1. Ecosystem Structure and Function

The ecosystem is the structural and functional unit of ecology where the living organisms interact with each other and the surrounding environment. In other words, an ecosystem is a chain of interaction between organisms and their environment. The term “Ecosystem” was first coined by A.G.Tansley, an English botanist, in 1935.

Read on to explore the structure, components, types and functions of the ecosystem in the ecosystem notes provided below.

Types of Ecosystem

An ecosystem can be as small as an oasis in a desert, or as big as an ocean, spanning thousands of miles. There are two types of ecosystem:

- Terrestrial Ecosystem
- Aquatic Ecosystem

Terrestrial Ecosystems

Terrestrial ecosystems are exclusively land-based ecosystems. There are different types of terrestrial ecosystems distributed around various geological zones. They are as follows:

1. Forest Ecosystems
2. Grassland Ecosystems
3. Tundra Ecosystems
4. Desert Ecosystem

Forest Ecosystem

A forest ecosystem consists of several plants, animals and microorganisms that live in coordination with the abiotic factors of the environment. Forests help in maintaining the temperature of the earth and are the major carbon sink.

Grassland Ecosystem

In a grassland ecosystem, the vegetation is dominated by grasses and herbs. Temperate grasslands, savanna grasslands are some of the examples of grassland ecosystems.

Tundra Ecosystem

Tundra ecosystems are devoid of trees and are found in cold climates or where rainfall is scarce. These are covered with snow for most of the year. The ecosystem in the Arctic or mountain tops is tundra type.

Desert Ecosystem

Deserts are found throughout the world. These are regions with very little rainfall. The days are hot and the nights are cold.

Aquatic Ecosystem

Aquatic ecosystems are ecosystems present in a body of water. These can be further divided into two types, namely:

1. Freshwater Ecosystem
2. Marine Ecosystem

Freshwater Ecosystem

The freshwater ecosystem is an aquatic ecosystem that includes lakes, ponds, rivers, streams and wetlands. These have no salt content in contrast with the marine ecosystem.

Marine Ecosystem

The marine ecosystem includes seas and oceans. These have a more substantial salt content and greater biodiversity in comparison to the freshwater ecosystem.

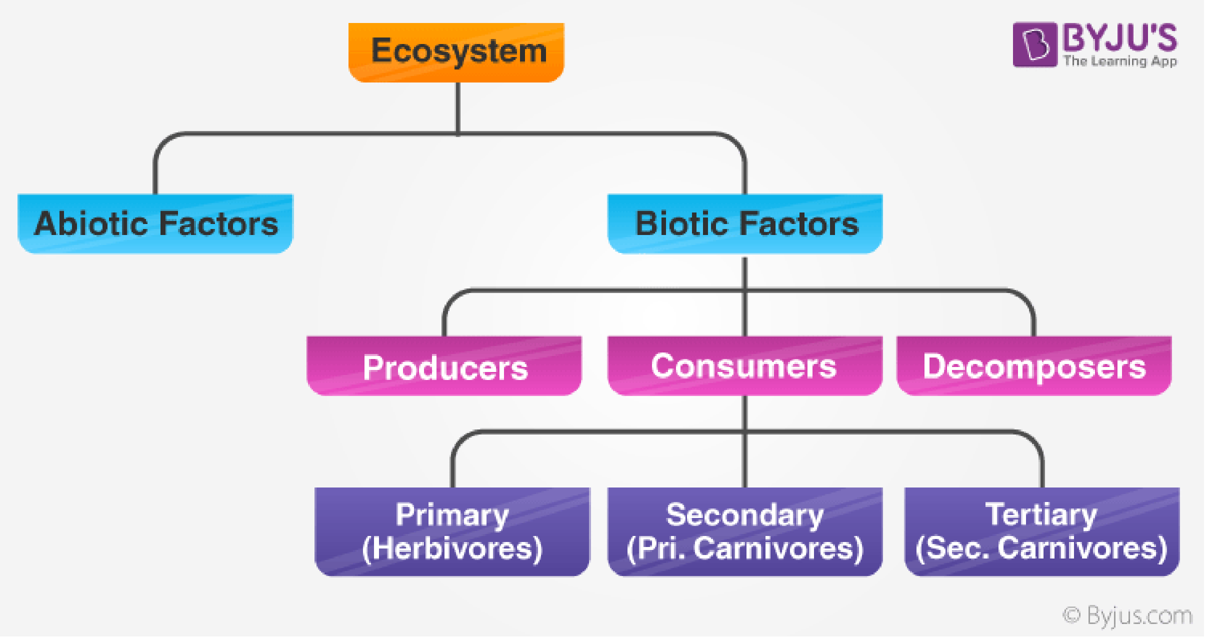
Structure of the Ecosystem

The structure of an ecosystem is characterised by the organisation of both biotic and abiotic components. This includes the distribution of energy in **our environment**. It also includes the climatic conditions prevailing in that particular environment.

The structure of an ecosystem can be split into two main components, namely:

- Biotic Components
- Abiotic Components

The biotic and abiotic components are interrelated in an ecosystem. It is an open system where the energy and components can flow throughout the boundaries.



Structure of Ecosystem highlighting the biotic and abiotic factors

Biotic Components

Biotic components refer to all life in an ecosystem. Based on nutrition, biotic components can be categorised into autotrophs, heterotrophs and saprotrophs (or decomposers).

- **Producers** include all autotrophs such as plants. They are called autotrophs as they can produce food through the process of photosynthesis. Consequently, all other organisms higher up on the food chain rely on producers for food.
- **Consumers** or heterotrophs are organisms that depend on other organisms for food. Consumers are further classified into primary consumers, secondary consumers and tertiary consumers.
    - ***Primary consumers*** are always herbivores that they rely on producers for food.
    - ***Secondary consumers*** depend on primary consumers for energy. They can either be a carnivore or an omnivore.
    - ***Tertiary consumers*** are organisms that depend on secondary consumers for food. Tertiary consumers can also be an omnivore.
    - ***Quaternary consumers*** are present in some food chains. These organisms prey on tertiary consumers for energy. Furthermore, they are usually at the top of a food chain as they have no natural predators.
- **Decomposers** include saprophytes such as fungi and bacteria. They directly thrive on the dead and decaying organic matter. Decomposers are essential for the ecosystem as they help in recycling nutrients to be reused by plants.

Abiotic Components

Abiotic components are the non-living component of an ecosystem. It includes air, water, soil, minerals, sunlight, temperature, nutrients, wind, altitude, turbidity, etc.

Functions of Ecosystem

The functions of the ecosystem are as follows:

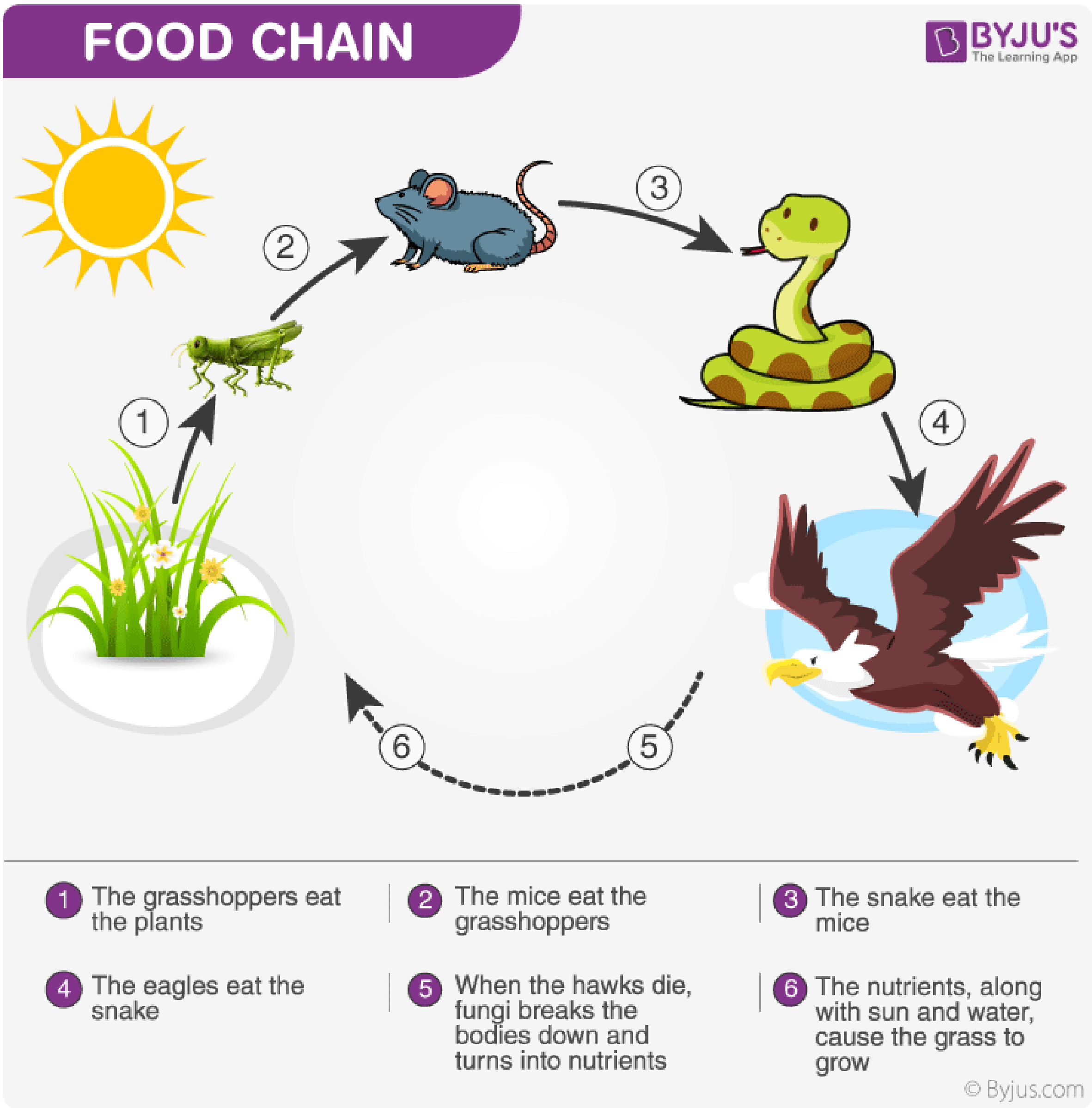
1.
    1. It regulates the essential ecological processes, supports life systems and renders stability.
    2. It is also responsible for the cycling of nutrients between biotic and abiotic components.
    3. It maintains a balance among the various trophic levels in the ecosystem.
    4. It cycles the minerals through the biosphere.
    5. The abiotic components help in the synthesis of organic components that involves the exchange of energy.

2 . Food Chain

The sun is the ultimate source of energy on earth. It provides the energy required for all plant life. The plants utilise this energy for the process of photosynthesis, which is used to synthesise their food.

During this biological process, light energy is converted into chemical energy and is passed on through successive levels. The flow of energy from a producer, to a consumer and eventually, to an apex predator or a detritivore is called the food chain.

Dead and decaying matter, along with organic debris, is broken down into its constituents by scavengers. The reducers then absorb these constituents. After gaining the energy, the reducers liberate molecules to the environment, which can be utilised again by the producers.



A classic example of a food chain in an ecosystem

- The food chain is an ideal representation of flow of energy in the ecosystem.
- In food chain, the plants or producers are consumed by only the primary consumers, primary consumers are fed by only the secondary consumers and so on.
- The producers that are capable to produce their own food are called autotrophs.
- Any food chain consists of three main tropic levels, viz., producers, consumers and decomposers.

- The energy efficiency of each tropic level is very low. Hence, shorter the food chain greater will be the accessibility of food.
- The typical food chain in a ground ecosystem proceeds as grass mouse—————-> snake ————> hawk.
- Food webs are more complex and are interrelated at different tropic levels.
- Organisms have more than one choice for food and hence can survive better.
- Hawks don’t restrict their food to snakes, snakes eat animals other than mice, and mice eat grass as well as grasshoppers, and so on.
- A more realistic illustration of feeding habits in an ecosystem is called a food web.

3. Food web

- Charles Elton presented the food web concept in year 1927, which he termed as food cycle.
- Charles Elton described the concept of food web as:
- The carnivore animals prey on the herbivores.
- These herbivores obtain the energy from sunlight.
- The later carnivores may also be preyed upon by other carnivores.
- Until a reach where an animal has no enemies it forms a terminus on this food cycle.
- There are chains of animals that are related together by food, and all are dependent on plants in the long run.
- This is termed as a food chain and all the food chains in a community is known as the food web.
- A food web is a graphical depiction of feeding connections among species of an ecological community.
- Food web includes food chains of a particular ecosystem.
- The food web is an illustration of various techniques of feeding that links the ecosystem.
- The food web also explains the energy flow through species of a community as a result of their feeding relationships.
- All the food chains are interconnected and overlapping within an ecosystem and they constitute a food web.
- In natural environment or an ecosystem, the relationships between the food chains are interrelated.
- These relationships are very complex, as one organism may be a part of multiple food chains.
- Hence, a web like structure is formed in place of a linear food chain.
- The web like structure if formed with the interlinked food chain and such matrix that is interconnected is known as a food web.
- Food webs are an inseparable part of an ecosystem; these food webs permit an organism to obtain food from more than one type of organism of the lower trophic level.

- Every living being is responsible and is a part of multiple food chains in the given ecosystem.

4. Ecological pyramids

- The trophic levels of different organisms based on their ecological position as producer to final consumer is represented by ecological pyramid.
- The food producer is present at the base of the pyramid and on the top.
- Other consumer trophic levels are present in between.
- The pyramid includes a number of horizontal bars presenting specific trophic levels.
- The length of each bar stands for the total number of individuals or biomass or energy at each trophic level in an ecosystem.
- An ecological pyramid is a graphical representation outlined to show the biomass or bio productivity at each trophic level in a given ecosystem.
- These are trophic pyramid, energy pyramid, or sometimes food pyramid.
- Biomass is the quantity of living or organic matter present in an organism.
- Biomass pyramids represent the amount of biomass, and how much of it is present in the organisms at each trophic level.
- The productivity pyramids shows the production or turnover in biomass.
- Ecological pyramids initiates with producers on the bottom such as green plants and proceed through the various trophic levels such as herbivores that feed on plants, then carnivores that feed on herbivores, then carnivores that feed those carnivores, and so on.
- The highest level is shown at the top of the chain.
- An ecological pyramid of biomass represents the relationship between biomass and trophic level by quantifying the biomass present at each trophic level of an ecological community at a particular time.
- It is a graphical representation of biomass present in per unit area in different trophic levels.
- Flow of energy through the food chain will be in a predictable way, entering at the base of the food chain, by photosynthesis in primary producers, and then moving up the food chain to higher trophic levels.
- The transfer of energy from one trophic level to the next is not efficient.
- It may also be useful and productive to analyse how the number and biomass of organisms differs across trophic levels.
- Both the number and biomass of organisms at each trophic level should be affected by the amount of energy joining that trophic level.
- When there is a direct correlation between energy, numbers, and biomass then biomass pyramids and numbers pyramids will be formed.
- However, the relationship between energy, biomass, and number can be complex by the growth form and size of organisms and ecological relationships occurring among trophic levels.

Types of pyramids:

- The ecological pyramids are of three categories:
    1. **Pyramid of numbers.**
    2. **Pyramid of biomass.**
    3. **Pyramid of energy or productivity.**

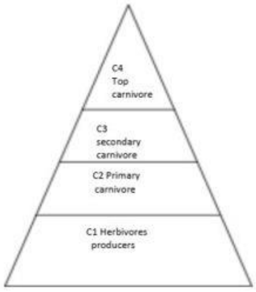


Fig: Pyramid of number of grassland ecosystem

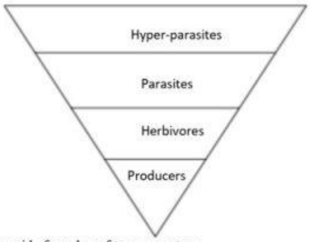


Fig: Pyramid of number of tree ecosystem.

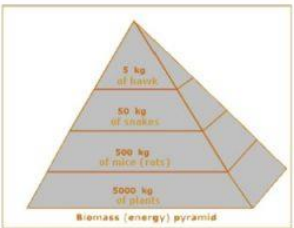


Fig: Pyramid of biomass

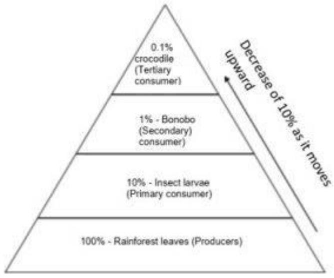


Fig: Pyramid of energy.

1. Pyramid of numbers:

- Pyramid of numbers represents the population of trophic level as the total number of individuals of different species present at each trophic level.
- Pyramid of numbers may be upright and or completely inverted depending upon count of individual present and so.
- The pyramid of number does not completely define the trophic structure for an ecosystem as it is very tough to count all the organisms present there.
- ***Pyramid of number- upright: grassland ecosystem***
- In this pyramid, the number of individuals is decreased from lower level to higher trophic level.
- The examples of pyramid of numbers are Grassland ecosystem and pond ecosystem.
- In grass ecosystem, at base (lowest trophic level) grass is present in plentiful amount.
- The next higher trophic level is primary consumer i.e. herbivore (example – grasshopper).
- The number count of grasshopper is less than that of grass.
- The next energy level is primary carnivore (example: rat). The number of rats are less than grasshopper, because, they feed on grasshopper.
- The next higher trophic level is secondary carnivore (example: snakes). They feed on rats.
- The next higher trophic level is the top carnivore. (example – Hawk).

- As we reach each higher trophic level, the numbers of individual decreases from lower to higher trophic level.
- ***Pyramid of numbers – inverted: tree ecosystem***
- In this type of pyramid, the number of individuals is increased from lower level to higher trophic level. Example, tree ecosystem.

2. Pyramid of biomass:

- Pyramid of biomass represents the total dry weight of organisms.
- It is usually determined by collecting all organisms inavding each trophic level separately and measuring their dry weight.
- This will serve to solve the size difference problem because all kinds of organisms at a trophic level are weighed.
- The unit for measurement of biomass is g/m2.
- The biomass of a species is expressed in terms of fresh or dry weight.
- Measurement of biomass in terms of dry weight is considered more accurate.
- Certain mass of living material of each trophic level at a particular time called as standing crop.
- The standing crop is measured as the mass of living organisms (biomass) or the number in a unit area.
- **pyramid of biomass: upright**
- The pyramid of biomass on land contains a large base of primary producers with a lesser trophic level present on top.
- The biomass of producer termed as autotrophs is at the maximum trophic level.
- The biomass of next trophic level from base, i.e., primary consumers is less than the producers.
- The biomass of next higher trophic level, i.e., secondary consumers is less than the primary consumers.
- The top, high trophic level consists very less amount of biomass.
- On other hand, in many aquatic ecosystems, the pyramid of biomass may be present in an inverted form whereas pyramid of numbers for aquatic ecosystem is upright.
- It is because the producers are small phytoplankton that grow and reproduce very rapidly.
- Here, the pyramid of biomass has a small base as compared to the consumer biomass at any instant actually exceeding the producer biomass and the pyramid is represent in inverted shape.

3. Pyramid of energy:

- The pyramid of energy represents the flow of energy from lower trophic level to higher trophic level.
- During the flow of energy from one organism to other, there is remarkable loss of energy.
- This loss of energy is in the form of heat.

- The primary producers like the autotrophs contain more amount of energy available.
- The least energy is available in the tertiary consumers.
- Thus, shorter food chain has more amount of energy available even at the highest trophic level.
- An energy pyramid is regarded most suitable to compare the functional roles of the trophic levels in an ecosystem.
- An energy pyramid represents the amount of energy at each trophic level and loss of energy taking place during transfer to another trophic level.
- Hence the pyramid is always upward, with a large energy base at the bottom.
- Suppose an ecosystem receives 1000 calories of light energy in a given day.
- Most of the energy is not absorbed by plants; some amount of energy is reflected back to space.
- Green plants utilise only a small portion of that absorbed energy, out of which the plant uses up some for respiration and of the 1000 calories, only 100 calories (10%) are stored as energy rich materials.
- Now, suppose an animal eats the plant containing 100 calorie of food energy, that animal uses some of it for its own metabolism and stores only 10 calorie as food energy.
- A lion that eats that animal gets an even smaller amount of energy.
- Thus, usable energy decreases while passing from sunlight to producer to herbivore to carnivore. Therefore, the energy pyramid will always be upright.

6 Community ecology

Community ecology is the study and theory of how populations of organisms interact with each other and react to their non-living surroundings. As a subset of the general study of ecology, this field of specialization explores the organization and functioning of biological communities.

Community ecologists protect the environment and save species from extinction by assessing and monitoring environmental conditions such as global warming.

Community Ecology: Definition

One of the earliest formal definitions of community ecology was suggested by Cornell professor **Robert Whittaker** in 1975. Whittaker characterized community ecology as an assemblage of living organisms that interact and form a community with a unique structure and species composition. Knowing how a community functions is vital to promoting and preserving biodiversity.

Community ecology examines how coexisting organisms interact and compete in a particular niche or geographical location such as a woodland, prairie or a lake. Community ecology encompasses all populations of all species that live together in the same area.

Community ecologists study ecological interactions and consider such things as how to intervene when a rising deer population is destroying the understory layer of a woodland.

Community Ecology Examples

Community ecology encompasses many types of ecological interactions that continue to change over time. A **forest community** includes the plant community, all trees, birds, squirrels, deer, foxes, fungi, fish in a forest stream, insects and all other species living there or migrating seasonally.

Similarly, a **coral reef** community includes a vast number of different species of corals, fish and algae. **Abundance** and **distribution** are strong forces that shape the biological community.

Community ecology focuses on how interactions between different species affect health, growth, dispersion and abundance of the ecological system. At the community level, species are often interdependent. Several short food chains are common in most biological communities. Food chains often overlap and form food webs of producers and consumers.

Community Ecology Theory

American, European and British scientists have long held many **differing theories** on the definition of community ecology, which was first called plant sociology. In the 20th century, opinions differed as to whether ecological niches were self-organized organismic communities or random assemblages of species that thrived because of their particular traits.

By the 21st century, theories broadened to include such ideas as the **metacommunity theory** that focuses on community structures and the **evolutionary theory** that incorporates principles of evolutionary biology into community ecology.

Currently held community ecology theory is based on the supposition that ecological communities are the result of different types of **assembly processes**. Assembly processes involve adaptation, speciation in evolutionary biology, competition, colonization, altitude, climate, habitat disturbances and ecological drift.

The theory of community ecology expands upon **niche theory**, which has to do with an organism having a specific place and role in an ecosystem.

Indicators of Ecological Health

Species richness refers to the richness, or number, of species found. For example, an annual bird count might yield a species richness of 63 different species of birds spotted in a nature center. One pileated woodpecker is counted the same as 50 chickadees in determining species richness of the area.

Species richness does not factor in the total number of individuals found within each species. The number and type of species present in a community gradually increases toward the equator. Species richness decreases towards the polar region. Fewer plant and animal species are adapted to cold biomes.

Species diversity looks at overall biodiversity. Species diversity measures species richness as well as the relative number of species present. High species diversity characterizes stable ecological communities. Sudden or significant changes in a community such as an influx of predators can disrupt the predator-prey ecological balance and reduce species diversity.

Community Ecology Structure

Community ecologists study the interaction between structure and organisms. Structure describes characteristics of ecological niches, species richness and species composition. Species interact with each other and with their environment in many different ways, such as competing for finite resources or working together to trap game. Population dynamics play a pivotal role in communities.

The **energy pyramid** shows how energy is made and transferred by organisms that comprise the food chain. Heterotrophic producers of usable food energy from the sun form the broad base of the pyramid.

Primary consumers such as herbivores cannot make food to fuel their cells and must eat producers to live. Secondary consumers are carnivores that eat primary consumers. Tertiary consumers devour secondary consumers, but the apex predator at the top of the pyramid has no natural enemies.

A **food chain** represents the flow of food energy in a community. For instance, phytoplankton are eaten by fish that may be caught and cooked by a human. Only **10 percent** of the energy consumed is transferred at each trophic level, which is why the energy pyramid is not inverted. Decomposers play a role by breaking down dead organisms to release nutrients back into the environment.

Types of Interspecific Interactions

In biology, interspecific interactions refer to the ways in which species interact in their community. The effect of such interactions on different species may be positive, negative or neutral for one or both. Many types of interactions occur in an ecological community and influence population dynamics.

These are a few examples of those types of interactions:

- **Mutualism**: both species benefit from interaction, such as bacteria in the gut that speed digestion (+/+).
- **Commensalism**: one species benefits without affecting the other, such as a spider spinning a web on a plant (+/0).
- **Parasitism:** one species benefits, but the other is harmed, such as pathogenic microbes (+/-).
- **Predation**: one species preys on the other for survival (+/-).
- **Competition**: two species fight over limited resources (-/-).

Species and Structure Interactions

Even small changes in nature can have big effects on community ecology. For instance, structure is influenced by factors such as slight temperature changes, disturbances to habitat, pollution, weather events and species interaction.

Relative abundance of food is a stabilizing factor in communities. Normally, there is a check-balance system of food and consumption.

Types of Species in Community Ecology

Foundation species, like coral in a coral reef community, play a pivotal role in community ecology and shaping structure. Coral reefs are commonly called "rainforests of the sea" because they provide food, shelter, breeding areas and protection for up to **25 percent of all marine life**, according to the Smithsonian Museum of Natural History. Threats to coral reefs include climate change, pollution, overfishing and invasive species.

Keystone species like **wolves** profoundly affect community structure relative to the abundance of the other species. If removed, the loss of key predators dramatically changes the entire community. Predators keep other populations in check that would otherwise overgraze and threaten plant species resulting in a loss of food and habitat. Overpopulation can also lead to starvation and disease.

Invasive species are invaders that are not native to the habitat and disrupt the community. Many types of invasive species like the Zebra Mussel, destroy native species. Invasive species grow rapidly and reduce biodiversity, which weakens the overall animal and plant community within that niche.

Community Ecology Definition of Succession

Ecological succession is a series of changes over time to community structure that affect community dynamics and encourage the assemblance of plants and animals. **Primary succession** starts with the introduction of organisms and species, usually on newly exposed rock. Pioneer species like lichens on rock come first.

Secondary succession happens when orderly recolonization occurs in an area that was previously inhabited before a disruption. For instance, after a wildfire decimates an area, bacteria modify the soil, plants sprout from roots and seeds, bushes and shrubs establish, followed by tree seedlings. Vegetation provides a vertical and horizontal structure that attracts birds and animals to the biological community.

7. Ecological Niche Definition

In ecology, a niche is the role or job of a species in a habitat. The word niche comes from the French word *nicher*, which means "to nest." An ecological niche describes how a species interacts with, and lives in, its habitat. Ecological niches have specific characteristics, such as availability of nutrients, temperature, terrain, sunlight and predators, which dictate how, and how well, a species survives and reproduces. A species *carves out* a niche for itself in a habitat by being able to adapt and diverge from other species. Modern-day ecologists study ecological niches in terms of the impact the species has on its environment, as well as the species' requirements.

According to the competitive exclusion principle, two species cannot occupy the same ecological niche in a habitat if they are competing for the same resources. When species compete in a niche, natural selection will first move to lessen the dependence of the species on the shared resources. If one species is successful, it reduces the competition. If neither evolves to reduce competition, then the species that can more efficiently exploit the resource will win out, and the other species will eventually become extinct.

Examples of Ecological Niches

Kirtland's Warbler

Kirtland's warbler is a rare bird that lives in small areas in Michigan's northern Lower and Upper Peninsulas. The niche of Kirtland's warbler is the jack pine forest, and the forest must have very specific conditions. Jack pine forests with areas of over 80 acres are ideal for this species. Specifically, these forests must have dense clumps of trees with small areas of grass, ferns and small shrubs in between. Kirtland's warbler nests on the ground beneath the branches when the tree is about 5 feet tall, or around 5-8 years old. When the tree reaches about 16-20 feet tall, the lower branches start to die, and the bird will no longer nest beneath the tree branches.

Jack pine forests remained virtually undisturbed during Michigan's lumber boom in the early 1800s because white pine was a much more valuable. The consistent availability of young jack pines for nesting was generated by naturally occurring wildfires in this habitat. When the lumber boom ended in the late 1800s, the wildfires continued and allowed the jack pine to spread and create more habitat for Kirtland's warbler. The species population reached its peak from 1885-1900. Humans began to alter this niche by fighting and putting out forest fires. Over time, this severely affected the Kirtland’s warbler population. Large areas of jack pine forest were designated for habitat management via logging, burning, seeding and replanting in the 1970s, and the species recovered.

The image above shows a female Kirtland’s Warbler, *Dendroica kirtlandii*.

Dung Beetle

As the name implies, dung beetles eat dung, both as adults and as larvae. They live on all continents except Antarctica. Dung is plentiful throughout the world, and over time, the dung beetle has learned to exploit it as a resource, and create its own niche. Dung beetles are known for the way in which they roll dung into a ball before transporting it. These balls area buried in an underground burrow to either be stored as food or used as brooding balls. The female lays eggs in the brooding ball and the larvae hatch inside. When they reach adult size, the beetles dig out of the ball and work their way to the soil surface. The actions of dung beetles serve several important functions in their habitat. Digging burrows and tunnels turns over and aerates the soil. The buried dung releases nutrients into the soil that benefits other organisms. In addition, the beetle’s use of dung leaves less available for flies to breed on, thus controlling some of the fly population.

The image above shows *Kheper nigroaeneus*, the Large Copper Dung Beetle, on a ball of dung.

Xerophytic Plants

Xerophytic plants have developed several adaptations to living in dry ecological niches. The adaptations evolved to help save water stored in the plant and to prevent water loss. Examples of xerophytes are cacti and aloe vera, also called succulents. These plants have thick fleshy leaves that store water, and long roots to reach water deep underground. Other adaptations that xerophytic plants use include the ability to move or fold up their leaves, dropping their leaves during dry periods, a waxy coating to prevent evaporation (called the cuticle) and thick hairy leaf coverings. The surface of plant leaves features stomata, which are tiny mouth-like structures that take in carbon dioxide and release oxygen and water. Plants usually open their stomata during the day and close them at night. Succulents do the opposite in order to reduce water loss during the heat of the day.

Extremophiles

Organisms can create ecological niches in some of the most inhospitable places on earth. Extremophiles are organisms, primarily eukaryotes, adapted to and thriving in areas of environmental extremes. The suffix -phile comes from the Greek word *philos*, which means loving. The type of extreme environment describes these organisms. Some examples are acidophiles (best growth between pH 1 and pH 5), thermophiles (best growth between 140°F and 176°F), barophiles (best growth at high pressures) and endolithic (growing within rock). Some organisms, called polyextremophiles, have adapted to more than one extreme. The study of extremophiles is important to the understanding of how life originated on earth and what life could be like in other worlds. Extremophiles are also important in biotechnology because their enzymes (called extremozymes) are used under extreme production conditions.

8. Ecotone and Edge effect

An ecotone is an area that acts as a boundary or a transition between two ecosystems. A common example could be an area of marshland between a river and its riverbank. Ecotones are of great environmental importance. Because the area is a transition between two ecosystems or biomes, it is natural that it contains a large variety of species of fauna and flora as the area is influenced by both the bordering ecosystems.

Examples of ecotones include marshlands (between dry and wet ecosystems), mangrove forests (between terrestrial and marine ecosystems), grasslands (between desert and forest), and estuaries (between saltwater and freshwater). Mountain ranges can also create ecotones due to the changes in the climatic conditions on the slopes.

Characteristics of Ecotones

- It may be wide or narrow.
- It is a zone of tension (as it has conditions intermediate to the bordering ecosystems).
- It could contain species that are entirely different from those found in the bordering systems.
- Ecotones can be natural or man-made. For example, the ecotone between an agricultural field and a forest is a man-made one.

Edge Effect

Edge effects refer to the changes in population or community structures that occur at the boundary of two habitats. Generally, there is a greater number of species found in these regions (ecotones) and this is called the edge effect. The species found here are called **edge species**.

Importance of Ecotone

1. They have a greater variety of organisms.
2. They also offer a good nesting place for animals coming in search of a nesting place or food.
3. They serve as a bridge of gene flow from one population to another because of the larger genetic diversity present.
4. They can act as buffer zones offering protection to the bordering ecosystems from possible damage. For example, a wetland can absorb pollutants and prevent them from seeping into the river.
5. Ecotones are also a sensitive indicator of global climate change. A shifting of boundaries between ecosystems is thought to be due to climate change. So, scientists and environmentalists are studying ecotones with greater interest now

    - Ecocline is a zone of gradual but continuous change from one ecosystem to another when there is no sharp boundary between the two in terms of species composition.
    - Ecocline occurs across the environmental gradient (gradual change in abiotic factors such as altitude, temperature (thermocline), salinity (halocline), depth, etc.).
- Edge effect refers to the **changes in population or community** structures that **occur at the boundary of two habitats (ecotone)**.
- Sometimes the number of species and the population density of some of the species in the ecotone is much greater than either community. This is called **edge effect**.
- The organisms which occur primarily or most abundantly in this zone are known as **edge species**.
- In the terrestrial ecosystems edge effect is especially applicable to **birds**.
- For example, the **density of birds is greater in the ecotone** between the forest.

What is Ecological Succession?

Ecological succession is the steady and gradual change in a species of a given area with respect to the changing environment. It is a predictable change and is an inevitable process of nature as all the biotic components have to keep up with the changes in **our environment**.

The ultimate aim of this process is to reach equilibrium in the ecosystem. The community that achieves this aim is called a climax community. In an attempt to reach this equilibrium, some species increase in number while some other decrease.

In an area, the sequence of communities that undergo changes is called sere. Thus, each community that changes is called a seral stage or seral community.

All the communities that we observe today around us have undergone succession over a period of time since their existence. Thus, we can say that evolution is a process that has taken place simultaneously along with that of ecological succession. Also, the initiation of life on earth can be considered to be a result of this succession process.

If we consider an area where life starts from scratch by the process of succession, it is known as primary succession. However, if life starts at a place after the area has lost all the life forms existing there, the process is called secondary succession.

It is obvious that primary succession is a rather slow process as life has to start from nothing whereas secondary succession is faster because it starts at a place which had already supported life before. Moreover, the first species that comes into existence during primary succession is known as pioneer species.

Types of Ecological Succession

These are the following types of ecological succession:

Primary Succession

Primary succession is the succession that starts in lifeless areas such as the regions devoid of soil or the areas where the soil is unable to sustain life.

When the planet was first formed there was no soil on earth. The earth was only made up of rocks. These rocks were broken down by microorganisms and eroded to form soil. The soil then becomes the foundation of plant life. These plants help in the survival of different animals and progress from primary succession to the climax community.

If this primary ecosystem is destroyed, secondary succession takes place.

Secondary Succession

Secondary succession occurs when the primary ecosystem gets destroyed. For eg., a climax community gets destroyed by fire. It gets recolonized after the destruction. This is known as secondary ecological succession. Small plants emerge first, followed by larger plants. The tall trees block the sunlight and change the structure of the organisms below the canopy. Finally, the climax community arrives.

Cyclic Succession

This is only the change in the structure of an ecosystem on a cyclic basis. Some plants remain dormant for the rest of the year and emerge all at once. This drastically changes the structure of an ecosystem.

Seral Community

"A seral community is an intermediate stage of ecological succession advancing towards the climax community."

A seral community is replaced by the subsequent community. It consists of simple **food webs** and food chains. It exhibits a very low degree of diversity. The individuals are less in number and the nutrients are also less.

There are seven different types of seres:

Types of Seres	**Explanation**
Hydrosere	Succession in aquatic habitat.
Xerosere	Succession in dry habitat.
Lithosere	Succession on a bare rock surface.
Psammosere	Succession initiating on sandy areas.
Halosere	Succession starting in saline soil or water.
Senile	Succession of microorganism on dead matter.
Eosere	Development of vegetation in an era.

Examples of Ecological Succession

Following are the important examples of ecological succession:

Acadia National Park

This national park suffered a huge wildfire. Restoration of the forest was left to nature. In the initial years, only small plants grew on the burnt soil. After several years, the forest showed diversity in tree species. However, the trees before the fire were mostly evergreen, while the trees that grew after the fire were deciduous in nature.

Ecological Succession of Coral Reefs

Small coral polyps colonize the rocks. These polyps grow and divide to form coral colonies. The shape of the coral reefs attracts small fish and crustaceans that are food for the larger fish. Thus, a fully functional coral reef exists.