or saprotroph.

Organisms and the Environment

Organisms don't just live on their own isolated from the environment. Instead, organisms interact with the environment in a variety of ways. Studying these interactions is a part of **ecology**.

The environment has two factors:

1. **Abiotic factors** include light intensity, temperature range, mineral availability, soil/rock type, and relative acidity (pH), just to name a few.
2. **Biotic factors** include the other organisms in the environment. The presence of other organisms will affect an organism's growth and chances of survival.

The Ecosystem

Here are some important things to remember about **ecosystems** (also called ecological systems):

- They can vary in size.
- An ecosystem needs a constant input of energy to maintain their chemical and physical organizations. Otherwise, ecosystems will rapidly disintegrate. This applies to other living systems as well.
- Every species in the ecosystem have a specific **niche**.
  - Think of niche as the way a species lives - the **habitat**, food, and way food is obtained are all aspects of the niche.
  - All the species in a habitat must have different niches (**competitive exclusion principle**). If two species living in the same habitat have the same niche, they will compete for the same food and resources. One species will eventually win, leaving one species in the niche.
- Organisms adapt to their habitat. For example, to better camouflage with the environment, a wolf living in the tundra will be gray, whereas a wolf living in a snowy area will be more white.
- Ecosystems tend to show cyclic changes around an equilibrium.
  - An ecosystem's stability is affected by environmental changes and the populations living within the ecosystem.
  - An ecosystem altered by human activities, environmental changes, and other factors can usually recover back to long-term stability through eventual changes.

Science of Ecology cont.

Flow of Energy

Energy enters ecosystems as sunlight or chemical compounds. **Producers** (also called autotrophs) use this energy to produce food for themselves and other organisms. There are two types of producers:

- *Photoautotrophs*: Producers that capture energy from the sun to produce food through the process of photosynthesis; includes plants, certain types of bacteria, and algae.
- *Chemoautotrophs*: Producers that use energy from chemical compounds to make food by chemosynthesis; includes some bacteria and archaea.

Consumers (also called heterotrophs) consume other living things to obtain energy. Consumers can be classified as:

- *Herbivore*: Consumes producers, examples include deer, rabbits, mice.
- *Carnivore*: Consumes herbivores or other carnivores, examples include wolves, lions, hawks, frogs, spiders.
- *Omnivore*: Consumes producers and other consumers, examples include humans, brown bears, pigs.

Decomposers are an important part of the ecosystem because they break down remains and wastes and release simple inorganic molecules that producers can use. Decomposers include:

- *Scavenger*: Consumes tissues of dead animals. Examples include vultures, raccoons.
- *Detritivore*: Consumes wastes and other organic debris (dead leaves, animal feces, and other organic debris that collects on soil or on the bottom of a body of water). Examples include dung beetles, earthworms.
- *Saprotroph*: Consumes any remaining organic material that is left over from other decomposers. Examples include fungi, single-celled protozoa.

Food Chains and Food Webs

Food chains and **food webs** help illustrate how energy flows through the ecosystem.

- A food chain shows a single pathway that energy and matter can take to flow through an ecosystem. It tends to be simpler than what really happens in nature.
- A food web shows the complexity of how energy and matter flow through an ecosystem by containing many intersecting food chains.

The position an organism occupies on the food chain or food web is called the **trophic level.** Example:

- First trophic level: Occupied by producers (plants, bacteria, algae).
- Second trophic level: Occupied by primary consumers (herbivores) who get their energy from producers or organisms in the first trophic level.
- Third trophic level: Occupied by secondary consumers (carnivores and omnivores) who get their energy from primary consumers or organisms in the second trophic level.

Energy moves between each trophic level, but only about 10% of the energy of the previous trophic level passes to the next trophic level. Therefore, it is unrealistic to imagine an ecosystem with more than four or five trophic levels because usually by those levels, there is very little energy that passes through, making it difficult for the organisms in that trophic level to survive.

- There are exceptions to this, such as the Amazon rainforest. Because there are many producers, there is a huge amount of energy available for use in the first trophic level, thus allowing more trophic levels in the ecosystem.

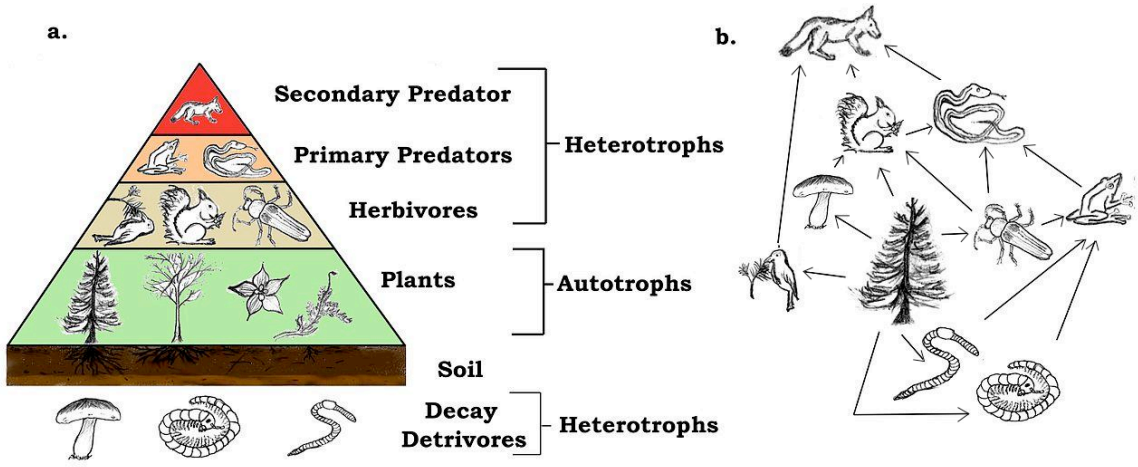

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Figure: A trophic pyramid (a) and an ecological food web (b). Trophic pyramids show lower trophic levels at the bottom of the pyramid. At higher trophic levels, the **biomass** decreases because there is less energy to support organisms.