Chapter

36

Ecosystem

An ecosystem is a functional unit of nature, where living organisms interact among themselves and also with the surrounding physical environment. For example, a pond is a good example of ecosystem.

COMPONENTS OF ECOSYSTEM

1. **Biotic components:** It is the living component of an ecosystem that includes biotic factors such as producers, consumers, decomposers and scavengers.
   - **(a) Producers:** They include plants and algae. They contain chlorophyll pigment which helps them carry out the process of photosynthesis in the presence of light. Thus, they are also called as **converters** or **transducers**.
   - **(b) Consumers:** Consumers or heterotrophs are organisms that obtain organic molecules by eating or digesting other organisms. These are the herbivores and carnivores of the ecosystem. By eating other organisms they gain both food as an energy supply and nutrient molecules from within the biomass ingested.

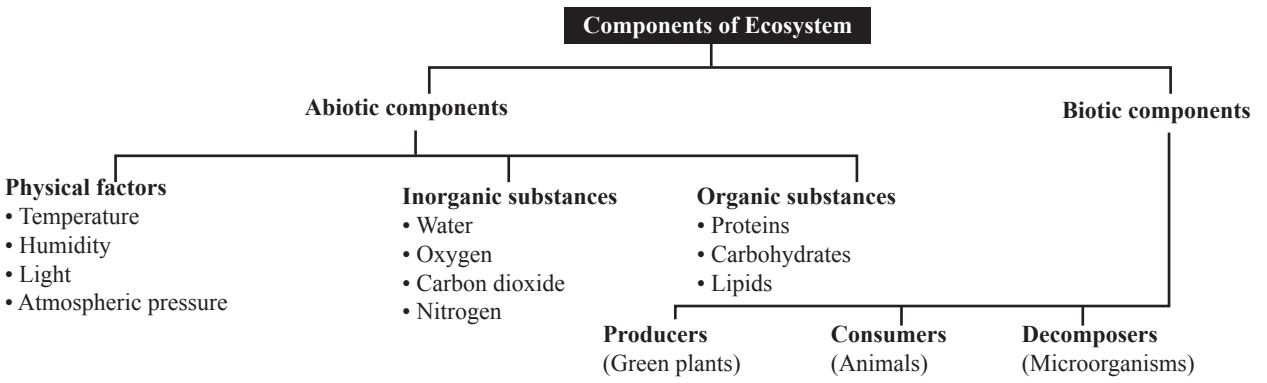
   Based on food preferences they can be grouped into three broad categories.
   - **(i.) Herbivores** that feed directly on plants. *E.g.* cow, deer and rabbit etc.
   - **(ii.) Carnivores** are animals which eat other animals. *E. g.* lion, cat, dog etc.
   - **(iii.) Omnivores** are organisms that feed upon plants and animals. *E.g.* human, pigs and sparrow.

- **Decomposers:** They include microorganisms such as bacteria and fungi. They form the largest population in a food chain and obtain nutrients by breaking down the remains of dead plants and animals.

  Decomposers can be divided into two groups based on their mode of nutrition.
  - ➢ **Detrivores:** They are the organisms that ingest non-living organic matter. These can include earthworms, beetles and many other invertebrates.
  - ➢ **Saprotrophs:** They are the organisms that live on or in non- living organic matter, secreting digestive enzymes into it and absorbing the products of digestion. These include fungi and bacteria.
- **Scavengers:** Scavengers are animals which eat dead bodies of other animals. Vultures, crows, jackals and hyena are few examples of scavengers. They are basically a kind of cleansing agents of the environment. They eat up the dead bodies of animals and therefore help in keeping forest environment clean.

2. **Abiotic components:** They are the non-living component of an ecosystem such as light, temperature, water, soil, air, inorganic nutrients etc.

   They are grouped into three categories:
   - **(a) Physical factors:** It includes sunlight, temperature, rainfall, humidity and pressure.
   - **(b) Inorganic substances:** Carbon dioxide, nitrogen, oxygen, sulphur, phosphorus, water, rock, soil and other minerals.
   - **(c) Organic compounds:** Carbohydrates, proteins, lipids and humic substances. They are the building blocks living systems.



Flow Chart: Components of ecosystem

TYPES OF ECOSYSTEM

Ecosystem are classified into two types: natural ecosystem and man-made ecosystem.

(i) Natural ecosystems are totally dependent on solar radiations. They are further divided into:

- ➢ **Terrestrial ecosystem:** *E.g.* Forest, grassland, desert etc.
- ➢ **Aquatic ecosystem:** *E.g.* Pond, lake, wetland, river and estuary

(ii) Man-made ecosystem: *E.g.* Crop fields and aquarium.

The entire biosphere can be regarded as a global ecosystem.

Pond as an Example of an Ecosystem (Aquatic Ecosystem)

A pond is a shallow, simple, self-sustainable water body that exhibits all basic components of an ecosystem.

I. Abiotic components in pond:

(i) Light: Solar radiation provides energy that controls the entire system. Penetration of light depends on transparency of water, amount of dissolved or suspended particles in water and the number of plankton.

On the basis of extent of penetration of light a pond can be divided into euphotic, mesophotic and aphotic zones.

Plenty of light is available to plants and animals in euphotic zone. No light is available in the aphotic zone.

(ii) Inorganic substances: These are water, carbon, nitrogen, phosphorus, calcium and a few other elements like sulphur depending on the location of the pond. The inorganic substances like O_2 and CO_2 are present in dissolved state in water. All plants and animals depend on water for their food and exchange of gases- nitrogen, phosphorus, sulphur and other inorganic salts are held in reserve in bottom sediment and inside the living organisms.

(iii) Organic compounds: The commonly found organic matter in the pond is amino acids and humic acids and the breakdown products of dead animals and plants. They are partly dissolved in water and partly suspended in water.

II. Biotic components:

1. **Producers or autotrophs:** They synthesize food for all the heterotrophs of the pond. *They can be categorized into two groups: Floating microorganisms and plants and rooted plants*.

(i) Floating microorganisms (green) and plants: They are called phytoplankton ("phyto"- plants, "plankton" –floating). They are microscopic organisms. Sometimes they are so abundant in pond that they make it look green in colour *e.g.*, *Spirogyra*, *Ulothrix*, *Cladophora*, *Diatoms*, *Volvox*.

(ii) Rooted plants: These are arranged in concentric zones from periphery to the deeper layers.

Three distinct zones of aquatic plants can be seen with increasing depth of water in the following order:

- ♦ **Zone of emergent vegetation:** *E.g. Typha*, *Bulrushes and Sagittaria*.
- ♦ **Zone of rooted vegetation with floating leaves**. *E.g. Nymphaea*
- ♦ **Zone of submergent vegetation:** *E.g.* All pond weeds like *Hydrilla*, *Rupia*, musk grass, etc.

2. **Consumers/Heterotrophs:** They are the animals which feed directly or indirectly on autotrophs. *E.g.* Tadpole, snails, sunfish, bass, etc.

Pond animals can be classified into the following groups:

- ➢ **Zooplanktons** are floating animals. *E.g.* Cyclops, Cypris
- ➢ **Nektons** are the animals that can swim and navigate at will. *E.g.* fishes
- ➢ **Benthic animals** are the bottom dwellers: *E.g.* Beetle, mites, mollusks and some crustaceans.

3. **Decomposers:** They are distributed throughout the entire in the whole pond but in the sediment most abundant. There are bacteria and fungi. *E.g. Rhizopus*, *Penicillium*, *Curvularia*, *Cladosporium* are found at the bottom of the pond.

Pond performs all the functions of an ecosystem such as

(a) Conversion of inorganic into organic material with the help of the radiant energy of the sun by the autotrophs.

(b) Consumption of the autotrophs by heterotrophs.

(c) Decomposition and mineralization of the dead matter to release them back for reuse by the autotrophs.

(d) Unidirectional flow of energy towards the higher trophic levels and its dissipation and loss as heat to the environment.

Ecosystem – Structure and Function

- The interaction between the various biotic and abiotic components of an ecosystem leads to maintenance of the ecosystem. These components function as a unit.
- Vertical distribution of different species occupying different levels is called **stratification**. *E.g.* trees occupy top vertical strata (layer) of a forest, shrubs the second and herbs and grasses occupy the bottom layers.
- **The aspects taken into consideration to study the functioning of ecosystem are:**

(i.) Productivity
(ii.) Decomposition
(iii.) Energy flow
(iv.) Nutrient cycling

Productivity

- The rate of biomass production is called **productivity**. It is expressed in terms of $g^{-2}\ yr^{-1}$ or $(kcal\ m^{-2})\ yr^{-1}$. It is used to compare productivity of different ecosystems.
- A constant input of solar energy is the basic requirement for any ecosystem to function and sustain.

(i) Primary productivity: It is the amount of biomass produced per unit area in a given time period by plants

during photosynthesis**.** It is expressed in terms of weight (g^{-2}) or energy (kcal m^{-2}).

GPP – R = NPP

Where, GPP-Gross Primary Productivity

NPP-Net Primary Productivity

It can be divided into gross primary productivity (GPP) and net primary productivity (NPP).

➢ **Gross primary productivity:** It is the rate of production of organic matter during photosynthesis. A considerable amount of GPP is utilized by plants in respiration.

➢ **Net primary productivity:** Gross primary productivity minus respiration losses (R) is the net primary productivity (NPP). NPP is the available biomass for the consumption to heterotrophs (herbivores and decomposers).

NPP = GPP – R

Primary productivity depends on

(a) The plant species inhabiting a particular area
(b) Environmental factors
(c) Availability of nutrients
(d) Photosynthetic capacity of plants

➢ Therefore, it varies in different types of ecosystems.

➢ The annual net primary productivity of the whole biosphere is approximately 170 billion tons (dry weight) of organic matter. Of this, despite occupying about 70% of the surface, the productivity of the oceans is only 55 billion tons. Rest of course, is on land.

(ii) Secondary productivity: It is defined as rate of production of organic matter by consumers over a period of time.

Decomposition

- Decomposition is the process that involves the breakdown of complex organic matter or biomass from the body of dead plants and animals with the help of decomposers into inorganic raw materials such as carbon dioxide, water and other nutrients.
- It is largely an oxygen-requiring process.
- **Detritus** (dead plant remains such as leaves, bark, flowers and dead remains of animals, including fecal matter) is the raw material for decomposition.
- **The various processes involved in decomposition are:**
  - **(a) Fragmentation:** It is the first step in the process of decomposition. It involves the breakdown of detritus into smaller particles by detritivores such as earthworm.
  - **(b) Leaching:** It is the process where the water soluble inorganic nutrients go down into the soil layers and get locked as unavailable salt.
  - **(c) Catabolism:** It is the process in which bacteria and fungi degrade detritus through various bacterial and fungal enzymes into smaller pieces.

    Fragmentation, leaching and catabolism operate simultaneously on the detritus.
  - **(d) Humification:** The next step is humification which leads to the formation of a dark coloured colloidal substance called humus. Humus is resistant to microbial action and so decomposes very slowly. Being colloidal in nature it serves as a reservoir of nutrients.
  - **(e) Mineralization:** The humus is further degraded by the action of microbes, which finally leads to the release of inorganic nutrients into the soil. This process of releasing inorganic nutrients from the humus is called mineralization.

  Decomposition produces a dark coloured, nutrient rich substance called **humus**. Humus finally degrades and releases inorganic raw materials such as CO_2, water and other nutrient in the soil.

Factors influencing decomposition

- **Chemical composition of detritus:** Decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water-soluble substances like sugars.
- **Climatic factors like temperature and soil moisture:** Warm and moist environment favour decomposition whereas low temperature and anerobiosis inhibit decomposition resulting in build-up of organic materials.

Table: Difference between production and decomposition

Production	Decomposition
It is the rate of producing organic matter (food) by producers.	It is the process of breaking down of complex organic matter from the body of dead animals and plants with the help of decomposers into organic raw materials such as CO_2 and H_2O and other nutrients.
It depends on the photosynthetic capacity of the producers.	It occurs with the help of decomposers.
Sunlight is required by plants for primary production.	Sunlight is not required by decomposition by decomposers.

Ecosystem Function-Energy Flow Through Ecosystem

Food chains and energy flow are the functional properties of ecosystems which make them dynamic. The biotic and abiotic components of an ecosystem are linked through them.

Energy Flow

- All life depends upon the flow of energy and materials through ecosystems. Food chain shows energy pathways. Energy passes from producer (plants) to plant-eaters, to animal-eaters and on to tertiary consumer.

- Energy enters the ecosystem from the sun. Sun is the only source of energy for all ecosystems (except deep sea hydro-thermal ecosystem). Plants and other photosynthetic organisms utilise less than 50% of the solar radiation known as **photosynthetically active radiation (PAR)**.
- Plants and photosynthetic and chemosynthetic bacteria (autotrophs), fix solar radiant energy to make food.
- Solar radiations pass through the atmosphere and are absorbed by the Earth's surface. These radiations help plants in carrying out the process of photosynthesis. Also, they help maintain the Earth's temperature for the survival of living organisms. Some solar radiations are reflected by the Earth's surface. Only 2- 10 percent of solar energy is captured by green plants (producers) during photosynthesis to be converted into food. The rate at which the biomass is produced by plants during photosynthesis is termed as "gross primary productivity". When these green plants are consumed by herbivores, only 10 % of the stored energy from producers is transferred to herbivores. The remaining 90% of this energy is used by plants for various processes such as respiration, growth and reproduction. Similarly, only 10% of the energy of herbivores is transferred to carnivores. This is known as ten percent law of energy flow.
- Ecosystems obey 2nd Law of thermodynamics. They need a constant supply of energy to synthesise the molecules they require, to counteract the universal tendency toward increasing disorderliness.

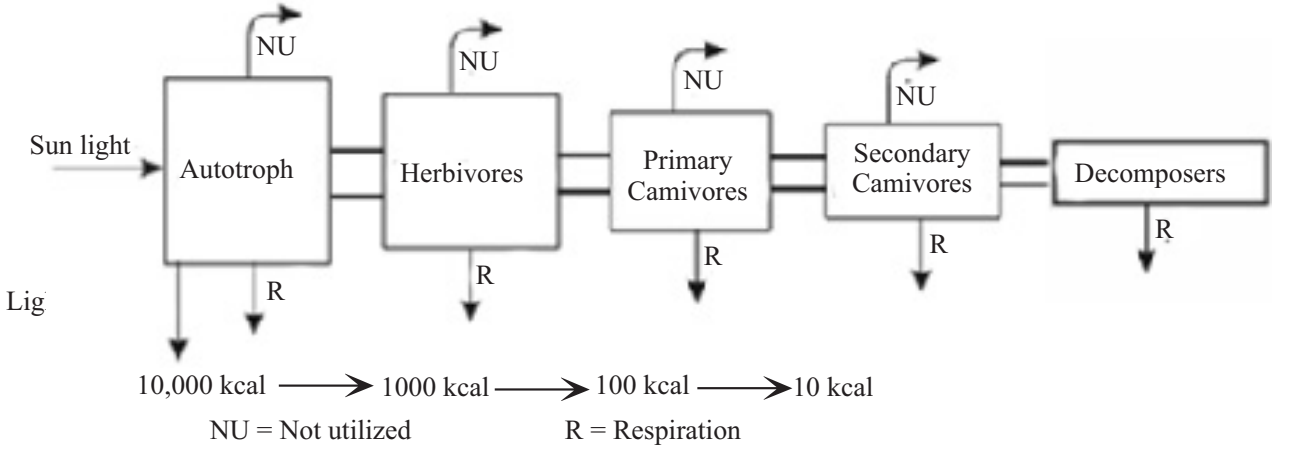


Fig. Energy flow

The entire process of energy flow can be summarized in the following four steps:

- The flow of energy in an ecosystem is always linear or one-way.
- At every step in a food chain the energy received by the organism is also used for its own metabolism and maintenance. The left over is passed to next higher trophic level. Thus energy flow decreases with successive trophic levels.
- It follows the ecological thumb rule of 10%.
- The number of steps is limited to four or five in a food chain for the transfer of energy.

Ten Percent Law

- It was given by **Lindemann** in 1942.
- It states that during transfer of energy from one trophic level to another, only about 10% is stored at higher levels; remaining 90% is lost in respiration (heat).

Food Chain and Food Web

- A food chain starts with green plants because they are **food producers.**
- Animals**,** which eat the plants**,** form the second link of the chain**.** Plant-eaters are the **first or primary food consumers** in a food chain**.** Next come predators which feed on the plant eaters (*i.e.* primary consumer)**.** These animal-eaters are **second or secondary food consumers.** Some animals-eaters (*i.e.* secondary consumers) are in turn eaten by other animals, for example, a snake feed on a toad which in turn feeds on fruit fly**.** These animal-eaters are called **tertiary food consumers.**
- The last link of food chain is occupied by **decomposers**, which feed on dead plants and animals. Decomposer decomposes the dead bodies of plants and animals into nutrients, water and carbon dioxide. The nutrients and water are returned to the soil while carbon dioxide is released into the air, which in turn are re-used for the growth of new plants.
- The first link in a food chain is always a producer and the last link is always a decomposer**.**

Position of human beings in the food chain: Human beings are consumers and may occupy primary, secondary or tertiary levels. Vegetarian people are 'primary consumers; when they consume small fish chicken or goat meat they are 'secondary' consumers and when they consume big fishes, they are 'tertiary' consumers.

There are two types of food chains:

(i) Grazing food chains: It extends from producers through herbivores to carnivores.

A simple **grazing food chain (GFC)** is depicted below:

Grass ⟶ Goat ⟶ Man ⟶

(Producer) (Primary consumer) (Secondary consumer)

(ii) Detritus food chains: It begins with dead organic matter to the detrivores organisms which in turn make food for protozoan to carnivores etc. It is made up of **decomposers (saprotrophs**) which are heterotrophic organisms, *e.g.* fungi and bacteria. They meet their energy and nutrient requirements by degrading dead organic matter or detritus. Decomposers secrete digestive enzymes that breakdown dead and waste materials into simple, inorganic materials, which are subsequently absorbed by them.

In an aquatic ecosystem, GFC is the major conduit for energy flow.

In a terrestrial ecosystem, a much larger fraction of energy flows through the DFC than through the GFC.

DFC may be connected with GFC at some levels. Some of the organisms of DFC are prey to the GFC animals. Some animals (cockroaches, crows etc.) are omnivores. These interconnections of food chains make a **food web**.

Difference between Grazing food chain and detritus food chain

Grazing Food Chain	Detritus Food Chain
In this food chain, energy is derived from the sun.	In this food chain, energy comes from organic matter or detritus generated in trophic levels of the grazing food chain.
It begins with producers, present at the first trophic level. The plants biomass is then eaten by herbivores which in turn are consumed by a variety of consumers.	It begins with detritus such as dead bodies of animals or fallen leaves, which are then eaten by decomposers or detrivores. These detrivores are in turn consumed by their predators.
Grazing food chains are long sized chains.	Detritus food chains are small sized chains.

Trophic Level

- Organisms occupy a place in the natural surroundings or in a community according to their feeding relationship**.** A specific place of organisms in the food chain is known as their trophic level**.**
- Producers belong to the first trophic level**,** herbivores to the second and carnivores to the third**.**

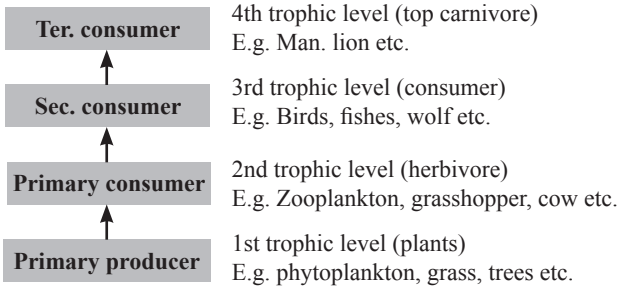


Fig. Various trophic levels

- The amount of energy decreases at successive trophic levels. When an organism dies it becomes dead biomass (detritus) that serves as an energy source for decomposers.
- Organisms at each trophic level depend on those at the lower trophic level for their energy demands.
- Each trophic level has a certain mass of living material at a particular time called as the **standing crop.** It is measured as the mass of living organisms (**biomass)** or the number in a unit area**.** Biomass of a species is expressed in terms of **fresh or dry weight.** Measurement of biomass in terms of dry weight is more accurate.
- The number of trophic levels in a food chain is restricted by 10 % flow of energy, less amount of energy available to the last trophic level.
- In an ecosystem the two chains are interconnected and make y-shaped food chain. These two types of food chains are:
  - ➢ Producers → Herbivores → Carnivores
  - ➢ Producers → Detritus Feeders → Carnivores

Food Web

- Trophic levels in an ecosystem are not linear rather they are interconnected and make a food web**.** Thus food web is a network interconnected food chains existing in an ecosystem.
- Green plants are eaten by several plant-eaters. These plant-eaters in turn are eaten by several animal-eaters. In this way**,** many food chains become linked together to form a web called **food web.** Food web shows many food chains linked together. One animal may be a member of several different food chains.
- Food webs are more realistic models of energy flow through an ecosystem.

Example

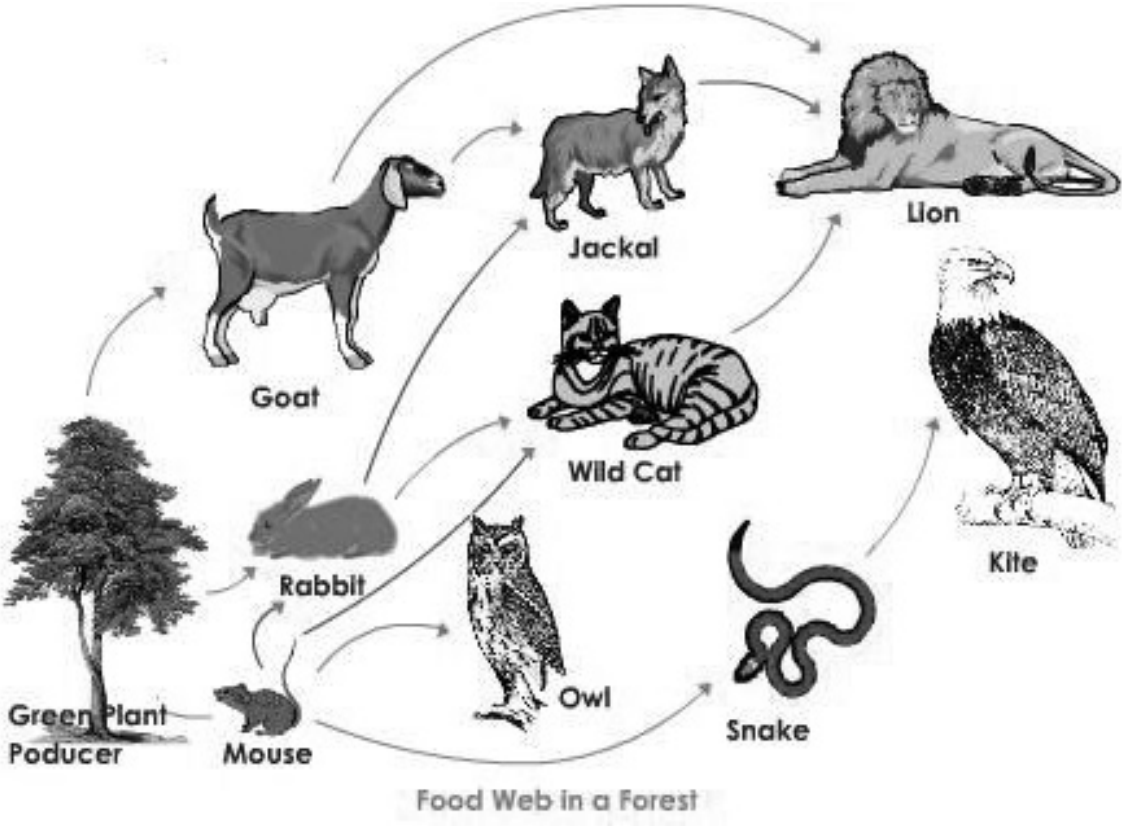


Fig. Food web

Table: Difference between food chain and food web

Food chain	Food web
It is a single linear sequence of organisms	It contains a number of interconnected food chain.
Members present at higher trophic levels feed on single types of organisms.	One organism has alternate food sources.
Food chains are straight.	They are never straight.

Ecological Pyramids

- The representation of a food chain in the form of a pyramid is called ecological pyramid.
- An ecological pyramid is a graphical representation of various ecological parameters such as the number of individuals present at each trophic level, the amount of energy or the biomass present at each trophic level.
- Ecological pyramids represent producers at the base, while the apex represents the top level consumers present in an ecosystem.
- **There are three main types of pyramids:**
  - **(i) Pyramid of numbers:** It is the graphical representation of the number of individuals present at each trophic level in a food chain of an ecosystem. The pyramid of numbers can be upright or inverted depending on the number of producers.

For *e.g.* in a grassland ecosystem, the pyramid of numbers is upright. In this type of food chain, the number of producers (plants) is followed by the number of herbivores (mice), which in turn is followed by the number of secondary consumers (Snakes) and tertiary carnivores (eagles). Hence, the number of individuals at the producer level will be maximum, while the number of individuals present at top carnivores will be least.

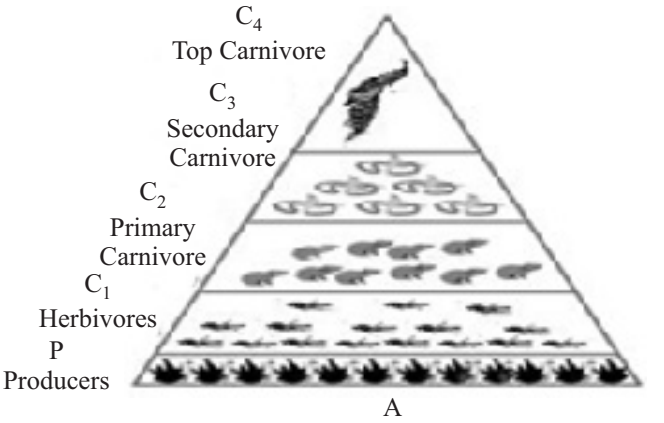


Fig. Upright pyramid of numbers showing decreasing number at successive stage.

On the other hand, in parasitic food chain, the pyramid of numbers is inverted. In this type of food chain, a single tree (producer) provides food to several fruit eating birds, which in turn support several insect species.

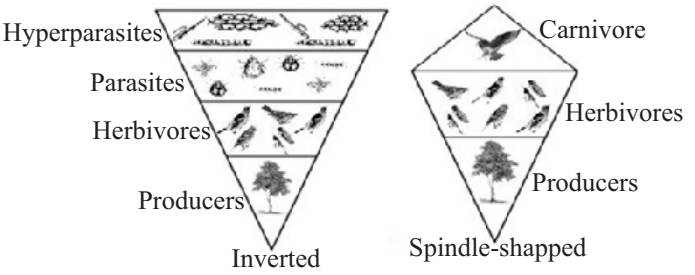


Fig. An inverted and spindle-shaped pyramids of numbers of a tree ecosystem.

(ii) Pyramid of biomass: A pyramid of biomass is a graphical representation of the total amount of living matter present at each trophic level of an ecosystem. It can be upright or inverted. It is upright in grassland and forest ecosystems as the amount of biomass present at the producer level is higher than at the top of carnivore level. The pyramid of biomass is inverted in a pond ecosystem as the biomass of fishes far exceeds the biomass of zooplankton (upon which they feed).

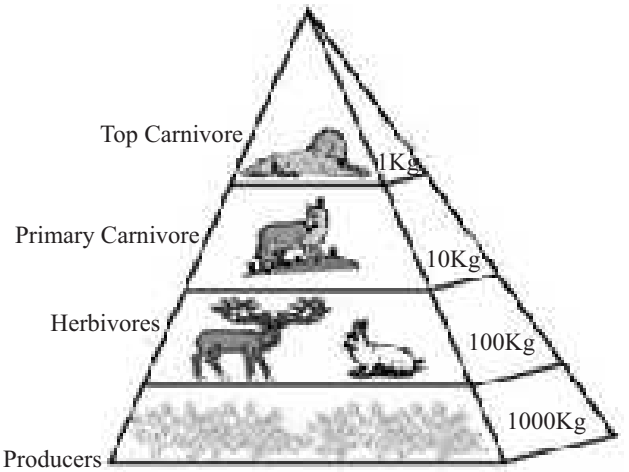


Fig. Upright pyramid of biomass in a Terrestrial Ecosystem

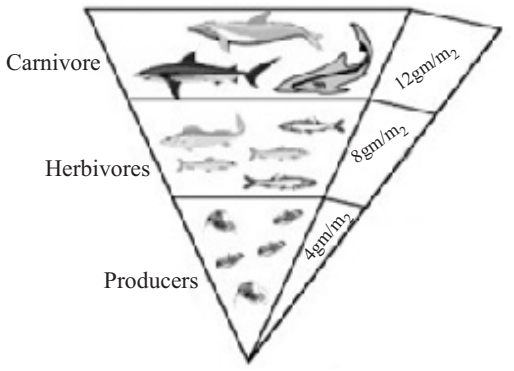


Fig. Inverted pyramid in an Aquatic Ecosystem

Examples for inverted pyramids:

- Insects feeding on a big tree.
- Pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton.
- Pyramid of energy is always upright, because when energy flows from a trophic level to the next trophic level, some energy is always lost as heat at each step.

(iii) Pyramid of energy: A pyramid of biomass is a graphical representation of the amount of energy trapped per unit time and area in different trophic level of a food chain with producers forming the base and the top carnivores at the tip. It is always upright. It is because when energy flows from a particular trophic level to the next, some energy is always lost as heat at each step.

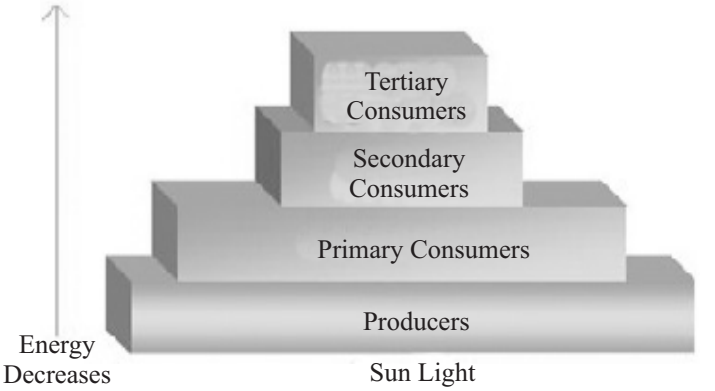


Fig. Upright pyramid of energy

Difference between upright and inverted pyramid

Upright pyramid	Inverted pyramid
The pyramid of energy is always upright.	The pyramid of biomass and pyramid of numbers can be inverted.
In the upright pyramid, the number and biomass of organisms in the producer level of an ecosystem is the highest, which keeps on decreasing at each trophic level in a food chain.	In an inverted pyramid, the number and biomass of organisms in the producer level of an ecosystem is the lowest, which keeps on increasing at each trophic level.

Limitations of ecological pyramids

- It does not take into account the same species belonging to two or more trophic levels.
- It assumes a simple food chain that almost never exists in nature.
- It does not accommodate a food web.
- Saprophytes are not included in ecological pyramids even though they play a vital role in the ecosystem.

Ecological Succession

- Ecological succession is a gradual, slow and predictable change in the species composition of an area leading to a **climax community**.

- The composition of all ecosystems keeps on changing with change in their environment. These changes finally lead to the climax community.
- Climax community is the community which is in equilibrium with its environment. It remains stable as long as the environment remains unchanged. The Rainforest is an example of climax community ecosystem.
- During succession some species colonize an area and become more numerous, whereas populations of other species decline and disappear.
- The entire sequences of communities that successively change in a given area are called **sere**. The individual transitional communities are termed **seral stages (seralcommunities)**.

Seral communities:

- ➢ Hydrosere - Community in freshwater
- ➢ Lithosere - Community on rock
- ➢ Pssamosere - Community on sand
- ➢ Halosere - Community in saline body
- ➢ Xerosere - Community in dry area

- In the successive seral stages there is a change in the diversity of species, increase in the number of species and organisms and an increase in the total biomass.
- The present day communities are the results of succession that occurred over millions of years.
- Succession and evolution would have been parallel processes at that time.
- Succession is divided into two types:

(i) Primary succession:

- ➢ The succession that takes place in areas where no living organisms ever existed. *E.g.* newly cooled lava, bare rock, newly created pond or reservoir.
- ➢ In primary succession, pioneer species are lichens, phytoplankton, etc.
- ➢ It is a slow process. It is because, before a biotic community is established, there must be formation of fertile soil through natural processes.

(ii) Secondary succession:

- ➢ The succession that takes place in areas which have lost all life forms due to destructions and floods**.** *E.g.* abandoned farm lands**,** burned or cut forests**,** lands that have been flooded**.** Pioneer species – grasses**,** wild flowers**,** algae**.**
- ➢ Since some soil or sediment is present**,** succession is faster than primary succession**.**
- ➢ The species that invade depend on the condition of the soil**,** availability of water etc**.**

- In succession, changes in vegetation affect food and shelter of various animals. Thus, as succession proceeds, the number and types of animals and decomposers also change.
- Natural or human induced disturbances (deforestation, fire etc.), can convert a particular seral stage of succession to an earlier stage. Such disturbances create new conditions that encourage some species and discourage or eliminate other species.

Succession in Plants

- **Based on the nature of the habitat, succession of plants is of two types: hydrarch and xerarch.**

(i) Hydrarch succession: It takes place in water areas. The successional series progress from hydric to the mesic conditions.

(ii) Xerarch succession: It takes place in dry areas. The series progress from xeric to mesic conditions.

- Both hydrarch and xerarch successions lead to medium water conditions (mesic) – neither too dry (xeric) nor too wet (hydric).
- The species invading a bare area are called **pioneer species**.

Xerarch Succession/Primary succession on rocks (xerophytic habitat):

- The species that invades bare area are called **pioneer species**.
- In primary succession on bare rock the pioneer species is the **lichen**.
- Lichen secretes acid to dissolve rock, helping in weathering and soil formation. The little soil, leads to growth of small plants like **bryophytes (mosses)**. They need only small amount of soil.
- The mosses speed up the process of soil accumulation by trapping wind-blown particles.
- Lichen moss carpet provides suitable substratum for the germination of seeds of **herbaceous plants**.
- Gradually more soil is accumulated and herbaceous species make way for the invasion of **shrubs** followed by **trees**.
- The **climax community** is generally dominated by **trees**.
- The **climax community** remains stable as long as the environment remains unchanged.

Hydrarch succession/ Primary succession in water:

- In primary succession in water, the **pioneer species** are **phytoplankton**. Zooplanktons → Sub merged plant stage (rooted hydrophytes) → Sub merged and free-floating plant stage. Reed-swamp stage → Marsh-meadow stage → Shrub stage → Trees → The climax again would be the forest → With time the water body is converted into land → All the succession whether taking place in water or on land, proceeds to a similar climax community – the mesic.

NUTRIENT CYCLING

- The amount of nutrients like carbon, nitrogen, phosphorus, calcium, etc. present in the soil at any given time, is referred to as the **standing state**. It varies in different kinds of ecosystems and also on a seasonal basis.
- Organism needs constant supply of nutrients to grow, reproduce, and regulate various body functions.
- Nutrients are never lost from the ecosystems. They are recycled again and again. The movement of nutrient elements through various components of an ecosystem is called **nutrient cycling (biogeochemical cycles)**. Hence, the cyclic flow of nutrients between non-living environment (soil, air and water) and the living organisms is called biogeochemical cycle.
- **In biosphere the nutrients exist in two states: Reservoir pool and cycling pool.**

(i) Reservoir pool: It is the pool/storehouse of nutrients from which the nutrients are slowly transferred to cycling pool.

(ii) Cycling pool: It is the pool of nutrients which is

repeatedly exchanged between the biotic and abiotic components of biosphere.

- **Based on existent of nutrients, nutrient cycles are of two types:**
  - **(a) Gaseous cycle:** Reservoir for these types of cycles exists in the atmosphere. *E.g.* Carbon cycle, Nitrogen cycle
  - **(b) Sedimentary cycle:** Reservoir for these types of cycles exists in earth's crust. Sedimentary cycles have their reservoirs in the Earth's crust or rocks. Elements such as sulphur, phosphorus, potassium, and calcium have sedimentary cycles.
- Environmental factors (soil, moisture, pH, temperature, etc.) regulate the rate of release of nutrients into the atmosphere. The reservoir meets with the deficit of nutrients due to imbalance in the rate of influx and efflux.
- **Importance of biogeochemical cycle:**

(i) The minerals such as carbon, nitrogen, carbon and hydrogen cycle through living and non-living components of the biosphere.

(ii) The amount of various materials cycling through biosphere remains more or less constant.

1. Carbon Cycle

- The cyclic flow of carbon in biosphere between its abiotic (soil, air and water) and biotic (plants and animals) components is called carbon cycle.
- The carbon cycle is an important gaseous cycle which has its reservoir pool in the atmosphere. Carbon constitutes **49 percent** of dry weight of organism. Out of total global carbon:
  - ➢ 71 percent carbon found dissolved in ocean.
  - ➢ About 1 percent in the atmosphere.
- Carbon is a fundamental element found in all living forms. All biomolecules such as carbohydrates, lipids and proteins required for life processes are made of carbon.
- Carbon is incorporated into living forms through a fundamental process called photosynthesis. Photosynthesis uses sunlight and atmospheric carbon dioxide to produce a carbon compound called "glucose". This glucose molecule is utilised by other living organisms. Thus, atmospheric carbon is incorporated in living forms.
- Now, it is necessary to recycle this absorbed carbon dioxide back into the atmosphere to complete the cycle. There are various processes by which carbon is recycled back into the atmosphere in the form of carbon dioxide gas.
- The process of respiration breaks down glucose molecules to produce CO_2 gas. The process of decomposition also releases carbon dioxide from dead bodies of plants and animals into the atmosphere.
- Combustion of fuels, industrialisation, deforestation, volcanic eruptions and forest fires act as other major sources of carbon dioxide.

Influence of human activity on carbon cycling.

- Rapid deforestation.
- Massive burning of fossil fuel for energy and transport
- Increased the rate of release of CO_2 into the atmosphere.

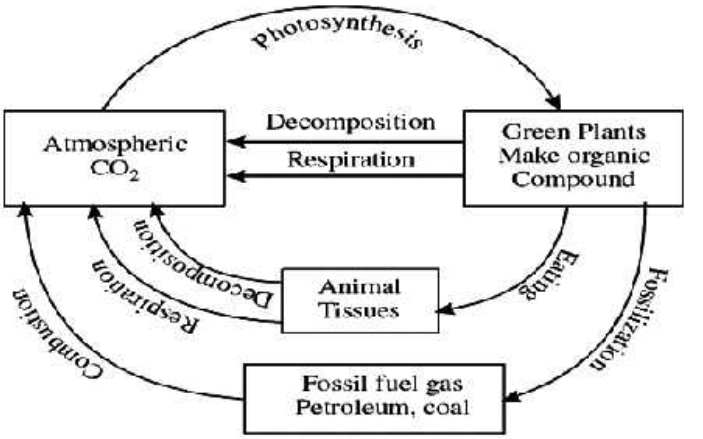


Fig. Carbon Cycle

2. Phosphorus Cycle

- Phosphorus is a major constituent of biological membranes, nucleic acids and cellular energy transfer systems. Many animals use phosphorus to make shells, bones and teeth.
- The natural reservoir of phosphorus is rock which contains phosphorus in the form of phosphates.
- During weathering of rock small amount of phosphates dissolved in soil solution and are absorbed by the roots of the plants.

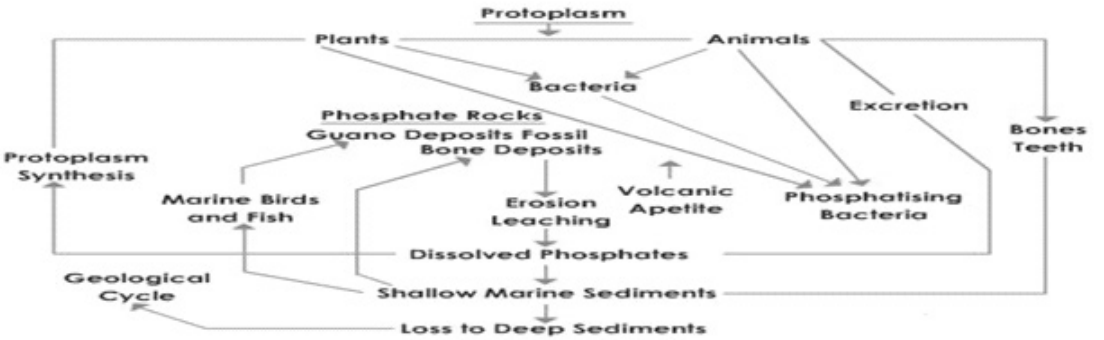


Fig. Phosphorus Cycle

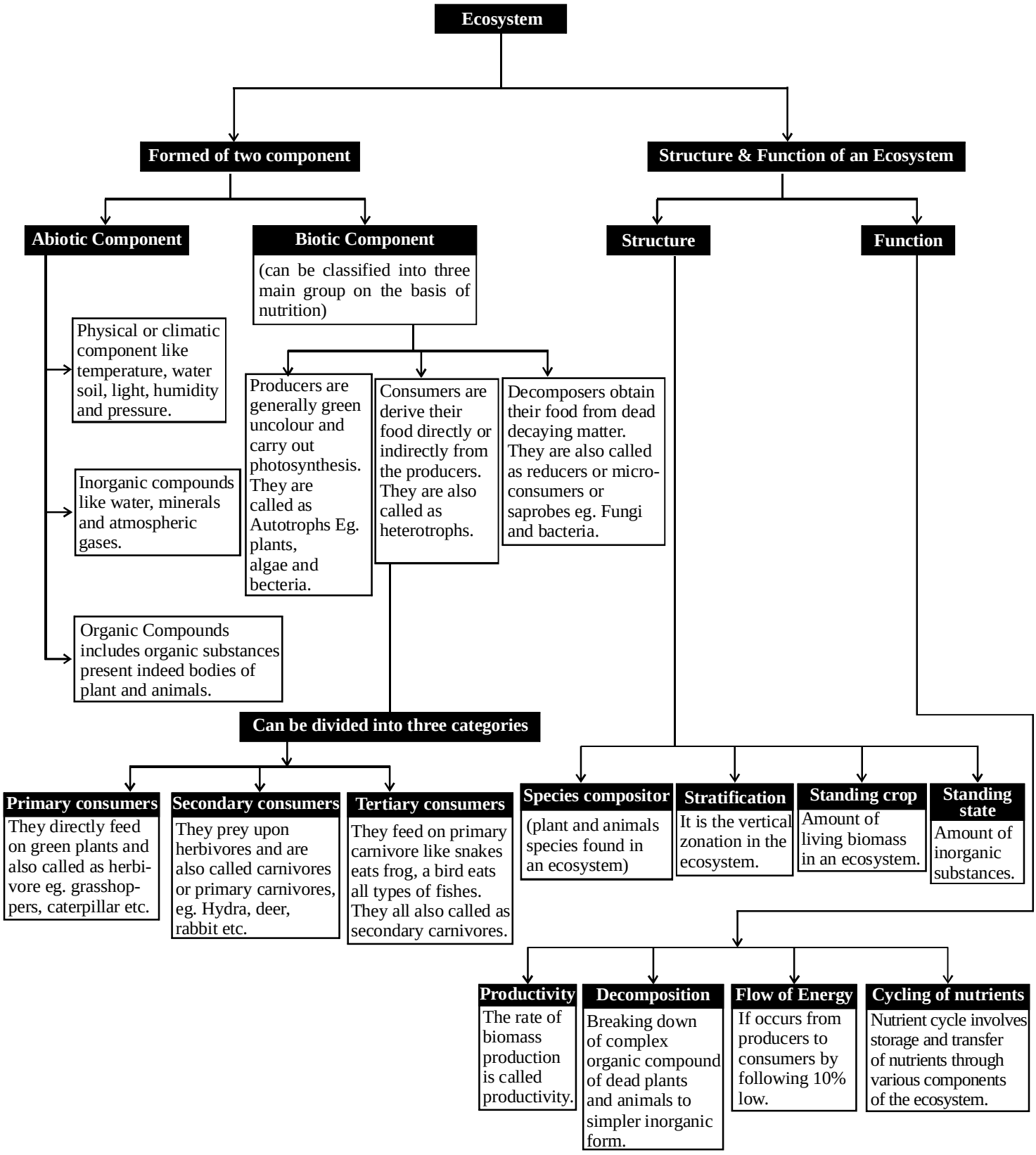
- Herbivore and other animals obtain organic form of phosphorus from plants.
- The waste product and dead organisms are decomposed by phosphate-solubilising bacteria releasing phosphorus.

Differences between carbon and phosphorous cycles

- There is no respiratory release of phosphorus into atmosphere.
- Atmospheric inputs of phosphorus through rainfall are much smaller.
- Gaseous exchange of phosphorus between organism and environment are negligible.

Ecosystem Services

- The products of ecosystem processes are called **ecosystem services**.
- Healthy forest ecosystems
  - ➢ Purify air and water.
  - ➢ Mitigate droughts and flood.
  - ➢ Cycle nutrients.
  - ➢ Generates fertile soil.
  - ➢ Provide wildlife habitat.
  - ➢ Maintain biodiversity.
  - ➢ Pollinate crops.
  - ➢ Provide storage site for carbon.
  - ➢ Provide aesthetic, cultural and spiritual values.
- Robert Constanza and his colleagues have tried to put price tags on nature's life-support services.
- Researchers have put an average price tag of US $ 33 trillion a year on these fundamental ecosystems services. This is nearly twice the value of the global gross national product GNP which is (US $ 18 trillion).
- Out of the total cost of various ecosystem services, the soil formation accounts for about 50%.
- Contributions of other services like recreation and nutrient cycling are less than 10% each.
- The cost of climate regulation and habitat for wildlife are about 6 % each.


Ecosystem
Formed of two component
Structure & Function of an Ecosystem
Abiotic Component
Biotic Component
(can be classified into three main group on the basis of nutrition)
Structure
Function
Physical or climatic component like temperature, water soil, light, humidity and pressure.
Inorganic compounds like water, minerals and atmospheric gases.
Organic Compounds includes organic substances present indeed bodies of plant and animals.
Producers are generally green uncolour and carry out photosynthesis. They are called as Autotrophs Eg. plants, algae and becteria.
Consumers are derive their food directly or indirectly from the producers. They are also called as heterotrophs.
Decomposers obtain their food from dead decaying matter. They are also called as reducers or micro-consumers or saprobes eg. Fungi and bacteria.
Can be divided into three categories
Primary consumers
They directly feed on green plants and also called as herbi-vore eg. grasshop-pers, caterpillar etc.
Secondary consumers
They prey upon herbivores and are also called carnivores or primary carnivores, eg. Hydra, deer, rabbit etc.
Tertiary consumers
They feed on primary carnivore like snakes eats frog, a bird eats all types of fishes. They all also called as secondary carnivores.
Species compositor
(plant and animals species found in an ecosystem)
Stratification
It is the vertical zonation in the ecosystem.
Standing crop
Amount of living biomass in an ecosystem.
Standing state
Amount of inorganic substances.
Productivity
The rate of biomass production is called productivity.
Decomposition
Breaking down of complex organic compound of dead plants and animals to simpler inorganic form.
Flow of Energy
If occurs from producers to consumers by following 10% low.
Cycling of nutrients
Nutrient cycle involves storage and transfer of nutrients through various components of the ecosystem.

EXERCISE - 1
Conceptual Questions

1. A pond is –
(a) A biome
(b) A community of plants and animals
(c) A natural ecosystem
(d) None of the above

2. Which one statement is correct regarding man made ecosystem?
(a) They are highly efficient
(b) They are poor in diversity
(c) They are vulnerable to drought, floods and diseases
(d) All are correct

3. The largest ecosystem of the world is-
(a) Forests (b) Grasslands
(c) Great lakes (d) Oceans

4. A natural ecosystem-
(a) Depends on man (b) Depends on plants
(c) Depends on animals (d) Is auto operated

5. Which of the following is a man made artificial ecosystem?
(a) Grassland ecosystem
(b) Agro ecosystem
(c) Ecosystem of artificial lakes and dams
(d) Forest ecosystem

6. A pea-cock eats snakes which eat frogs. Frogs which in turn thrive on leaves of the plants. The peacock is:
(a) primary consumer
(b) secondary consumer
(c) decomposer
(d) apex of the food pyramid

7. Ecosystem is –
(a) Always open
(b) Always closed
(c) Both open and closed depending upon community
(d) Both open and closed depending upon biomass

8. Biotic components of an ecosystem include-
(a) Producers, consumers and decomposers
(b) Producers and consumers
(c) Producers only
(d) Consumers only

9. What is the annual net primary productivity of whole biosphere?
(a) 170 billion tons (dry weight) of organic matter
(b) 165 billion tons (dry weight) of organic matter
(c) 160 billion tons (dry weight) of organic matter
(d) 155 billion tons (dry weight) of organic matter

10. Which most often limits the primary productivity of the ecosystem ?
(a) Solar radiation/light (b) Oxygen
(c) Consumers (d) Nitrogen

11. Select the formula for ecological efficiency
(a) $\frac{\text{Gross primary productivity} \times 100}{\text{Incident total solar radiation}}$
(b) $\frac{\text{Food primary assimilated} \times 100}{\text{Food energy ingested}}$
(c) $\frac{\text{Net primary productivity} \times 100}{\text{Gross primary productivity}}$
(d) $\frac{\text{Energy in biomass production at a trophic level} \times 100}{\text{Energy in biomass production at previous trophic level}}$

12. Vegetation of a geographic region with low rainfall, high temperature, loose and sandy soil is of the type called:
(a) grassland (b) scrub forest
(c) xerophytic (d) evergreen tropical forest

13. An ecosystem resist change because it is in a state of
(a) Imbalance
(b) Homeostasis
(c) Shortage of components
(d) Deficiency of light

14. Ecosystem has two components
(a) Plants and animals (b) Weeds and trees
(c) Biotic and abiotic (d) Frog and men

15. Which of the following is the most stable ecosystem?
(a) Mountain (b) Desert
(c) Forest (d) Ocean

16. Energy storage at consumer level is called
(a) Gross primary productivity
(b) Secondary productivity
(c) Net primary productivity
(d) Net productivity

17. Primary productivity
(a) is equal to the standing crop of an ecosystem.
(b) is greatest in freshwater ecosystems.
(c) is the rate of conversion of light to chemical energy in an ecosystem.
(d) is inverted in some aquatic ecosystems.

18. Energy flow in an ecosystem is:
(a) unidirectional (b) bidirectional
(c) multidirectional (d) All of these

19. Which one is nature's cleaner ?
(a) Consumers
(b) Producers
(c) Decomposers and scavengers
(d) Symbionts

20. Who is referred to as the farmer's friend ?
(a) Ant (b) Sparrow
(c) Earthworm (d) Rabbit

21. Which one of the following statement is correct?
(a) Decomposition rate is slower if detritus is rich in lignin and chitin, and quicker, if detritus is rich in nitrogen and water - soluble substances like sugars.
(b) Decomposition rate is slower if detritus is rich in nitrogen and water - soluble substances like sugars, and quicker, if detritus is rich in lignin and chitin.
(c) Decomposition rate is slower if detritus is rich in cellulose, and quicker, if detritus is rich in phosphorus.
(d) Decomposition rate is quicker if detritus is rich in lignin, and quicker, if detritus is rich in sulphur.

22. What are the two most important climatic factors that regulate decomposition through their effects on soil microbes ?
(a) Temperature and rainfall
(b) Temperature and soil - moisture
(c) Temperature and humidity
(d) Temperature and pressure

23. Which one of the following statement is correct?
(a) Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition
(b) Warm and moist environment inhibit decomposition whereas low temperature and anaerobiosis favour decomposition
(c) Warm and anaerobiosis favour decomposition whereas low temperature favours decomposition
(d) Warm and low temperature inhibit decomposition whereas anaerobiosis favours decomposition

24. Which of the following process helps in nutrient conservation ?
(a) Mineralisation (b) Immobilisation
(c) Leaching (d) Nitrification

25. How much portion of the PAR is captured by the plants?
(a) 5 – 10% (b) 7 – 10%
(c) 8 – 10% (d) 2 – 10%

26. Each trophic level has a certain mass of living material at a particular time is known as
(a) catabolism (b) standing crop
(c) humification (d) primary productivity

27. Bacteria and fungi in a forest ecosystem are generally
(a) Producers
(b) Decomposers
(c) Primary consumers
(d) Secondary consumers

28. What will happen if decomposers are removed from the ecosystem?
(a) Energy cycle is stopped
(b) Mineral cycle is stopped
(c) Consumers cannot absorb solar energy
(d) Rate of decomposition of mineral increases

29. Ecosystem is:
(a) always open
(b) always closed
(c) both open and closed depending upon community
(d) both open and closed depending upon biomass

30. Bamboo plant is growing in a fir forest then what will be the trophic level of it?
(a) First trophic level (T_1)
(b) Second trophic level (T_2)
(c) Third trophic level (T_3)
(d) Fourth trophic level (T_4)

31. An ecosystem which can be easily damaged but can recover after some time if damaging effect stops will be having:
(a) low stability and high resilience
(b) high stability and low resilience
(c) low stability and low resilience
(d) high stability and high resilience

32. Which one of the following ecosystem types has the highest annual net primary productivity?
(a) Tropical deciduous forest
(b) Temperate evergreen forest
(c) Temperate deciduous forest
(d) Tropical rain forest

33. The slow rate of decomposition of fallen logs in nature is due to their:
(a) low moisture content
(b) poor nitrogen content
(c) anaerobic environment around them
(d) low cellulose content

34. The **correct** sequence of plants in a hydrosere is:
(a) *Volvox* → *Hydrilla* → *Pistia* → *Scirpus* → *Lantana* → *Oak*
(b) *Pistia* → *Volvox* → *Scirpus* → *Hydrilla* → *Oak* → *Lantana*
(c) *Oak* → *Lantana* → *Volvox* → *Hydrilla* → *Pistia* → *Scirpus*
(d) *Oak* → *Lantana* → *Scirpus* → *Pistia* → *Hydrilla* → *Volvox*

35. Mass of living matter at a trophic level in an area at any time is called
(a) standing crop (b) deteritus
(c) humus (d) standing state

36. Which one of the following animals may occupy more than one trophic levels in the same ecosystem at the same time?
(a) Sparrow (b) Lion
(c) Goat (d) Frog

37. Which one of the following is not a gaseous biogeochemical cycle in ecosystem ?
(a) Sulphur cycle (b) Phosphorus cycle
(c) Nitrogen cycle (d) Carbon cycle

38. In grass-deer-tiger food chain, grass biomass is one tonne. The tiger biomass shall be
(a) 100 kg (b) 10 kg
(c) 200 kg (d) 1 kg

39. Which one of the following is a primary consumer in maize field ecosystem?
(a) Lion (b) Grasshopper
(c) Wolf (d) Phytoplankton

40. Whale is-
(a) Primary producer
(b) Carnivorous secondary consumer
(c) A decomposer
(d) Herbivorous

41. If an ecosystem is composed of only three trophic levels then how much energy will be conserved at the III trophic level –
(a) 30% (b) 20%
(c) 10% (d) 1%

42. The animals which occupy the same trophic level are-
(a) Lion & Bees
(b) Deer & Bees
(c) Snakes & Earthworm
(d) Crow & Cow

43. The organisms which used as food material but they are not killed by other organisms in a nature are called-
(a) Primary consumer (b) Secondary consumer
(c) Top consumer (d) Decomposers

44. Which type of pyramid shows best efficiency of ecosystem?
(a) Pyramid of number (b) Pyramid of biomass
(c) Pyramid of volume (d) Pyramid of energy

45. Decomposers of an ecosystem include
(a) microscopic animals
(b) bacteria and fungi
(c) Both (a) and (b)
(d) Bacteria, fungi and macroscopic animals

46. In simple ecosystem with grass, deer and tiger in food chain, how much amount of food available to the tiger if the grass production is one tonne ?
(a) 100 kg (b) 10 kg
(c) 1 kg (d) 100 gm

47. Which type of pyramid of number is present in tree ecosystem?
(a) Upright (b) Inverted
(c) Rhomboidal (d) Both (a) and (b)

48. Which type of pyramid shows standing crop ecosystem ?
(a) Pyramid of energy (b) Pyramid of number
(c) Pyramid of biomass (d) None of above

49. In an ecosystem the function of the producers is –
(a) To convert organic compound into inorganic form
(b) To utilize chemical energy
(c) To trap solar energy and convert into chemical energy
(d) To release energy

50. A food chain can have trophic levels –
(a) Three or four (b) Three
(c) Two (d) One

51. In a food chain herbivores/deer are-
(a) Primary producers
(b) Primary consumers
(c) Secondary consumers
(d) Decomposers

52. Grassland with scattered trees is called:
(a) savannah (b) deciduous forest
(c) evergreen forest (d) tropical rain forest

53. PAR is
(a) Photoperiod Active Radiation
(b) Photosynthetically Active Radiation
(c) Photoperiod Active Resources
(d) Photosynthetically Active Resources.

54. Tip of ecological pyramid is occupied by
(a) producers (b) herbivores
(c) carnivores (d) omnivores

55. In a food web, each successive trophic level has
(a) increased total energy
(b) less total energy content
(c) more total energy content
(d) non-estimated energy content

56. 10% law of flow of energy in ecosystem was proposed by
(a) Lindeman (b) Carl Mobius
(c) Tansley (d) Darwin

57. When the number of organisms at successive levels are plotted, they assume the shape of a pyramid. This is called the pyramid of
(a) energy (b) number
(c) biomass (d) both (a) and (c)

58. Tropical deciduous forest trees shed their leaves to:
(a) protect themselves from heat.
(b) save energy.
(c) enhance rate of respiration.
(d) prevent loss of water.

59. Succession in saline soil is –
(a) Mesosere (b) Lethasere
(c) Psammosere (d) Halosere

60. The species that invade a bare area are called
(a) keystone species (b) extinct species
(c) pioneer species (d) rare species

61. Which one of the following is a major constituent of biological membranes, nucleic acids and cellular energy transfer systems?
(a) Phosphorus (b) Carbon
(c) Oxygen (d) Nitrogen

62. Which one of the following is considered as pioneer community in xerarch?
(a) Annual herb (b) Perennial herb
(c) Scrub stage (d) Lichen

63. The early settlers on a barren area (rock) are
(a) Ferns (b) Mosses
(c) Lichens (d) Diatoms

64. A community which starts succession in a habitat is
(a) Pioneer community (b) Seral community
(c) Biotic community (d) Ecosere

65. Last stabilised community in a plant succession is known as
(a) Seral community (b) Pioneer community
(c) Ecosere (d) Climax community

66. Intermediate community between pioneer and climax communities is called
(a) Seral community (b) Biotic community
(c) Temporary community (d) Ecosere

67. Trophic level in a food chain which cycles the various materials between environment and living organisms is constituted by:
(a) producers (b) consumers
(c) decomposers (d) All of these

68. Succession in a 6 metre deep pond exhibits a sequence of
(a) Submerged Plants → Reeds → Herbs → Floating Plants → Shrubs → Trees
(b) Floating Plants → Submerged Plants → Reeds → Herbs → Shrubs → Trees
(c) Shrubs → Trees → Submerged Plants → Floating Plants → Reeds → Herbs
(d) Submerged Plants → Floating Plants → Reeds → Herbs → Shrubs → Trees

69. Ecological succession on sand is
(a) Psammosere (b) Xerosere
(c) Halosere (d) Hydrosere

70. In ecological succession from pioneer to climax community, the biomass shall
(a) decrease
(b) increase and then decrease
(c) no relation
(d) increase continuously

71. Find out the correct order of succession levels in Xerarch
(a) Lichen moss stage, Annual herb stage, Perennial herb stage, Scrub stage, Forest
(b) Annual herb stage, Perennial herb stage, Lichen moss stage, Scrub stage, Forest
(c) Perennial herb stage, Annual herb stage, Perennial Scrub stage, Lichen moss stage, Forest
(d) Scrub stage, Forest, Annual herb stage, Lichen moss stage, Scrub stage, Forest

72. Phosphorus usually becomes a limiting factor at certain times of the year in
(a) Aquatic ecosystem (b) Grassland ecosystem
(c) Forest ecosystem (d) All of the above

73. Which of the following in an ecosystem exhibits one way flow rather than cyclic flow ?
(a) Potassium (b) Carbon
(c) Free energy (d) Nitrogen

74. Which ecosystem does not show variations dependent upon geographic location and rainfall ?
(a) Marine ecosystem
(b) Fresh water ecosystem
(c) Desert ecosystem
(d) Tropical ecosystem

75. Which of the following statements is not a major concern about our altering of the carbon cycle?
(a) The Greenland and Antarctic ice caps are expected to melt if global warming continues.
(b) High-sulphur fuels are used by power plants because they are less expensive than low-sulphur fuels.
(c) The increase in atmospheric CO_2 exceeds the ability of the oceans to absorb the increase.
(d) CO_2 is a gas that traps infrared radiation.

EXERCISE - 2
Applied Questions

1. Which of the following is expected to have the highest value ($gm/m^2/yr$) in a grassland ecosystem?
(a) Secondary Production
(b) Tertiary Production
(c) Gross Production (GP)
(d) Net Production (NP)

2. More than 70% of world's freshwater is contained in:
(a) polar ice
(b) glaciers and mountains
(c) antarctica
(d) greenland

3. Which one of the following is not used for construction of ecological pyramids?
(a) Number of individuals (b) Rate of energy flow
(c) Fresh weight (d) Dry weight

4. A lake near a village suffered heavy mortality of fishes within a few days. Consider the following reasons for this:
1. Lots of urea and phosphate fertilizer were used in the crops in the vicinity
2. The area was sprayed with DDT by an aircraft
3. The lake water turned green and stinky
4. Phytoplankton populations in the lake declined initially thereby greatly reducing photosynthesis.

Which two of the above were the main causes of fish mortality in the lake?
(a) 2 and 3 (b) 3 and 4
(c) 1 and 3 (d) 1 and 2

5. About 70% of total global carbon is found in:
(a) grasslands (b) agroecosystems
(c) oceans (d) forests

6. Consider the following statements concerning food chains
1. Removal of 80% tigers from an area resulted in greatly increased growth of vegetation
2. Removal of most of the carnivores resulted in an increased population of deers
3. The length of food chains is generally limited to 3-4 trophic levels due to energy loss
4. The length of food chains may vary from 2 to 8 trophic levels

Which two of the above statements are correct?
(a) 2 and 3 (b) 3 and 4
(c) 1 and 4 (d) 1 and 2

7. Which one of the following types of organisms occupy more than one trophic level in a pond ecosystem?
(a) Fish (b) Zooplankton
(c) Frog (d) Phytoplankton

8. Study the four statements (a–d) given below and select the two correct ones out of them:
1. A lion eating a deer and a sparrow feeding on grain are ecologically similar in being consumers
2. Predator star fish *Pisaster* helps in maintaining species diversity of some invertebrates
3. Predators ultimately lead to the extinction of prey species
4. Production of chemicals such as nicotine, strychnine by the plants are metabolic disorders

The two correct statements are:
(a) 2 and 3 (b) 3 and 4
(c) 1 and 4 (d) 1 and 2

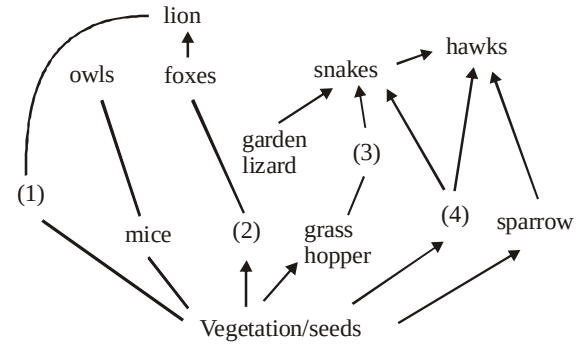
9. The biomass available for consumption by the herbivores and the decomposers is called:
(a) net primary productivity
(b) secondary productivity
(c) standing crop
(d) gross primary productivity

10. Which one of the following statements for pyramid of energy is incorrect, whereas the remaining three are correct ?
(a) Its base is broad
(b) It shows energy content of different trophic level organisms
(c) It is inverted in shape
(d) It is upright in shape

11. Both, hydrarch and xerarch successions lead to:
(a) medium water conditions
(b) xeric conditions
(c) highly dry conditions
(d) excessive wet conditions

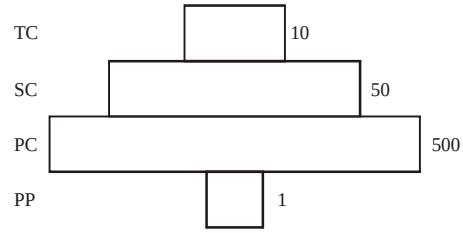
12. The rate of formation of new organic matter by rabbit in a grassland, is called
(a) net productivity
(b) secondary productivity
(c) net primary productivity
(d) gross primary productivity

13. Identify the likely organisms (a), (b), (c) and (d) in the food web shown below.



	(1)	(2)	(3)	(4)
(a)	Deer	Rabbit	Frog	Rat
(b)	Dog	Squirrel	Bat	Deer
(c)	Rat	Dog	Tortoise	Crow
(d)	Squirrel	Cat	Rat	Pigeon

14. Given below is an imaginary pyramid of numbers. What could be one of the possibilities about certain organisms at some of the different levels ?



(a) Level PC is "insects" and level SC is "small insectivorous birds".
(b) Level PP is "phytoplanktons" in sea and "whale" on top level TC
(c) Level one PP is "pipal trees" and the level SC is "sheep".
(d) Level PC is "rats" and level SC is "cats".

15. Which one of the following is not a function of an ecosystem
(a) Energy flow (b) Decomposition
(c) Productivity (d) Stratification

16. Natural reservoir of phosphorus is :
(a) Animal bones (b) Rock
(c) Fossils (d) Sea water

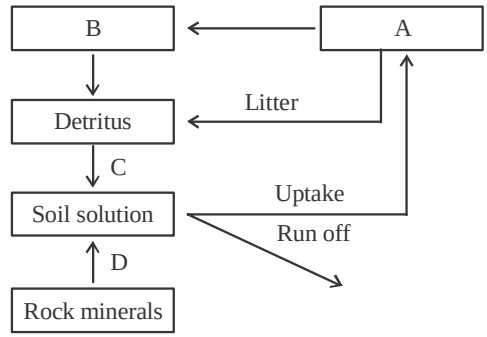
17. Pneumatophores are characteristic of plants growing in
(a) saline soils
(b) sandy soils
(c) marshy places and salt lakes
(d) dryland regions

18. When man eats fish which feeds on zooplankton which have eaten small plants, the producer in the chain is

(a) Zooplankton (b) Small plants

(c) Fish (d) Man

19. Identified A, B, C and D of a nutrient cycle.



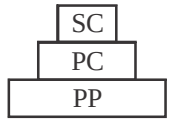
(a) A – Consumers; B – Decomposition; C – Producers D – Weathering

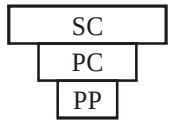
(b) A – Consumers; B – Weathering; C – Producers; D – Decomposition

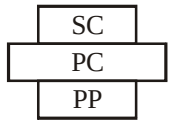
(c) A – Producers; B – Consumers; C – Decomposition; D – Weathering

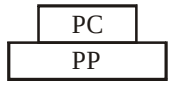
(d) A – Consumers; B – Producers; C – Decomposition D – Weathering

20. Which of the given below pyramids represents the variation in biomass at different trophic levels in pond ecosystem?

(a) 

(b) 

(c) 

(d) 

21. Find out the pairs which are correctly matched.

	Column-I		**Column-II**
A.	Primary succession	1.	Autotrophs
B.	Climax community	2.	Community that has completed succession
C.	Consumer	3.	Colonization of a new environment
D.	Producer	4.	Animals

(a) A → (c); B → (b); C → (d); D → (a)

(b) A → (c); B → (a); C → (d); D → (b)

(c) A → (a); B → (c); C → (b); D → (d)

(d) A → (b); B → (c); C → (d); D → (a)

22. Match column - I with column -II and choose the correct option.

	Column-I		**Column-II**
A.	Presence of 3-4 storey of plant crowns in a forest	1.	Blue-green algae
B.	A biome having grasses with scattered trees	2.	Stratification
C.	Man made ecosystem	3.	Savannah
D.	Pioneer in Hydrosere	4.	Dam

(a) A → (c); B → (b); C → (d); D → (a)

(b) A → (c); B → (a); C → (d); D → (b)

(c) A → (a); B → (c); C → (b); D → (d)

(d) A → (b); B → (c); C → (d); D → (a)

23. Food chains differ from food webs in that

1. food chains are single sequence of who eats whom in a community.
2. food chains better represent the entire community.
3. food webs represent the complex interaction among food chains.
4. food chain is the flow of energy in a population.

(a) 1 and 3 (b) 1 and 4

(c) 1, 2 and 3 (d) 1, 2, 3 and 4

24. Which of the following include (s) ecosystem services ?

1. Purification of air and water by forests
2. Forests mitigate droughts and flood
3. Forests act as store house of carbon
4. Forests influence hydrological cycle

(a) 1 and 3 (b) 1 and 4

(c) 1, 2 and 3 (d) All of these

DIRECTIONS for Q. 25: Given question contain STATE-MENT-1 (Assertion) and STATEMENT-2 (Reason) and has 4 choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

(a) Statement- 1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement -1

(b) Statement -1 is True, Statement -2 is True ; Statement-2 is NOT a correct explanation for Statement - 1

(c) Statement - 1 is True, Statement- 2 is False

(d) Both the Statements are False.

25. **Statement 1:** Net primary productivity is gross primary productivity minus respiration.

Statement 2 : Secondary productivity is produced by heterotrophs.

EXERCISE - 3
Exemplar & Past Years NEET/AIPMT Questions

Exemplar Questions

1. Decomposers like fungi and bacteria are
(i) autotrophs (ii) heterotrophs
(iii) saprotrophs (iv) chemo-autotrophs
Choose the correct answer
(a) (i) and (iii) (b) (i) and (iv)
(c) (ii) and (iii) (d) (i) and (ii)

2. The process of mineralisation by microorganisms helps in the release of
(a) inorganic nutrients from humus
(b) both organic and inorganic nutrients from detritus
(c) organic nutrients from humus
(d) inorganic nutrients from detritus and formation of humus.

3. Productivity is the rate of production of biomass expressed in terms of
(i) $(kcal\ m^{-3})\ yr^{-1}$ (ii) $g^{-2}yr^{-1}$
(iii) $g^{-1}yr^{-1}$ (iv) $(kcal\ m^{-2})\ yr^{-1}$
(a) (ii) (b) (iii)
(c) (ii) and (iv) (d) (i) and (iii)

4. An inverted pyramid of biomass can be found in which ecosystem?
(a) Forest (b) Marine
(c) Grassland (d) Tundra

5. Which of the following is not a producer?
(a) *Spirogyra* (b) *Agaricus*
(c) *Volvox* (d) *Nostoc*

6. Which of the following ecosystems is most productive in terms of net primary production?
(a) Deserts (b) Tropical rain forests
(c) Oceans (d) Estuaries

7. Pyramid of numbers is
(a) Always upight
(b) Always inverted
(c) Either upright or inverted
(d) Neither upright nor inverted

8. Approximately how much of the solar energy that falls on the leaves of a plant is converted to chemical enegry by photosynthesis?
(a) Less than 1% (b) 2 - 10%
(c) 30% (d) 50%

9. Among the following where do you think the process of decomposition would be the fastest?
(a) Tropical rain forest (b) Antarctic
(c) Dry arid region (d) Alpine region

10. How much of the net primary productivity of a terrestrial ecosystem is eaten and digested by herbivores?
(a) 1% (b) 10%
(c) 40% (d) 90%

11. During the process of ecological succession the changes that take place in communities are
(a) orderly and sequential
(b) random
(c) very quick
(d) not influenced by the physical environment

12. Climax community is in a state of
(a) non-equilibrium (b) equilibrium
(c) disorder (d) constant change

13. Among the following bio-geo-chemical cycles which one does not have losses due to respiration?
(a) Phosphorus (b) Nitrogen
(c) Sulphur (d) All of the above

14. The sequence of communites of primary succession in water is
(a) Phytoplanton, sedges, free-floating hydrophytes, rooted hydrophytes, grasses and trees.
(b) Phytoplankton, free-floating hydrophytes, rooted hydrophytes, sedges, grasses and trees.
(c) Free-floating hydrophytes, sedges, phytoplankton, rooted hydrophytes, grasses and trees.
(d) Phytoplankton, rooted submerged hydrophytes, floating hydrophytes, reed swamp, sedges, meadow and trees.

15. The reservoir for the gaseous type of bio-geochemical cycle exists in
(a) stratosphere (b) atmosphere
(c) ionosphere (d) lithosphere

16. If the carbon atoms fixed by producers already have passed through three species, the trophic level of the last species would be
(a) scavenger (b) tertiary producer
(c) tertiary consumer (d) secondary consumer

17. Which of the following type of ecosystem is expected in an area where evaporation exceeds precipitation, and mean annual rainfall is bellow 100mm
(a) Grassland (b) Shrubby forest
(c) Desert (d) Mangrove

18. The zone at the edge of a lake or ocean which is alternatively exposed to air and immersed in water is called
(a) pelagic zone (b) benthic zone
(c) lentic zone (d) littoral zone

19. Edaphic factor refers to
(a) water (b) soil
(c) relative humidity (d) altitude

20. Which of the following is an ecosystem service provided by a natural ecosystem?
(a) Cycling of nutrients
(b) Prevention of soil erosion
(c) Pollutant absorption and reduction of the threat of global warming
(d) All of the above

NEET/AIPMT (2013-2017) Questions

21. Natural reservoir of phosphorus is : ***[2013]***

(a) Animal bones (b) Rock
(c) Fossils (d) Sea water

22. Which one of the following processes during decomposition is correctly described? ***[2013]***

(a) Humification-Leads to the accumulation of a dark coloured substance humus which undergoes microbial action at every fast rate
(b) Catabolism-Last step decomposition under fully anaerobic condition
(c) Leaching-Water soluble inorganic nutrients rise to the top layers of soil
(d) Fragmentation-Carried out by organisms such as earthworm

23. Secondary productivity is rate of formation of new organic matter by ***[2013]***

(a) Parasite (b) Consumer
(c) Decomposer (d) Producer

24. Which one of the following is a primary consumer in maize field ecosystem? ***[NEET Kar. 2013]***

(a) Lion (b) Grasshopper
(c) Wolf (d) Phytoplankton

25. When man eats fish which feeds on zooplankton which have eaten small plants, the producer in the chain is ***[NEET Kar. 2013]***

(a) Zooplankton (b) Small plants
(c) Fish (d) Man

26. The age pyramid with broad base indicates ***[NEET Kar. 2013]***

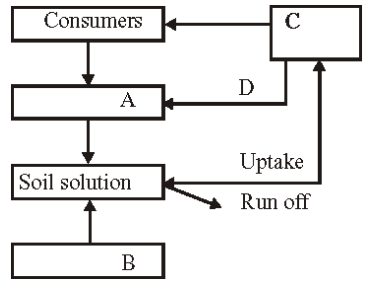
(a) High percentage of young individuals
(b) High percentage of old individuals
(c) Low percentage of young individuals
(d) A stable population

27. Match the following and select the correct option: ***[2014]***

(A)	Earthworm	(i)	Pioneer species
(B)	Succession	(ii)	Detritivore
(C)	Ecosystem service	(iii)	Natality
(D)	Population growth	(iv)	Pollination

	(A)	(B)	(C)	(D)
(a)	(i)	(ii)	(iii)	(iv)
(b)	(iv)	(i)	(iii)	(ii)
(c)	(iii)	(ii)	(iv)	(i)
(d)	(ii)	(i)	(iv)	(iii)

28. Given below is a simplified model of phosphorus cycling in a terrestrial ecosystem with four blanks (A-D). Identify the blanks:- ***[2014]***



	A	B	C	D
(a)	Rock minerals	Detritus	Litter fall	Producers
(b)	Litter fall	Producers	Rock minerals	Detritus
(c)	Detritus	Rock minerals	Producer	Litter fall
(d)	Producers	Litter fall	Rock minerals	Detritus

29. If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain? ***[2014]***

plant → mice → snake → peacock:

(a) 0.02 J (b) 0.002 J
(c) 0.2 J (d) 0.0002 J

30. Vertical distribution of different species occupying different levels in a biotic community is known as: ***[2015 RS]***

(a) Stratification (b) Zonation
(c) Pyramid (d) Divergence

31. The mass of living material at a trophic level at a particular time is called : ***[2015 RS]***

(a) Standing state
(b) Net primary productivity
(c) Standing crop
(d) Gross primary productivity

32. In an ecosystem the rate of production of organic matter during photosynthesis is termed as: ***[2015 RS]***

(a) Gross primary productivity
(b) Secondary productivity
(c) Net productivity
(d) Net primary productivity

33. Secondary Succession takes place on/in : ***[2015 RS]***

(a) Degraded forest
(b) Newly created pond
(c) Newly cooled lava
(d) Bare rock

34. During ecological succession: ***[2015 RS]***

(a) the establishment of a new biotic community is very fast in its primary phase.
(b) the numbers and types of animals remain constant.
(c) the changes lead to a community that is in near equilibrium with the environment and is called pioneer community.
(d) the gradual and predictable change in species composition occurs in a given area.

35. Increase in concentration of the toxicant at successive trophic levels is known as : ***[2015 RS]***

(a) Biodeterioration (b) Biotransformation
(c) Biogeochemical (d) Biomagnification

36. In which of the following both pairs have correct combination? ***[2015 RS]***

(a)	Gaseous nutrient cycle	Carbon and sulphur
	Sedimentary nutrient cycle	Nitrogen and Phosphorus
(b)	Gaseous nutrient cycle	Nitrogen and sulphur
	Sedimentary nutrient cycle	Carbon and Phosphorus
(c)	Gaseous nutrient cycle	Sulphur and Phosphorus
	Sedimentary nutrient cycle	Carbon and Nitrogen
(d)	Gaseous nutrient cycle	Carbon and Nitrogen
	Sedimentary nutrient cycle	Sulphur and Phosphorus

37. During biological nitrogen fixation, inactivation of nitrogenase by oxygen poisoning is prevented by : ***[2015 RS]***

(a) Xanthophyll (b) Carotene
(c) Cytochrome (d) Leghemoglobin

38. An association of individuals of different species living in the same habitat and having functional interactions is: ***[2015 RS]***

(a) Biotic community (b) Ecosystem
(c) Population (d) Ecological niche

39. Most animals that live in deep oceanic waters are: ***[2015 RS]***

(a) secondary consumers (b) tertiary consumers
(c) detritivores (d) primary consumers

40. Which of the following is a characteristic feature of cropland ecosystem ? ***[2016]***

(a) Absence of soil organisms
(b) Least genetic diversity
(c) Absence of weeds
(d) Ecological succession

41. Which of the following would appear as the pioneer organisms on bare rocks? ***[2016]***

(a) Lichens (b) Liverworts
(c) Mosses (d) Green algae

42. The term ecosystem was coined by ***[2016]***

(a) E.P. Odum (b) A.G. Tansley
(c) E.Haeckel (d) E. Warming

43. Which ecosystem has the maximum biomass? ***[2017]***

(a) Grassland ecosystem (b) Pond ecosystem
(c) Lake ecosystem (d) Forest ecosystem

Hints & Solutions

EXERCISE - 1

1. (c) 2. (d) 3. (d) 4. (d) 5. (b) 6. (d)
7. (c) 8. (a) 9. (a) 10. (a) 11. (d) 12. (c)

13. (b) An ecosystem resist changes because it is in a state of greater stability. It is called as homeostasis or an ecosystem maintains a functional balance or relatively stable state of equilibrium amongst its different components. This phenomenon is called balance of nature or homeostasis.

14. (c) The ecosystem comprises abiotic and biotic components. The entire living community comprising plants and animals constitute the biotic component whereas the entire physical environment forms the abiotic component.

15. (d) 2/3 parts of each is ocean here, various types of food chains form food webs. This ecosystem is most stable due to buffering action of water.

16. (b) Secondary productivity is the rate of storage of organic matter by consumers per unit area per unit time.

17. (c) 18. (a) 19. (c) 20. (c) 21. (a) 22. (b)
23. (a) 24. (b) 25. (d) 26. (b) 27. (b) 28. (b)
29. (a)

30. (a) First trophic level is occupied by producers. Second trophic level is occupied by primary consumers. Third trophic level is occupied by the secondary consumers.

31. (a) An ecosystem having low stability can be easily damaged. An ecosystem having high resilience will take less time to recover.

32. (d) They are found in the equatorial regions rainfall exceeds 140 cm. The warm humid climate supports broad leaved evergreen plants. Productivity is very high (12000 k. cal/ m^2/ year). The vegetation show stratification into two or more well defined layers.

33. (d) The slow rate of decomposition of fallen logs in nature is due to their low cellulose content. It plays an essential part in abscission in plants, while microbial cellulases enable the digestion of plant material by herbivores.

34. (a) The correct sequence of plants in a hydrosere is *Volvox*, *Hydrilla*, *Pistia*, *Scirpus*, *Lanatana* and *Oak*. A hydrosere is a plant succession which occurs in a fresh water lake. In time, an area of open fresh water such as a lake will naturally dry out, ultimately becoming woodland. During this change, a range of different landtypes such as swamp and marsh will succeed each other. The succession from open water to climax woodland is likely to take at least two hundred years.

35. (a) A standing crop is the quantity or total weight or energy content of the organism, which are in a particular location at a particular time.

36. (a) It feeds upon grains hence called primary consumer and can also feed on insects hence called secondary consumer at the same time in the same ecosystem.

37. (b) Phosphorus is mostly used as phosphate. Its reservoir pool is phosphate rocks while cycling pool is soil for terrestrial ecosystems and water for aquatic ecosystems.

38. (b) Only 10% of the mass is flown from one trophic level to another in the form of energy.

39. (b) In an ecosystem, producers (e.g., plants/phytoplankton) belong to first trophic level, herbivores or primary consumer (e.g., grasshopper) to the second and carnivores or secondary consumer (e.g., lion, wolf) to the third trophic level.

40. (b) 41. (d) 42. (d) 43. (a) 44. (b) 45. (b)
46. (b) 47. (b) 48. (c) 49. (c) 50. (a) 51. (b)
52. (a) 53. (b) 54. (c)

55. (b) In food web, each successive trophic level has less total energy content as per law of Lindeman. Some energy is lost in transfer from one another level.

56. (a) Lindeman proposed the 10% law of flow of energy in ecosystem. According to this law only 10% energy passed from one trophic level to other in a food chain.

57. (b) In the pyramid of number, the number of individual organisms at each trophic level is shown.

58. (d) 59. (d) 60. (c) 61. (a) 62. (d)

63. (c) Lichens are the early settlers on a barren area because they can tolerate desiccation, heating during summer noon or excessive cooling during winter nights. They secrete lichen acids and carbonic acid. The acids slowly corrode rock surface and release minerals required for proper growth of lichens.

64. (a) The first biotic community which develops in a bare area is called pioneer community. It has very little diversity. This stage takes the longest time to change the environment for invasion of the next community.

65. (d) Climax community is the stable, self perpetuating and final biotic community that develops at the end of biotic succession and is in perfect harmony with the physical environment.

66. (a) The various biotic communities that develop during biotic succession are termed as seral or transitional communities. The entire sequence of development stage of biotic succession from pioneer to a climax community is known as sere.

67. (c) 68. (d) 69. (a) 70. (d) 71. (a) 72. (a)
73. (c) 74. (a)

75. (b) The use of high-sulphur coal has more to do with acid precipitation than it does with global warming.

EXERCISE - 2

1. (c) Grasslands will have highest value of gross production. Net production is obtained after subtracting the respiratory utilization from gross production. Secondary and tertiary production is related with secondary and tertiary consumers respectively.
2. (a) Three fourth surface of earth is covered by oceans which contain 97.5% of total water. It is marine water with about 3.5% salt content only 2.5% is fresh water which occurs on land. Most of this water (1.97%) occurs as frozen ice caps and glaciers, 0.5% fresh water occurs as ground water. Rivers and lakes contain 0.02%, soil 0.01% while atmosphere possesses 0.001% of water as vapours.
3. (c) Fresh weight is not used for the construction of ecological pyramids because the total fresh weight does not change into energy. Hence we can say that fresh weight is not continuous in the tropic levels.
4. (c) Lots of urea and phosphate fertilizer were used in the crops in the vicinity and the lake water turned green and stinky. Due to this, lake near a village suffered heavy mortality of fishes within a few days.
5. (c) About 70% of total global carbon is found in oceans. This oceanic reservoir regulates the amount of carbon dioxide in the atmosphere. Atmosphere contains only about one percent of total global carbon.
6. (a)
7. (a) A pond ecosystem is a delicate balance of fish, plants and other animals. Fish occupy more than one tropic level in pond ecosystem. Small fishes act as secondary consumer. They feed on primary consumer. Large fishes act as tertiary consumer. They feed on smaller fishes.
8. (d) The statement (a) and (b) are correct. The statement (c) is incorrect because predators cannot lead to the extinction of prey species. Predator and prey evolve together. The statement (d) is incorrect because chemical such as nicotine and strychnine produced by the plants are not metabolic disorders but are metabolic wastes.
9. (a) The biomass available for consumption by the herbivores and the decomposers is called net primary productivity. It is equal to the rate of organic matter created by photosynthesis minus the rate of respiration and other losses.
10. (c) An energy pyramid is the graphical representation of the tropic level (nutritionals) by which the incoming solar energy is transferred into an ecosystem. It can never be inverted in shape.
11. (a) Hydrarch succession takes place in wetter areas and xerarch succession respectively, which takes place in dry areas. So, both hydrarch and xerarch successions leads to medium water conditions.
12. (b) At the trophic level of consumers the rate at which food energy is assimilated is called secondary productivity. Rabbit is a consumer.
13. (a) Food web is a network of food chains or feeding relationships by which energy and nutrients are passed on from one species of living organisms to another.
14. (a)
15. (d) Four important functional aspects of the ecocystem are (i) Productivity (ii) Decomposition, (iii) Energy flow and (iv) Nutrient cycling.
16. (b) The natural reservoir of phosphate is rock which contains phosphorus in the form of phosphates when rocks are weathered, minute amounts of these phosphate dissolve in soil solution and are absorbed by the roots of the plants . Herbivores and other animals obtain this element from plants.
17. (c) Some plants growing in salty marshes develop special roots for respiration, called pneumatophores. They are (–)vely geotropic.
18. (b) Plants are producers which can prepare their food by the process of photosynthesis. Zooplanktons, fish and man are primary, secondary and tertiary carnivores respectively.
19. (c) 20. (c) 21. (a) 22. (d) 23. (a)
24. (d) Healthy ecosytems provide a wide range of economic, environmental and aesthetic goods and services. Ecosystem services refer to the product of ecosystem processes. Forests maintain biodiversity and generate fertile soils.
25. (b) Net primary productivity is the rate of organic matter built up or stored by producers in their bodies per unit time and area. Net productivity is equal to gross primary productivity minus loss due to respiration and other reasons. Rate of increase in energy containing organic matter or biomass by heterotrophs or consumers per unit time and area is known as secondary productivity.

EXERCISE - 3

Exemplar Questions

1. (c) Those organisms which are able to synthesise their own food are known as autotrophs. *e.g.*, plants while the organisms which derive their food, from autotrophs or plants are termed as **heterotrophs**. These may be herbivores, carnivores and omnivores.
Saprotrophs are the organisms, which obtain their

nourishment from dead organic matter or decayed remains of both plants and animals. They are also known as decomposer. They play an important role in recycling of minerals by decomposing dead organic matter.

2. (a) During the process of decomposition five important steps occured i.e fragmentation, leaching, catabolism humification and mineralisation. Humus and mineral (inorganic nutrients) are obtained by humification and mineralisaton.
Mineralisation is also responsible for release of inorganic substances, both minerals (K^+, Mg^{++}, Ca^{++} and NH_4^+) and non- minerals like H_2O and CO_2 from dead organic matter of plant's and animal's remains.

3. (c) The rate of production of biomass or organic matter by any trophic level per unit area over a time period is productivity. It is expressed/measured in term of weight (*e.g.*, $gm/m^2/yr^2$) or energy (e.g., $kcal/m^2/yr$).

4. (b) In case of aquatic ecosystem like pond ecosystem, marine ecosystem, pyramid of biomass, is inverted because the biomass of fishes exceeds than that of phytoplanktons that make the small standing crop of aquatic ecosystems. In aquatic ecosystem, the biomass of trophic level depends upon reproductive potential and longevity of its members.

5. (b) Agaricus, it belong to basidiomycetes fungi, which is a heterotrophs, of class saprotrophs. It is popularly called as mushroom. Whereas *Spirogyra*, is a green algae and an autotrophs, *i.e*., producer. *Nostoc* and *Volvox* are blue-green algae (cyanobacteria) and are also a producer (autotroph).

6. (b) In terms of net primary productivity tropical rain forest is at the top followed by coral reef, eastuaries and desert and ocean. Thus option 'b' is correct while 'a', 'c' and 'd' are wrong.

7. (c) Pyramid of number in ecosystems can be either inverted or upright. In terrestrial ecosystem pyramids of number is upright. In case of successive decrease in members of trophic level like a big tree, it is inverted whereas pyramid of energy is always upright.

8. (b) The ultimate source of enegry in all ecosystems is sun except deep hydrothermal ecosystem. Solar radiation (less than 50% is Photosynthetically Active Radiation (PAR)) and about 2 - 10% or 1 - 5% of solar incident energy is captured by the autotrophs and converted to chemical enegry by the process of photosynthesis.

9. (a) The tropical rain forest receive little solar radiation at The lowest forest floor and its soil is rich in mineral and humus.
For high microbial activity of decomposers to decompose the fallen leaves and dead organic matter, the high temperature and moisture (humidity) are favourable in this type of biome. The process of decomposition is fastest.

10. (b) Predation occurs at every steps of a predator or grazing food chain for example herbivore are eaten up by carnivore. 10% energy is trasferred at every trophical level.

11. (a) Ecological succession is the gradual and predictable changes in the species composition of a given area. These changes are orderly and sequentail. The entire seqences of communities that successively change in a given area are termed as sere.
The other options are not the features of ecological succession.

12. (b) During ecological or biotic succession climax community is stable, self perpetuating. It is the final biotic community and is developed at the end of succession. It is present in state of perfect hormony and equlibrium with physical environment.
Climax community has maximum diversity and niche specialisation, thus all the other option are not related to climax community and are wrong.

13. (d) Due to the process of respiration phosphorus, nitrogen and sulphur biogeochemical cycle does not have any losses. While cycles like carbon and oxygen are affected by the process of respiration.

14. (d) The sequences of communities of primary succession in hydrosere is phytoplankton (pioneer stage) $\rightarrow$ rooted submerged hydrophytes $\rightarrow$ floating hydrophyte (floating stage) $\rightarrow$ reed swamp $\rightarrow$ sedges $\rightarrow$ meadow and woodland (trees). The other options are incorrect.

15. (b) Reserve pool and cycling pool are two stores of nutrients. The reservoir for gaseous type of nutrient and biogeochemical cycle (nitrogen and carbon cycle) exist in atmosphere whereas earth crust is the reservoir for sedimentary cycle. Whereas stratosphere, ionosphere and lithosphere are the parts of atmosphere.

16. (c) Producer $\rightarrow$ Ist Trophic level $\rightarrow$ (Primary consumer)
IInd Trophic level $\rightarrow$ IIIrd Trophic level
(Secondary consumer) (Tertiary consumer)
Scavengers are the detrivores that feeds on the tissue of dead animals (e.g., vultures) and plays no role in carbon fixation. Producers fix the carbon dioxide which is passed through the different trophic level.

17. (c) In true desert biome rainfall is less than 100mm/year, which is characterised by extremely hot days and cold nights. Evaporation from true desert always exceeds 7-50 times the precipitation (rainfall). Desert ecosystem of biomes are present more in Northern hemisphere than Southern hemisphere.
Whereas Grassland ecosystem receives medium rain fall ranging from 25-75 cm/yr, but its evaporation rate is not higher than precipitation rate.
Shrubby forest receives rainfall 90-150 cm/yr.
Mangrove forests receive annual rainfall ranging from 100-150 cm/yr.

18. (d) The zone at the edge of a lake or ocean or in aquatic

habitat which is alternatively exposed to air is the littoral zone, hence, light is also available and immersed in water. This coastal zone is rich producers from surface to bottom, with a large number of brown and red alga attached at the zone. Different zones is an aquatic ecosystem.

Any zone of water in a sea or lake that is neither close to bottom nor the shore is pelagic zone.

It is the bottom part of the water body (aphotic zone) where light is not available and is dark. Microorganisms and benthic organisms are found in this zone. It is referred as benthic zone.

Lentic zone refers to standing or relativelly still water in an equatic ecosystem.

19. (b) Soil like soil texture, background mineral, its topography and pH value etc, are edaphic factor.

Water, relative humidity and altitude another abiotic components of an ecosystem but affects the climatic conditions hence are climatic factors. The variations in these factors affects the ecosystem and these factors are also the deciding factor of the different types of ecosystem found on earth.

20. (d) A natural ecosystems maintain its biotic and abiotic factors naturally. The products of ecosystem processes are known as the ecosystem services. A healthy ecosystem provides a wide range of economic, environmented and aesthetic goods and services.

Following are the various ecosystem services provided by a natural ecosystem that includes

(i) Purify air and water
(ii) Migration of droughts and floods
(iii) Nutrient cycling
(iv) Generation of fertile soil
(v) Maintenance of biodiversity
(vi) Provide storage site for carbon
(vii) Pollinate crops
(viii) Also provides aesthetic, cultural and spiritual values

Thus, all the other options are correct.

NEET/AIPMT (2013-2017) Questions

21. (b) The natural reservoir of phosphate is rock which contains phosphorus in the form of phosphates when rocks are weathered, minute amounts of these phosphate dissolve in soil solution and are absorbed by the roots of the plants . Herbivores and other animals obtain this element from plants.

22. (d) Humification, catabolism, leaching and fragmentation are the steps of decomposition which operate simultaneously on the detritus. Fragmentation is breaking down detritus into smaller particles by detritivores like earthworm. By the process of leaching, water soluble inorganic nutrients go down into soil horizon and get precipitated as unavailable salts. Humification occurs at a very slow rate.

23. (b) The rate of resynthesis of organic matter by the consumers is known as secondary productivity. It depends upon the loss while transferring energy containing organic matter from the previous trophic level plus the consumption due to respiration and predation. Respiration loss is about 20% for autotrophs, 30% for herbivores and upto 60% in case of carnivores. Therefore net productivity decreases with each trophic level.

24. (b) In an ecosystem, producers (e.g., plants/phytoplankton) belong to first trophic level, herbivores or primary consumer (e.g., grasshopper) to the second and carnivores or secondary consumer (e.g., lion, wolf) to the third trophic level.

25. (b) Plants are producers which can prepare their food by the process of photosynthesis. Zooplanktons, fish and man are primary, secondary and tertiary carnivores respectively.

26. (a) Age pyramid is a graphic representation of different age groups of population with pre-reproductive groups at the base, reproductive ones in the middle and post-reproductive groups at the top. In **Triangular age pyramid,** the number of pre-reproduction individual is very large while reproductive are moderate and post-reproductive are fewer.

27. (d) Detrivores, (*e.g.* earthworm) break down detritus into smaller particles. The species that invade a bare area in succession is called pioneer species. The products of ecosystem processes are termed as ecosystem services, *e.g.*, healthy forest ecosystems purify air and water, mitigate droughts and floods etc. Natality refers to number of births during a given period in the population.

28. (c) Phosphorus is an important element for living beings. Consumers obtain phosphorus directly or indirectly from plants. Phosphorus is also present in phosphatic rocks. It is released during the decomposition of plant and animal remains. The released phosphorus may reach the deeper layers of soil and gets deposited as phosphate rocks. All plants and animals eventually die and in due time, their organic remains or debris decay through the action of micro-organism and the phosphates are released into the water for recycling.

29. (a) According to 10 percent law, during the transfer of energy from organic food from one trophic level to the next, only about ten percent of energy from organic matter is stored as flesh. The remaining is lost during transfer, broken down in respiration, or lost to incomplete digestion by higher trophic levels. If 20 J of energy is trapped at producer level, then 0.02 J of energy will be available to peacock as food in the given food chain.

30. (a) Stratification is the occurrence of vertical zonation in the ecosystem & indicates the presence of favorable environmental conditions, for e.g., trees occupy top

vertical strata or layer of a forest, shrubs the second. Herbs & grasses occupy the bottom layers. It is absent or poor where environmental conditions are unfavorable, e.g. desert ecosystems have very few trees & shrubs.

31. (c) Standing crop is the amount of living biomass in an ecosystem. It indicates the productivity & luxuriance of growth. It is expressed in the form of number or biomass of organisms per unit area.

32. (a) Gross Primary Productivity (GPP) is the rate of production of biomass or accumulation of energy by green plants per unit area per unit time. GPP depends on the chlorophyll content.

33. (a) Secondary succession takes place in disturbed area having poor vegetation.

34. (d) The gradual and predictable change, in the composition of species takes place in a given area during ecological succession.

35. (d) Biomagnification means an increase in concentration of toxins through the trophic levels of a food chain.

36. (d) Carbon and Nitrogen are gaseous nutrient cycle. Sulphur and phosphorus are sedimentary nutrient cycle.

37. (d) Leghaemoglobin prevents oxygen poisoning which causes inactivation of nitrogenase.

38. (a) Biotic community is an association of individuals of different species living in the same habitat and showing functional interactions.

39. (c) Detritivores are the organisms which feed on dead plants and animal residues.

40. (b) Cropland ecosystem is largest anthropogenic ecosystem characterized by less diversity and high productivity.

41. (a) Lichens produce small amounts of carbonic acids from their "roots" and these slowly dissolve the rock, releasing nutrients. Other nutrients are obtained from water-borne or air-borne particles of both organic and inorganic materials. The body of a lichen contains an alga; this is able to photosynthesise sugars, some of which are passed on to the fungal component of the lichen. In return the alga gets a tiny but significant amount of shelter within the tissues of the lichen.

42. (b) Sir Arthur George Tansley was an English botanist and a pioneer in the science of ecology who coined the term ecosystem.

43. (d) Forest ecosystem has the maximum biomass.
Some very high productive ecosystem are
– Tropical rain forest
– Coral reef
– Estuaries
– Sugarcane fields