



---

# **Ecosystem**





---

## **DISCLAIMER**

The content provided in these notes are created and owned by the Authors and licensed to Sorting Hat Technologies Private Limited (Company) for the sole purpose of providing access to the agreed upon Learners of the Company's Platform. The Company disclaims all rights and liabilities in relation to the content, images or any material of the notes. The Authors are the sole owners of the content and shall be solely responsible for, including without limitation, any claims, liabilities, damages, losses or suits that may arise with respect to the content in these notes.



# Ecosystem

## INTRODUCTION

- Ecology (Gr. Oikos-house; Logos-study) involves the study of inter-relationships of organisms with one another and with their environment.
- In a given geographical area organisms demonstrate interspecific and intraspecific relationships for survival. Biotic community lives in an environment which fulfills its material and energy requirements too. Hence, living organisms and their physical environment are in an inseparable relationship. This relationship constitutes different ecosystems.
- So ecosystem is the functional unit of nature.

## ECOSYSTEM

- **Sir Arthur Tansley** coined the term ecosystem.
- Ecosystem is a self-sustained unit in which living and non-living components interact with each other.
- **Types of ecosystem**

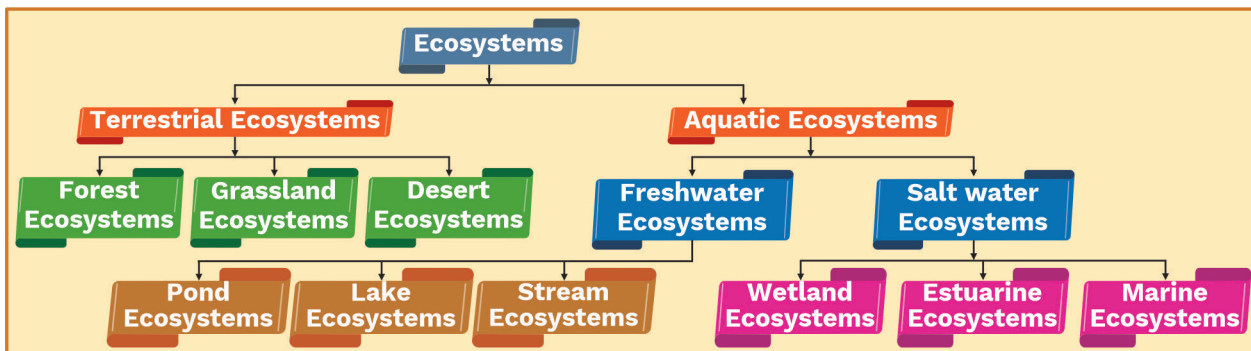
## Definition

**Ecosystem:** It is a self-sustained and functional unit of nature consisting of biotic and abiotic factors, where the living organisms (biotic factors) interact among themselves and also with their physical environment (abiotic factors).

## Previous Year's Question

The maximum energy amongst ecosystems is contributed by

- (1) crops
- (2) forests
- (3) coal
- (4) fuel gas

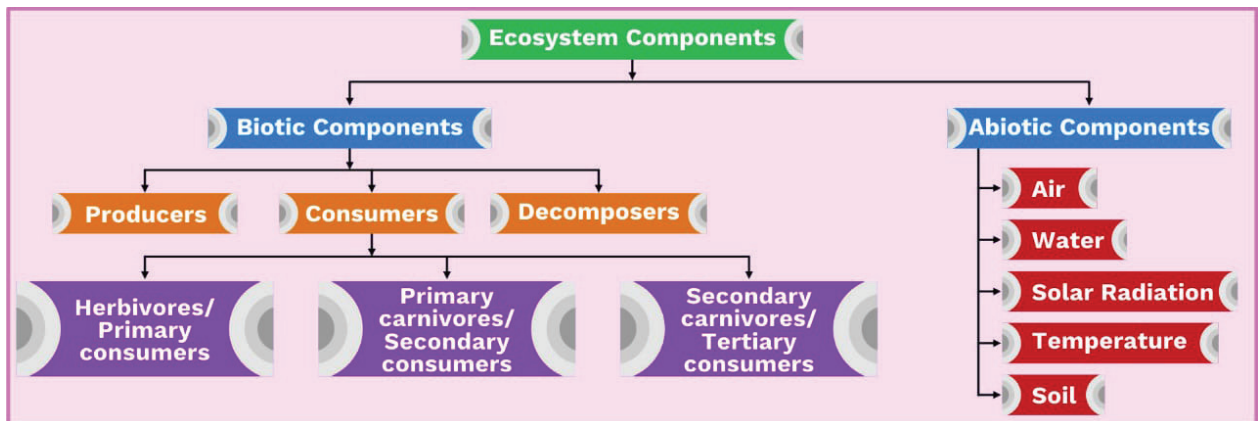


**Note:** Crop fields, orchards, gardens and aquaria are some man-made ecosystems.

## Gray Matter Alert!!!

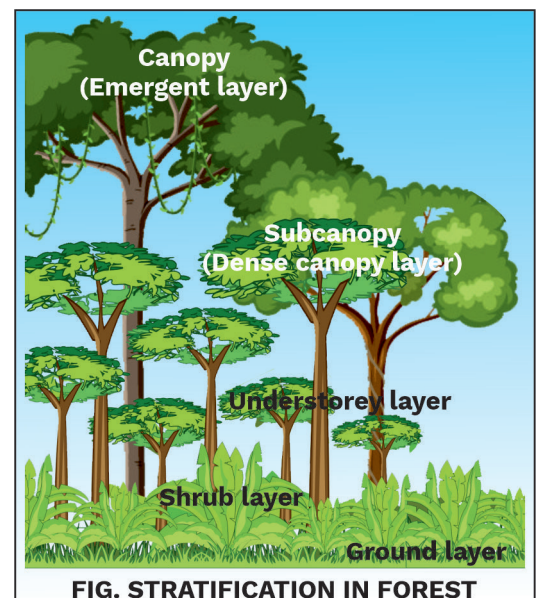
Biogeocoenosis was the term used for ecosystem by Russian ecologist, Sukachev (1944).

- **Components of an ecosystem**



### ECOSYSTEM: STRUCTURE AND FUNCTION

- The interaction of biotic and abiotic components results in a physical structure characteristic of each type of ecosystem.
- The two important structural features of an ecosystem are:
  - Species composition
  - Stratification
- **Species composition**— All the plants, animals and microbial species present in the ecosystem.
- **Stratification**— It refers to the **vertical distribution** of different species occupying different levels in the ecosystem.
- **Stratification in a forest**
  - Trees above 40 feet occupy the top vertical layer of a forest.
  - Trees of 20-40 feet an height constitute dense canopy layer and understorey layer.
  - Shrubs occupy the second layer.
  - Herbs and grasses occupy the bottom layer.
- **Stratification in a deep pond or a lake**
  - Littoral zone is represented by shallow water having rotten strata which help in thriving rooted plants.
  - Limnetic zone occupies depth up to which light penetrates in water and has planktons, nektons and neustons.

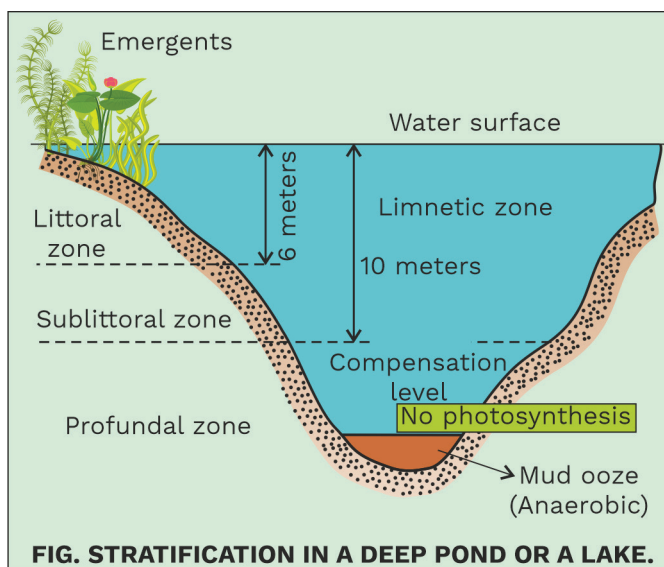


**FIG. STRATIFICATION IN FOREST**

#### Definition

**Stratification:** It refers to the vertical distribution of different species occupying different levels in an ecosystem.

- Profundal zone is represented by the area where sunlight cannot penetrate. This zone lacks photosynthetic organisms. The mud contains only anaerobic bacteria, fungi and other micro-organisms.



**Note:** In shallow ponds, vertical stratification is very little.

- **Significance**
  - Stratification increases the number of habitats which reduces interspecific competition.

### FUNCTIONS OF ECOSYSTEM

- Ecosystem performs four major functions like productivity, decomposition, energy flow and nutrient cycling.

### Productivity

- A constant input of solar energy is the basic requirement of any ecosystem to function and sustain.
- The **biomass** (organic matter) produced per unit area over a time period by plants is expressed in terms of **weight ( $g^{-2}$ )** or **energy ( $kcal m^{-2}$ )**.

### Gray Matter Alert!!!

Ecosystems in the tropics, such as tropical rain forests, have most of the species of plants and animals.



### Previous Year's Question

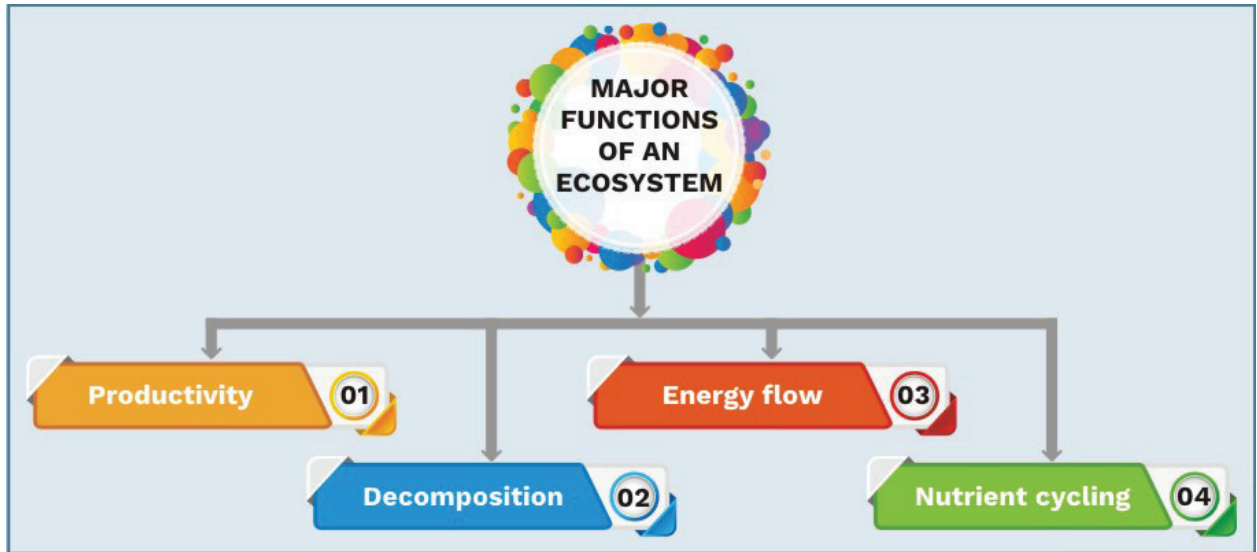
- Ecosystem consists of
- (1) decomposers
  - (2) producers
  - (3) consumers
  - (4) all of these

### Definition

**Productivity:** The rate of production of biomass, is called productivity.



- The rate of biomass production is called primary productivity and is expressed in terms of  $\text{g}^{-2}\text{yr}^{-1}$  or  $\text{kcal m}^{-2}\text{y}^{-1}$ .



#### Primary productivity has two aspects

- Gross Primary Productivity (**GPP or  $P_g$** ) is the rate of production of organic matter during photosynthesis.
- It is measured in terms of assimilation number i.e. amount of  $\text{CO}_2$  fixed by a gram of chlorophyll in an hour.
- Net Primary Productivity (**NPP**) is the amount of energy available in the producers after utilisation of some energy for respiration, i.e.,  **$\text{GPP} - \text{R} = \text{NPP}$**  (NPP is the amount of energy available in the producers for the consumption of herbivores).

#### Factors affecting primary productivity

- the plant species in a particular area
- availability of nutrients
- photosynthetic capacity of plants, and
- environmental factors.
- The annual net primary productivity of the whole biosphere is approximately **170 billion tons** (dry weight) of organic matter.
- Of this, the productivity of oceans is only **55 billion tons**, while the rest is on land.

#### Definition

**Primary Productivity:** It is defined as the amount of biomass or organic matter produced per unit area over a time period by the plants during photosynthesis.

#### Previous Year's Question

Decomposers are  
(1) Animalia and Monera  
(2) Protista and Monera  
(3) Fungi and Plantae  
(4) Bacteria and fungi





### Secondary productivity

- It is defined as the rate of assimilation and formation of new organic matter by consumers. It is of two types:
  - **Gross secondary productivity** is the amount of food consumed minus egested material. It varies for different consumers.
  - **Net secondary productivity** refers to rate of a resynthesized organic matter by the consumers. The average net productivity for all consumers is 10 per cent. So, it is low for herbivores and high for carnivores.

#### Note:

#### Community productivity

It is the rate of net synthesis of organic matter (biomass) by a community per unit time and area. It is calculated as net primary production minus heterotrophic consumption during a specific period. Generally the entire growing season or year is considered.

### Decomposition

- Detritus is the raw material for decomposition.
- Following are the steps in the process of decomposition:

#### Fragmentation

- It is the process of breaking of the detritus into smaller particles by detritivores.

#### Leaching

- It is the process in which water-soluble inorganic substances run down into soil horizon and get precipitated as unavailable salts.

#### Catabolism

- The enzymatic conversion of the detritus into simple organic compounds and then into inorganic compounds, is called catabolism.
- The enzymes are secreted by the decomposers like bacteria and fungi.

### Definition

#### Secondary Productivity:

It is defined as the rate of assimilation and formation of new organic matter by consumers.

### Rack Your Brain



Two types of food chains get connected when a woodpecker eats an earthworm. Justify.

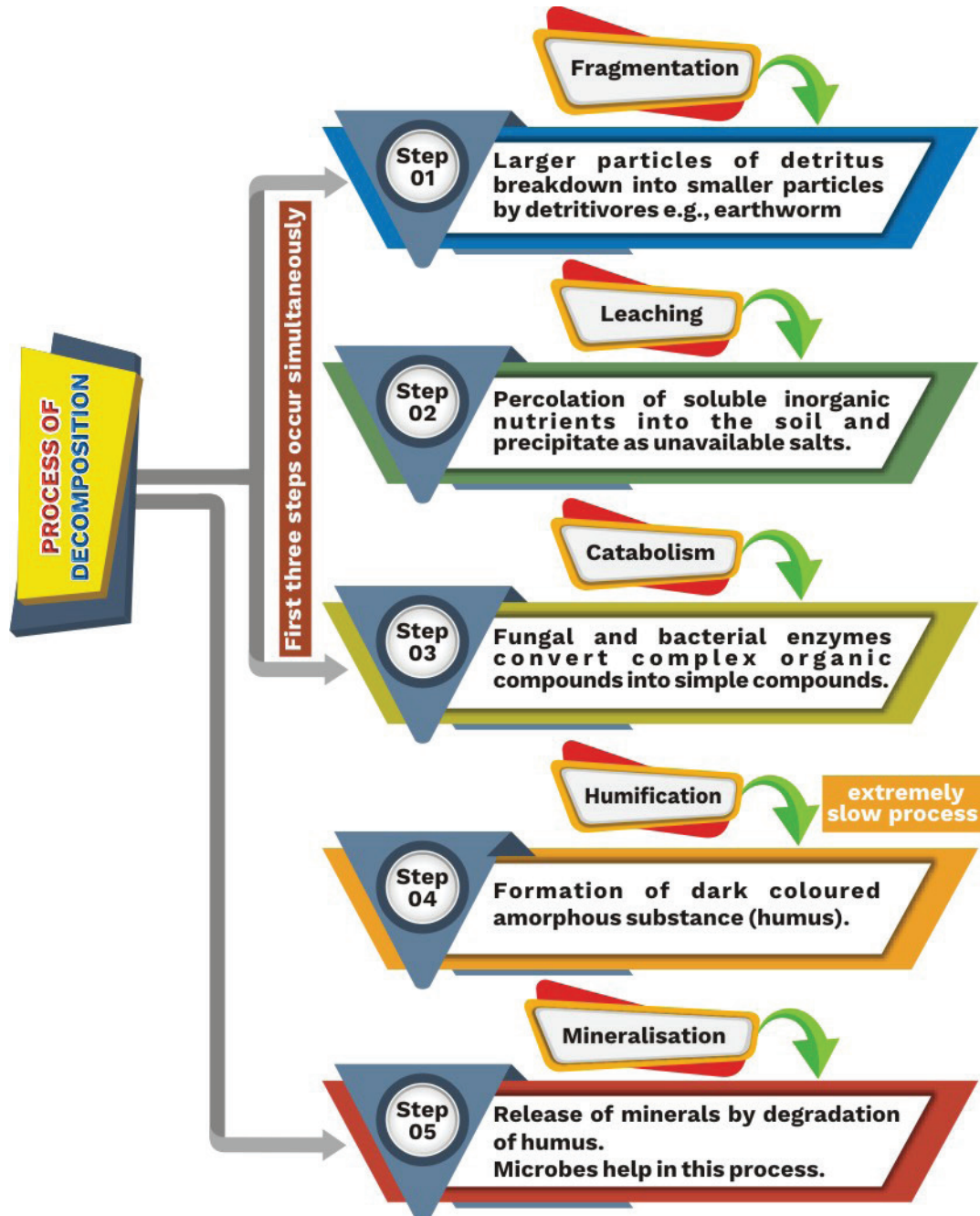
### Definition

**Decomposition:** It is the process in which the complex organic matter is broken down into simpler organic substances and ultimately into inorganic compounds.

### Definitions

**Detritus:** The dead remains of the plants and animals and also the faecal matter, constitutes detritus.

**Detritivores:** Detritivores are those organisms which feed on the detritus and break it down into smaller particles, e.g., earthworm.



### Humification

- Humification during decomposition leads to the accumulation of dark coloured amorphous substances called humus.

### Rack Your Brain



Which process will primarily be affected if all the bacteria and fungi get destroyed?



### Mineralisation

- It is the process in which the humus is degraded by certain microbes and the inorganic nutrients are released.
- Decomposition is largely an **aerobic process**, i.e., it requires oxygen.
- **The factors affecting decomposition:**
  - The chemical composition of detritus and the climatic factors.
  - Decomposition is slow, if detritus is rich in **lignin and chitin**.
  - Decomposition is faster if detritus is rich in **nitrogen and water-soluble** substances (e.g., sugars).
  - Temperature and soil moisture are the important climatic factors that regulate decomposition through their effects on the activities of soil microbes.
  - **Warm and moist environment and aerobic conditions** favour decomposition.
  - **A dry environment, low temperature and anaerobic conditions** inhibit decomposition.

### FOOD CHAIN

- It is a series of groups of organisms dependent on others for food. This relationship constitutes a chain hence, is called a food chain.

#### Types of food chain

- In nature generally two types of food chain can be distinguished – grazing food chains and detritus food chains.

#### Grazing food chain (GFC)

- It begins with the producers, that capture the solar energy and through photosynthesis feeds the energy into the food chain.  
For example,



### Definition

**Bioenergetics:** The study of energy transfer from one trophic level to the next trophic level.

### Gray Matter Alert!!!

Diclofenac has been banned in India since 2006. Diclofenac, was commonly used as a livestock anti-inflammatory drug. It is one of the major contributing factors in declining populations of vultures. Vultures are important members of food chains.

### Definition

**Food Chain:** Food chain refers to the transfer of energy (food) from the producer through a series of organisms.

### Definition

**Ten per cent law:** From one trophic level to another trophic level, about 90 per cent of the energy is lost and only 10 per cent of energy is available to be transferred.

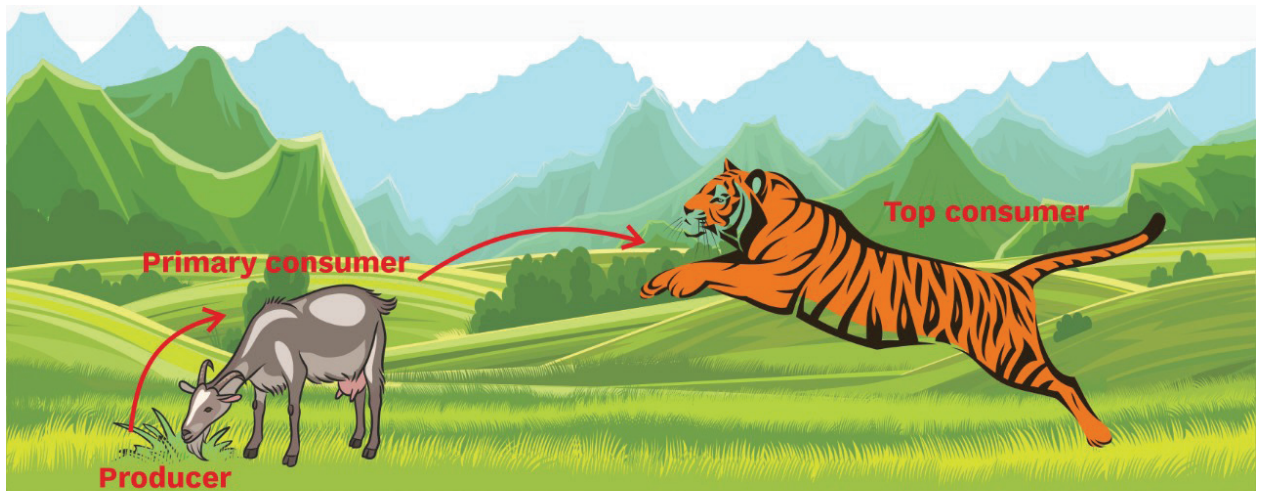


FIG. GRAZING FOOD CHAIN

- In a food chain there is unidirectional flow of energy from sun to producers and then to various consumers.
- Usually there are maximum four or five trophic levels in a food chain.

#### Rack Your Brain



Why there cannot be unlimited number of trophic levels in a food chain?

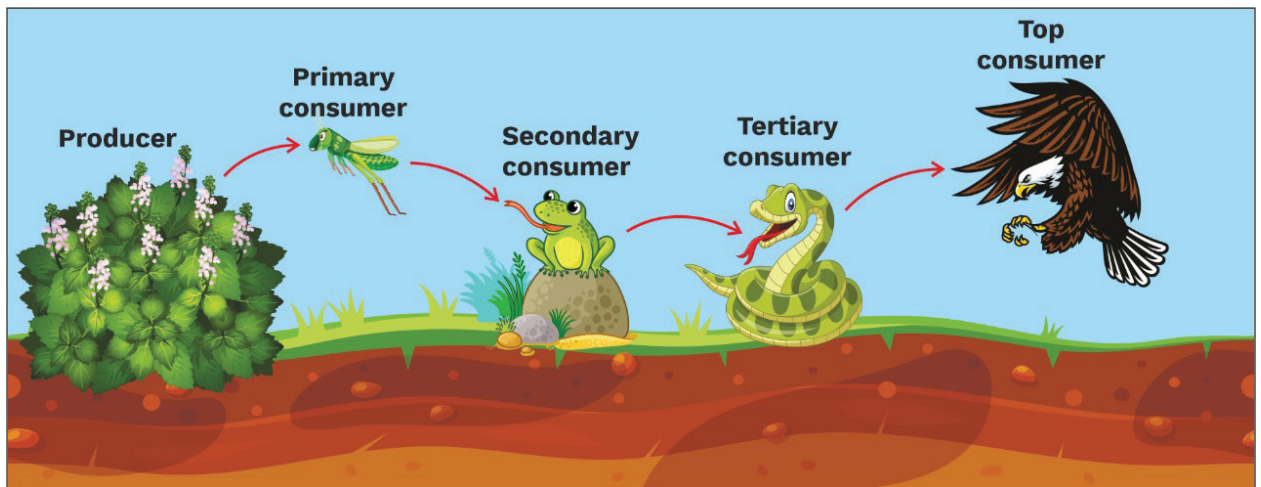


FIG. TERRESTRIAL FOOD CHAIN

- Shorter food chains provide greater amount of energy to the top level consumers.

**Note:** In an aquatic ecosystem, GFC is the major type of food chain for energy flow.

#### Definition

**Trophic Level:** Every step or level in a food chain is called a trophic level.



### Detritus Food Chain (DFC)

- It begins with the dead organic matter and decomposers (saprotrophs) e.g., bacteria and fungi.
- A larger fraction of energy flows through this type of food chain than the grazing food chain in terrestrial ecosystems.
- The place or position occupied by an organism in the food chain, is known as trophic level.
- Producers occupy the first trophic level, the herbivores (primary consumers) occupy the second, and the carnivores (secondary consumers) are on the third.
- The amount of energy decreases at successive trophic levels; only 10 per cent of the energy is transferred to each trophic level from the lower trophic level. This is called as **10 per cent law of energy transfer**.
- So, the number of trophic levels in a grazing food chain is restricted to four or five.
- At each trophic level, mass of living material at a particular time is called the standing crop.

**Note:** Standing crop is measured as the mass of living organisms (biomass) or the number in a unit area.

### Previous Year's Question



The driving force for an ecosystem is

- (1) Biomass
- (2) Producers
- (3) Carbohydrates in producers
- (4) Solar energy

### Definition



**Standing Crop:** The amount of living matter (biomass) present at every trophic level is known as standing crop.

### Gray Matter Alert!!!

Lindeman (1942) proposed 10 per cent law.

Characters	Grazing Food Chain	Detritus Food Chain
Primary source of energy	Solar radiations	Detritus
First trophic level	All herbivores	Detritivores (a mixed group in terms of trophic levels and may be herbivores, omnivores and primary carnivores)
Size	Long-sized chains	Small-sized chains
Examples	Predatory food chains on land and in water	Mangrove fallen leaves in brackish zone of South Florida





**Note:** In nature, the food chains interact with each other forming a food web.

### ENERGY FLOW

- **Sun** is the ultimate source of energy for all ecosystems on the earth.
- Only about **50 per cent** of the incident solar radiation is **photosynthetically active radiation (PAR)**.
- Plants capture only **2–10 per cent of the PAR** and all organisms (herbivores, carnivores, omnivores and decomposers) are dependent for their food on producers, either directly or indirectly.
- The flow of energy from the sun to producers and then to consumers is **unidirectional** and it keeping with the first law of thermodynamics.
- In an ecosystem, the energy transferred in the form of food and leads to degradation. The loss of a major part of food energy as heat during

### Gray Matter Alert!!!

The ten per cent law of transfer of energy from one trophic level to the next can be attributed to Raymond Lindeman (1942). Lindeman did not call it a “law” and cited ecological efficiencies ranging from 0.1 per cent to 37.5 per cent.



### Previous Year's Question

The 10 per cent law of energy transfer law of food chain was given by

- |              |             |
|--------------|-------------|
| (1) Tansley  | (2) Stanley |
| (3) Lindeman | (4) Weisman |

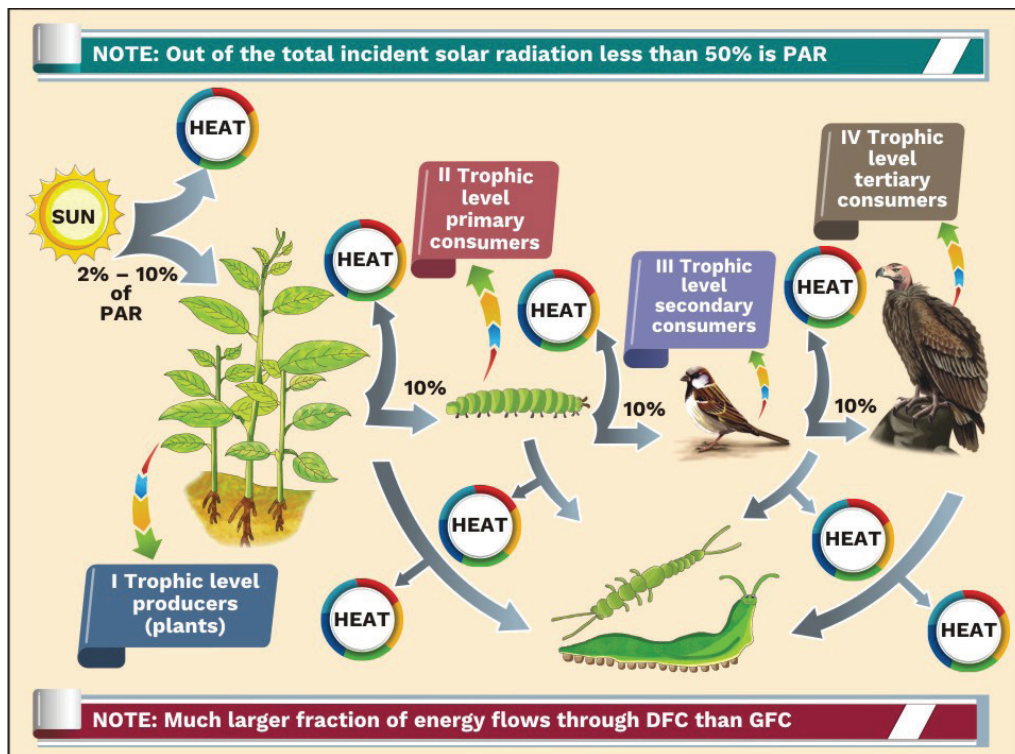


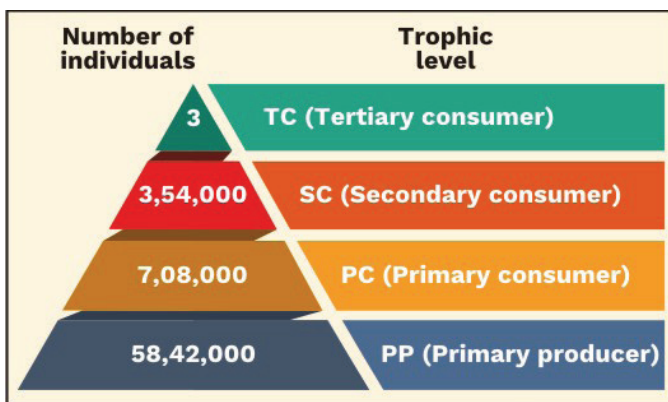
FIG. ENERGY FLOW THROUGH DIFFERENT TROPHIC LEVELS



metabolic activities and a very small fraction stored as biomass; and thus, it is keeping with the second law of thermodynamics.

### ECOLOGICAL PYRAMIDS

- The food or energy relationship among organisms at different trophic levels can be expressed in terms of number, biomass or energy.
- The expression assumes the shape of a pyramid, where the base represents the producers or first trophic level, while the apex represents the tertiary or top level consumer.
- Each trophic level represents a functional level not any one species in particular.
- Types of ecological pyramid usually studied:
  - Pyramid of number
  - Pyramid of biomass
  - Pyramid of energy



**FIG. PYRAMID OF NO. IN A GRASSLAND ECOSYSTEM. ONLY THREE TOP-CARNIVORES ARE SUPPORTED IN AN ECOSYSTEM BASED ON PRODUCTION OF NEARLY 6 MILLIONS PLANTS**

- In general, all the pyramids are upright.
- Pyramid of energy is always upright (never inverted) because during the flow of energy from one trophic level to the next some energy is lost as heat (at each step).

### Definition

**Ecological Pyramids:** The graphic representation of the trophic structure (organisms in various trophic levels) of a food chain is called ecological pyramid.



### Previous Year's Question

In an ecosystem, bacteria are considered as

- (1) micro consumers
- (2) secondary consumers
- (3) macro consumers
- (4) primary consumers

### Gray Matter Alert!!!

The term ecological pyramid was given by Charles Elton.

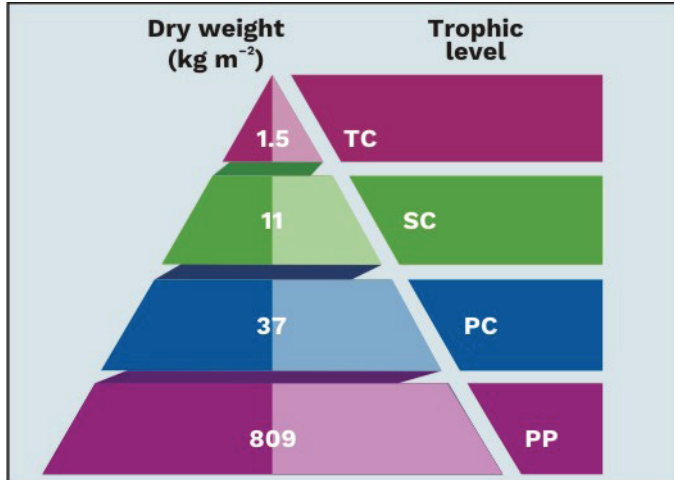
The concept of pyramid of numbers was developed by him.



### Previous Year's Question

The pyramid of energy is always

- (1) inverted
- (2) upright
- (3) both of these
- (4) inverted in forest ecosystem



**FIG. PYRAMID OF BIOMASS SHOWS A SHARP DECREASE IN BIOMASS AT HIGHER TROPHIC LEVELS**

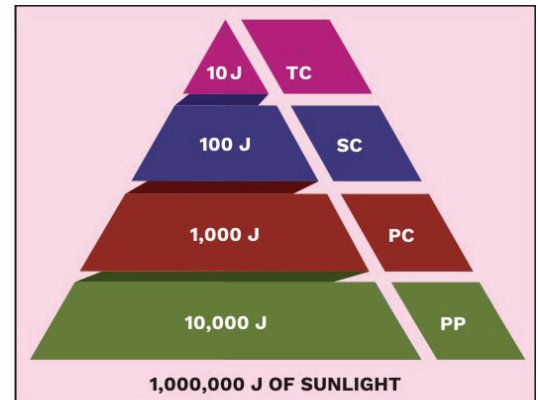
### Exceptions

- In a tree ecosystem, the pyramid of number is inverted (Number of insects and small birds feeding on the tree are more in number than one tree).
- Pyramid of biomass in a sea or ocean ecosystem is inverted (biomass of a fish is far more than the phytoplanktons on which it feeds).
- There are certain limitations of ecological pyramids, such as,
- It does not take into account the same species belonging to two or more trophic levels.
- It assumes a simple food chain, whereas in nature it does not exist;
- Saprophytes/decomposers are not given any place in ecological pyramids.

### ECOLOGICAL EFFICIENCIES

- The percentage ratios between energy flow at different trophic levels of a food chain.

$$\text{Ecological efficiency} = \frac{\text{Energy in biomass production at a trophic level}}{\text{Energy in biomass production at previous trophic level}} \times 100$$

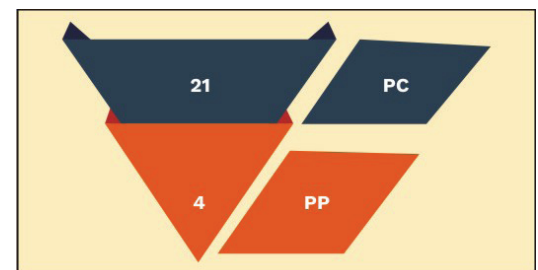


**FIG. AN IDEAL PYRAMID OF ENERGY (PLANTS TAKE 2-10 PERCENT OF SUNLIGHT)**

### Previous Year's Question



- Pyramid of energy is always
- (1) cup shaped
  - (2) upright
  - (3) inverted
  - (4) spindle shaped



**FIG. INVERTED PYRAMID OF BIOMASS, SMALL STANDING CROP OF PHYTOPLANKTON SUPPORTS LARGE STANDING CROP OF ZOOPLANKTON**





### Types of Ecological Efficiency

- Trophic level energy intake efficiency (Lindeman's efficiency) ratio between the amount of energy assimilated at two successive trophic levels.
- It varies from 1-5 per cent for producers.
- It is 10-20 per cent for higher trophic levels.

#### Rack Your Brain



Why is pyramid of biomass in a sea generally inverted?

$$\text{Energy intake efficiency} = \frac{\text{Amount of energy intake at a trophic level}}{\text{Energy in biomass production at previous trophic level}} \times 100$$

- Trophic assimilation efficiency is percentage ratio between net production and energy assimilated at trophic level.
- It varies from 10-50 per cent.
- Photosynthetic efficiency is percentage ratio between gross primary productivity and incident solar radiation.
- It varies from 1-5 per cent.

#### Previous Year's Question



Energy transfer from one trophic level to other in a food chain is

- |         |        |
|---------|--------|
| (1) 20% | (2) 1% |
| (3) 10% | (4) 2% |

$$\text{Photosynthetic efficiency} = \frac{\text{Gross primary productivity}}{\text{Incident total solar radiation}} \times 100$$

- Net production efficiency is the percentage ratio between net primary productivity and gross primary productivity.
- It is about 50 per cent.

$$\text{Net production efficiency} = \frac{\text{Net primary production}}{\text{Gross primary productivity}} \times 100$$

### ECOLOGICAL SUCCESSION

- It is a community-controlled phenomenon in which the structure and composition of communities change in an orderly and sequential manner, leading ultimately to the establishment of a climax community.
- There is a gradual and fairly predictable change in the species composition of a given area during succession.

#### Gray Matter Alert!!!

The term ecological succession was given by Ragnar Hault in 1885.



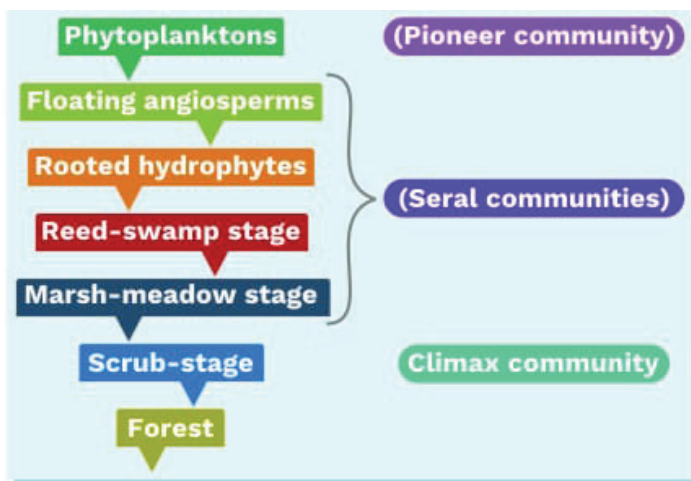
- During succession, **pioneer species** colonise an area and their populations become more numerous.
- In these successive **seral stages**, there is a change in the diversity of species, increase in the number of species and organisms and also in the total biomass.
- The individual transitional communities are called seral stages or seral communities.
- Succession is of two types.

### SUCCESSION OF PLANTS

- Based on the nature of the habitat, succession of plants can be grouped into two categories:
  - Hydrarch succession
  - Xerarch succession

### Hydrarch Succession

- It starts in life-less water bodies or wet areas and progresses from aquatic to mesic conditions.
- In primary hydrarch succession, **pioneers** are **phytoplanktons**.
- Later on following changes occur successively like rooted submerged plants grow → rooted floating angiosperms plants develop → free floating plants arise → reed swamp stage → marsh meadow stage → scrub stage → climax community.



### Definition

**Pioneer Species:** The species which invade a bare area and initiate the ecological succession, are called pioneer species.

### Rack Your Brain



Why does standing state vary on seasonal basis in any ecosystem?

### Definition

**Sere:** The entire sequence of communities, that successively change in a given area resulting in a climax community, is called a sere.

### Previous Year's Question



Which of the following is correct about food chain?

- (1) Zooplanktons → Phytoplanktons → Fishes
- (2) Phytoplanktons → Fishes → Zooplanktons
- (3) Phytoplanktons → Zooplanktons → Fishes
- (4) None of these

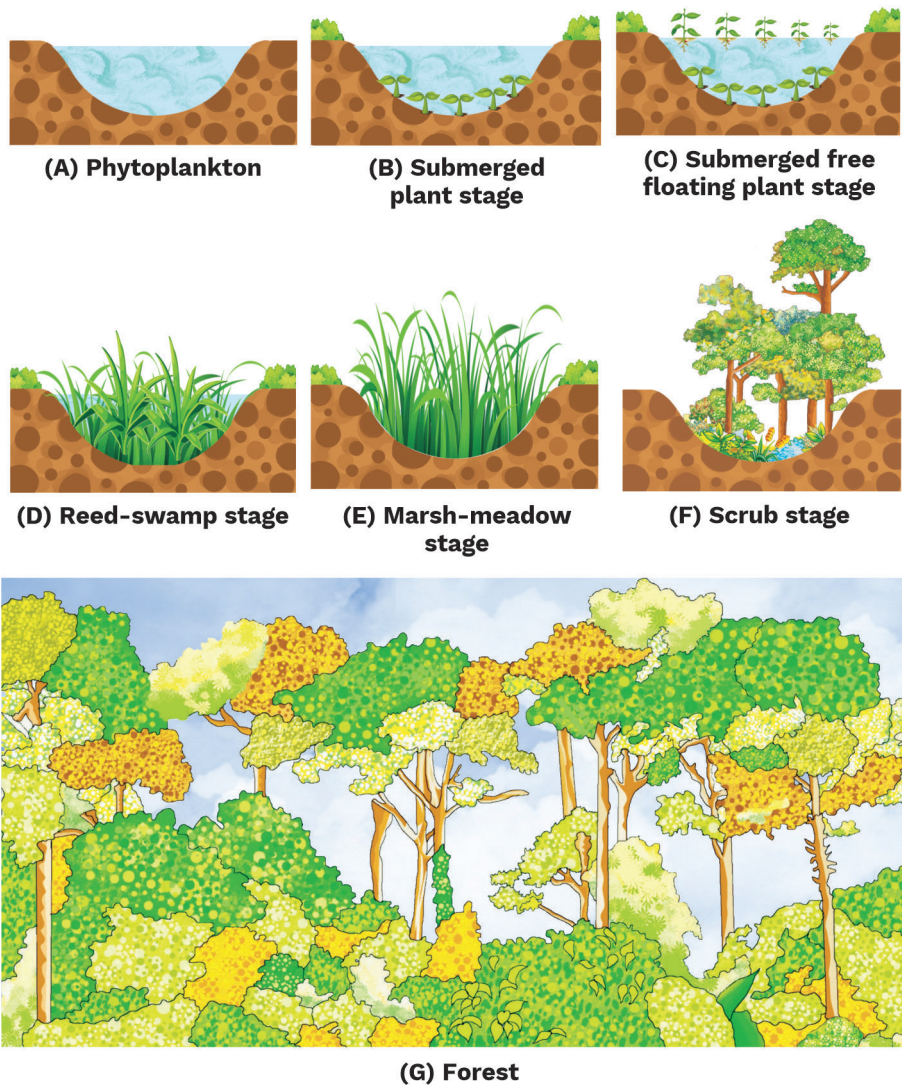


FIG. DIAGRAMMATIC REPRESENTATION OF PRIMARY SUCCESSION

### Xerarch Succession

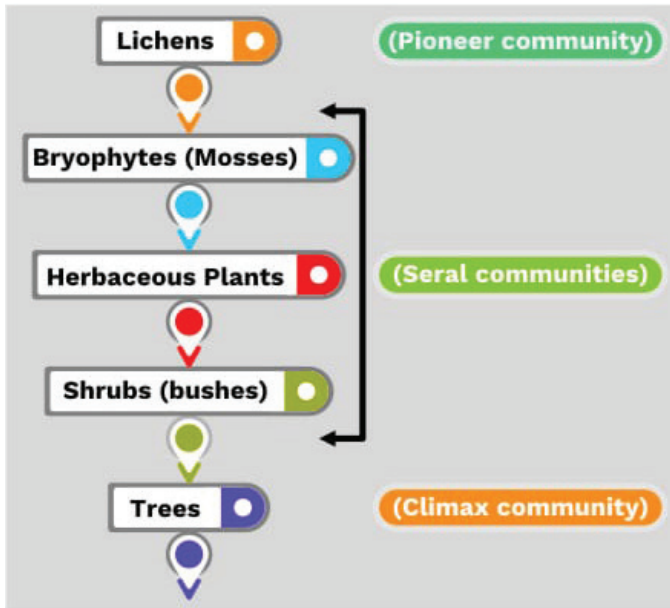
- It starts in dry or xeric conditions (bare rocks) and progresses from xeric to mesic conditions.
- **Pioneer species** is **lichens** as these are able to secrete acids to dissolve rocks. Thus, help in weathering of rocks and soil formation.
- Later on bryophytes colonise the area. Gradually, some other lower plants, small plants and finally trees grow.

### Gray Matter Alert!!!

Reed-swamp stage is also known as amphibious stage.



- The stages in xerarch succession are as follows:



### Previous Year's Question

The boundary or transition between two or more communities is called

- (1) ecotone
- (2) thermocline
- (3) biome
- (4) ecotype

- Similarities and dissimilarities between hydrarch and xerarch are shown in the table below:

S.No.	Hydrarch Succession	Xerarch Succession
1.	It takes place in water bodies or wet areas.	It takes place in dry or xeric conditions (bare rocks).
2.	Succession progresses from hydric to mesic conditions.	Succession progresses from xeric to mesic conditions.
3.	Pioneer species is phytoplanktons.	Pioneer species is lichens as these are able to secrete acids to dissolve rocks.
4.	Climax community is forest.	Climax community is forest.



- In secondary succession, the type of pioneer species depends on the following factors:
  - Condition of the soil
  - Availability of water
  - Environmental conditions
  - Seeds or other propagules.

### The two general facts about succession

- Primary succession is a very slow process that may take thousands of years for the establishment of climax community.
- All succession, hydrarch or xerarch, lead to the establishment of similar mesic communities.

### Definition

**Autogenic succession:** Once, ecological succession starts the vegetation modifies its own environment and eventually keeps replacing itself by new ecological communities.

S.No.	Primary Succession	Secondary Succession
1.	Takes place in a place where no life existed before.	Takes place in a region where life existed in the past but got destroyed completely. For example, forest fires, earthquakes usually destroy the life of an area.
2.	Extremely slow process.	Comparatively fast process.
3.	Suitable substratum and soil needs to be formed.	Suitable substratum and soil is already present.

**Note:** Succession and evolution are parallel processes.

### NUTRIENT CYCLING (Biogeochemical Cycles)

- The nutrients are never lost from an ecosystem, but are recycled through living organisms, rocks, soil, air and water.
- The amount of nutrients such as carbon, nitrogen, phosphorus, calcium, etc., present in the soil at any given time is referred as **standing state**.
- Each bio-geochemical cycle is comprised of two types of pools:
  - **Reservoir pool:** It is the large, slow-moving and generally non-biological.
  - **Exchange or cyclic pool:** It is small, fast moving component which is exchanging rapidly

### Rack Your Brain



Why is secondary succession faster than primary succession?

### Definition

**Standing State:** The amount of nutrients such as nitrogen, phosphorus, calcium, etc., present in the soil at any given time is called standing state.



between organisms and their immediate environment.

- On the basis of movement of nutrients, biogeochemical cycles are of 2 types:
  - **Perfect cycles:** In these cycles e.g., gaseous cycles, nutrients remain in circulation more or less uniformly. In these cycles nutrients self-adjust rather quickly because of large reservoir.
  - **Imperfect cycles:** These cycles get more easily disrupted by local disturbances as the bulk of material remains in the relatively inactive and immobile reservoir on the earth's crust e.g., sedimentary cycles of phosphorus, sulphur, calcium, potassium, etc.
- On the basis of nutrient reservoir cycles are of two types: gaseous cycles and sedimentary cycles.
- **Gaseous cycles**
  - The reservoir for gaseous cycles exists in the atmosphere, e.g., carbon cycle, nitrogen cycle, etc.
- **Sedimentary cycles**
  - The reservoir for sedimentary cycles exists in the earth's crust, e.g., phosphorus cycle, sulphur cycle, etc.
  - Environmental factors like temperatures, soil nature and moisture can regulate the rate of release of nutrients.
  - The function of the reservoir is to meet the deficit which occurs due to imbalances in the rate of influx and efflux.

#### **CARBON CYCLE**

- Carbon cycle occurs in atmosphere, oceans and living and dead organisms.
- About **49 per cent of dry weight** of an organism is constituted by carbon.
- Carbon dioxide in the atmosphere and fossil fuel represent the reservoir of carbon.
- About 71 per cent of the global carbon is found dissolved in the ocean and this oceanic reservoir

#### **Rack Your Brain**



Give the term for biomass at a particular time for a trophic level.

#### **Definition**

**Biogeochemical Cycle or Nutrient Cycle:** The continuous exchange of nutrients or elements among organisms and between organisms and their physical environment is called biogeochemical cycle.

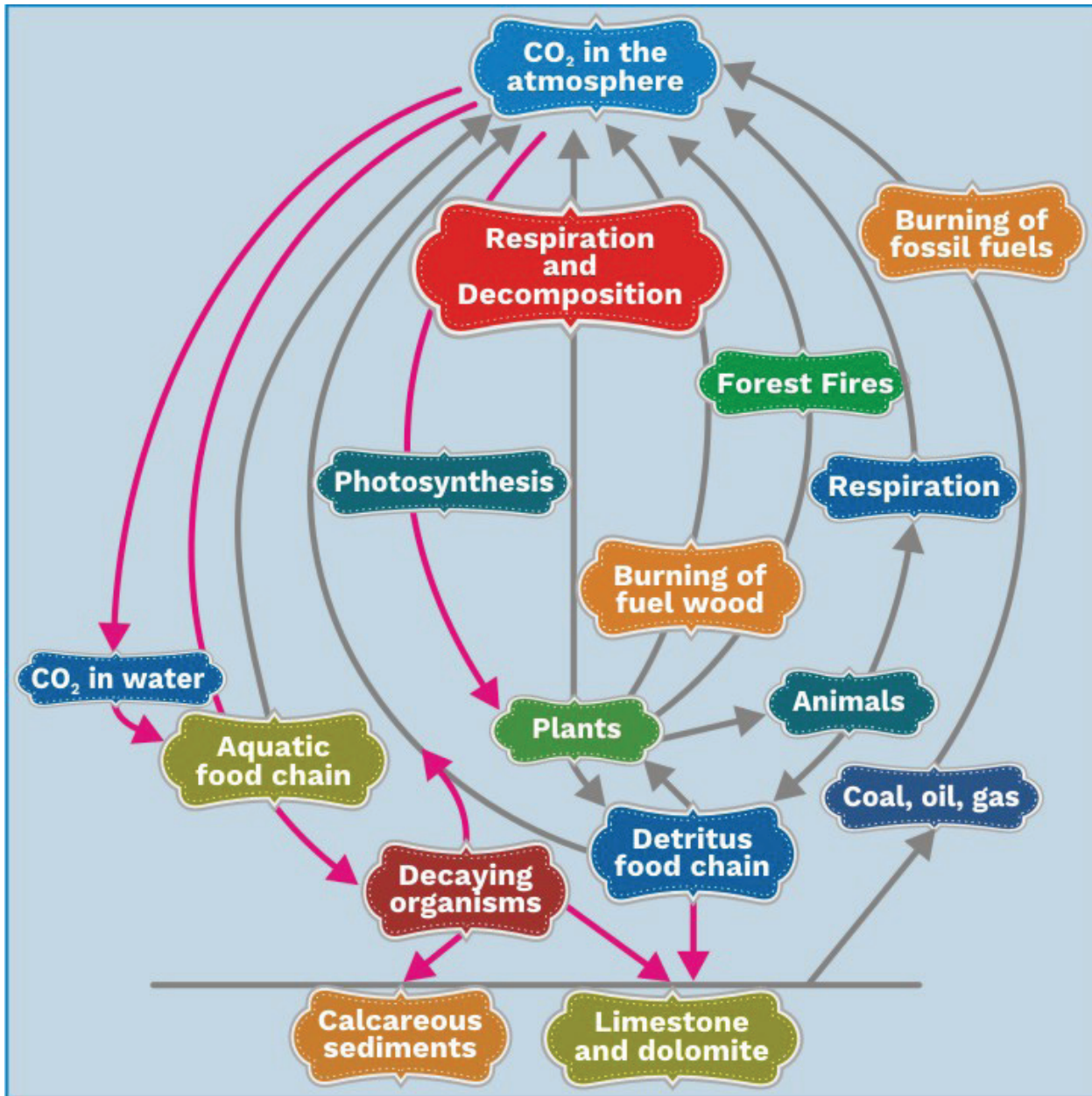
#### **Previous Year's Question**



Which one of the following is a sedimentary cycle?

- (1) Carbon cycle
- (2) Oxygen cycle
- (3) Hydrogen cycle
- (4) Phosphorus cycle





**FIG. CARBON CYCLE**

regulates the amount of carbon dioxide in the atmosphere.

- About  $4 \times 10^{13}$  kg of carbon is fixed in the biosphere through photosynthesis annually.

**Rack Your Brain**



Why are nutrient cycles also called biogeochemical cycles?

- A considerable amount of this is returned to the atmosphere as carbon dioxide through the respiratory activities of producers and consumers and decomposition by decomposers.
- Additional sources which add carbon dioxide to the atmosphere are burning of fossil fuels, fuel, wood and organic matter, forest fires and volcanic activity.
- Some amount of fixed carbon is lost as sediments (limestone, dolomite, etc.)

**Note:** Decomposers contribute substantially to  $\text{CO}_2$  pool by their activities.

### Previous Year's Question

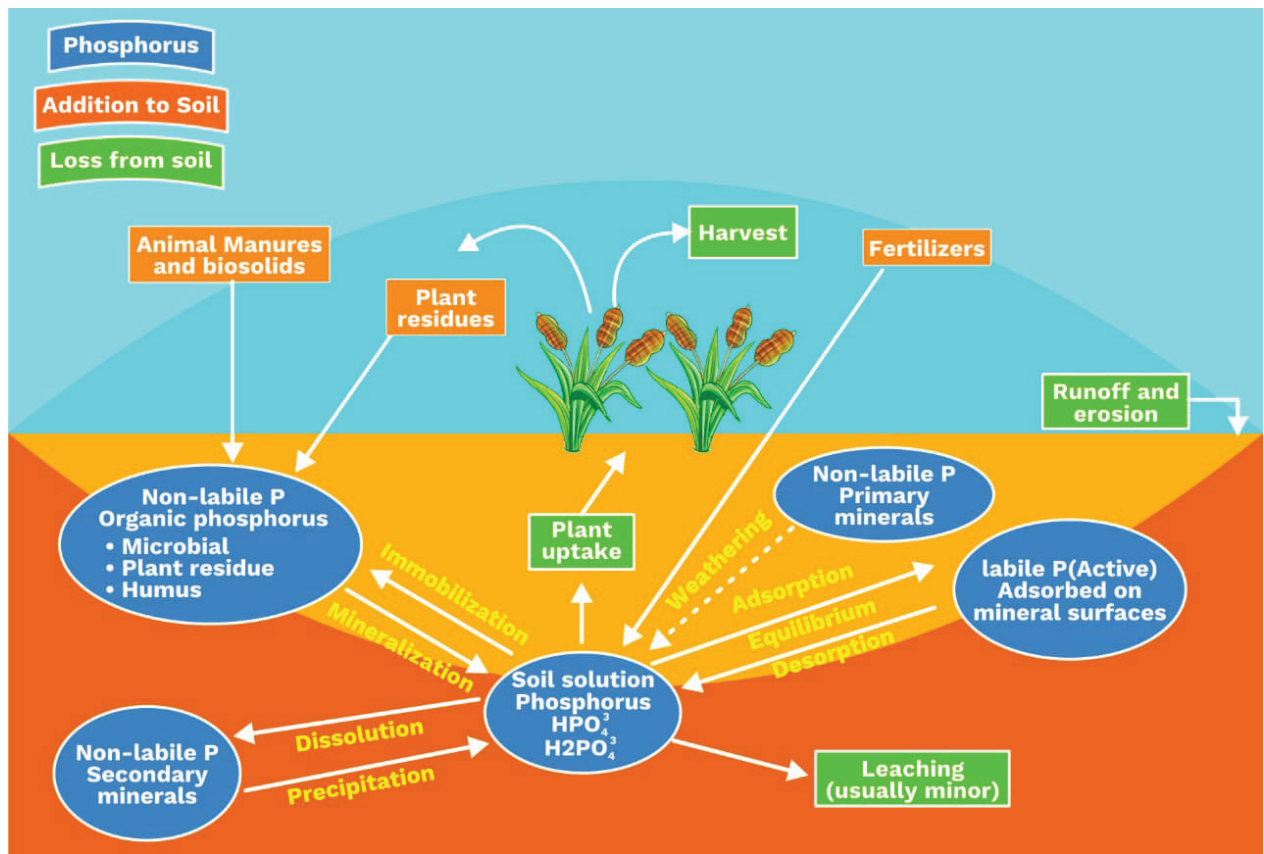


A bamboo plant is growing in a forest. What will be its trophic level?

- (1)  $T_1$
- (2)  $T_2$
- (3)  $T_3$
- (4)  $T_4$

### PHOSPHORUS CYCLE

- The natural reservoir of phosphorus is a rock in the form of phosphates.



**THE PHOSPHORUS CYCLE**



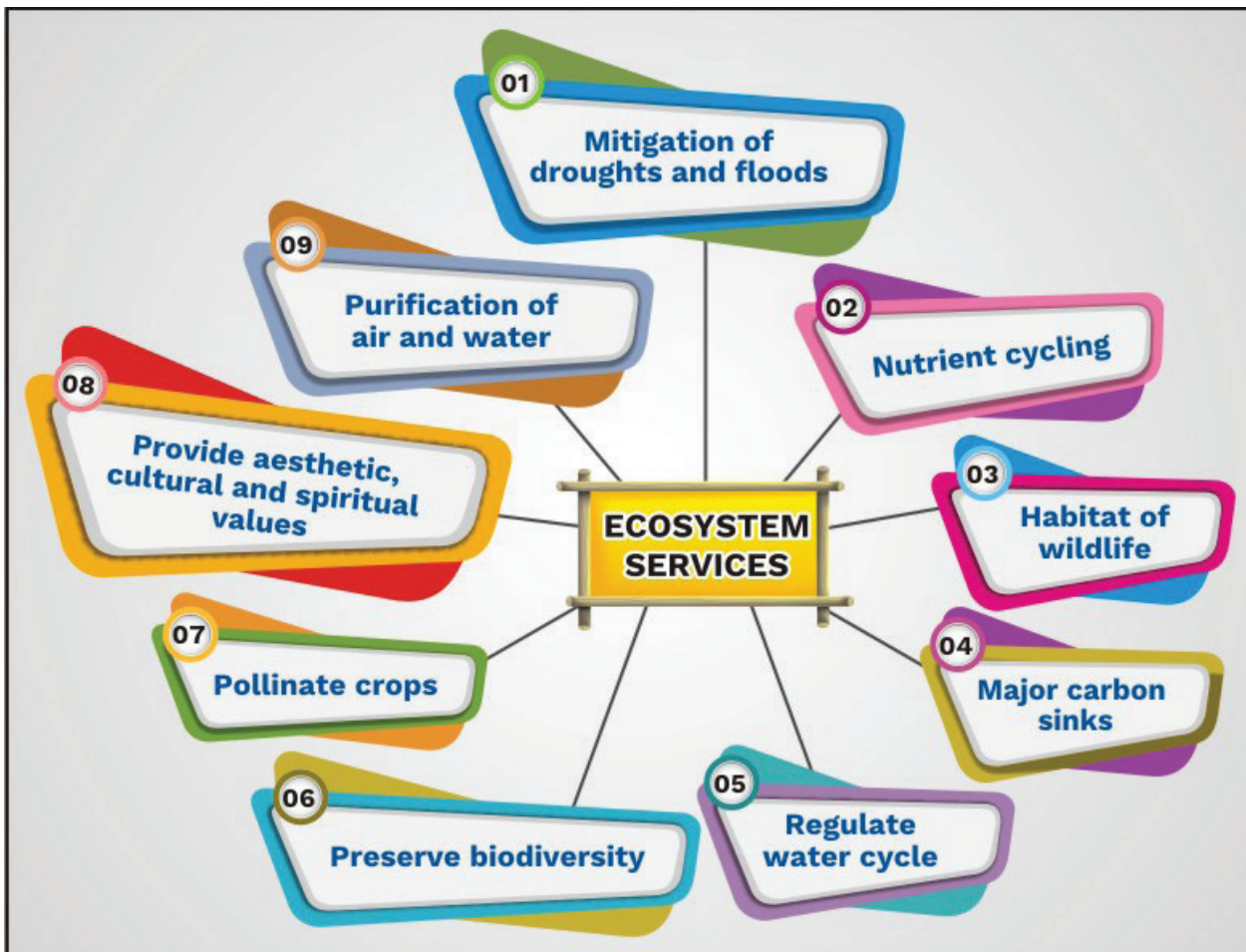
- Minute quantities of phosphates get dissolved in the soil solution during weathering of rocks.
- Phosphates enter the plants through their roots and then the food chain.
- The organic wastes and dead organisms are decomposed by phosphate-solubilising bacteria, which release phosphorus back into the soil.
- The atmospheric input of phosphorus through rainfall or gaseous exchange of phosphorus between organisms and environment is negligible.

### Definition

**Ecosystem Services:** The products of ecosystem processes are termed as ecosystem services.

### ECOSYSTEM SERVICES

- Robert Constanza et al. have tried to put price tags on nature's life-support services.



- Researchers have estimated them to be **33 trillion US dollar** a year which is nearly twice the GNP.
- While our global **gross national product** (GNP) is only **18 trillion US dollars**.
- The following services are provided by forests:
  - Purify air
  - Mitigate droughts and floods
  - Help in cycling of nutrients
  - Provide habitat to a number of wildlife
  - Act as store house of carbon
  - Influence the hydrological cycle
  - Maintain biodiversity

#### **Approximate cost of various ecosystem services**

- Out of total cost of various ecosystem services the soil formation accounts for about 50 per cent.
- Contribution to other services, e.g., recreation and nutrient cycling are less than 10 per cent each.
- The cost of climate regulation and habitat for wildlife are about 6 per cent each.

#### **Rack Your Brain**



Interaction of biotic and abiotic factors in a pond forms a \_\_\_\_\_.

#### **Previous Year's Question**



Inverted pyramid of biomass can be traced in one of the following ecosystems.

- (1) Rain forest
- (2) Desert
- (3) Ocean
- (4) Tundra

#### **Note:**

#### **Ecotone**

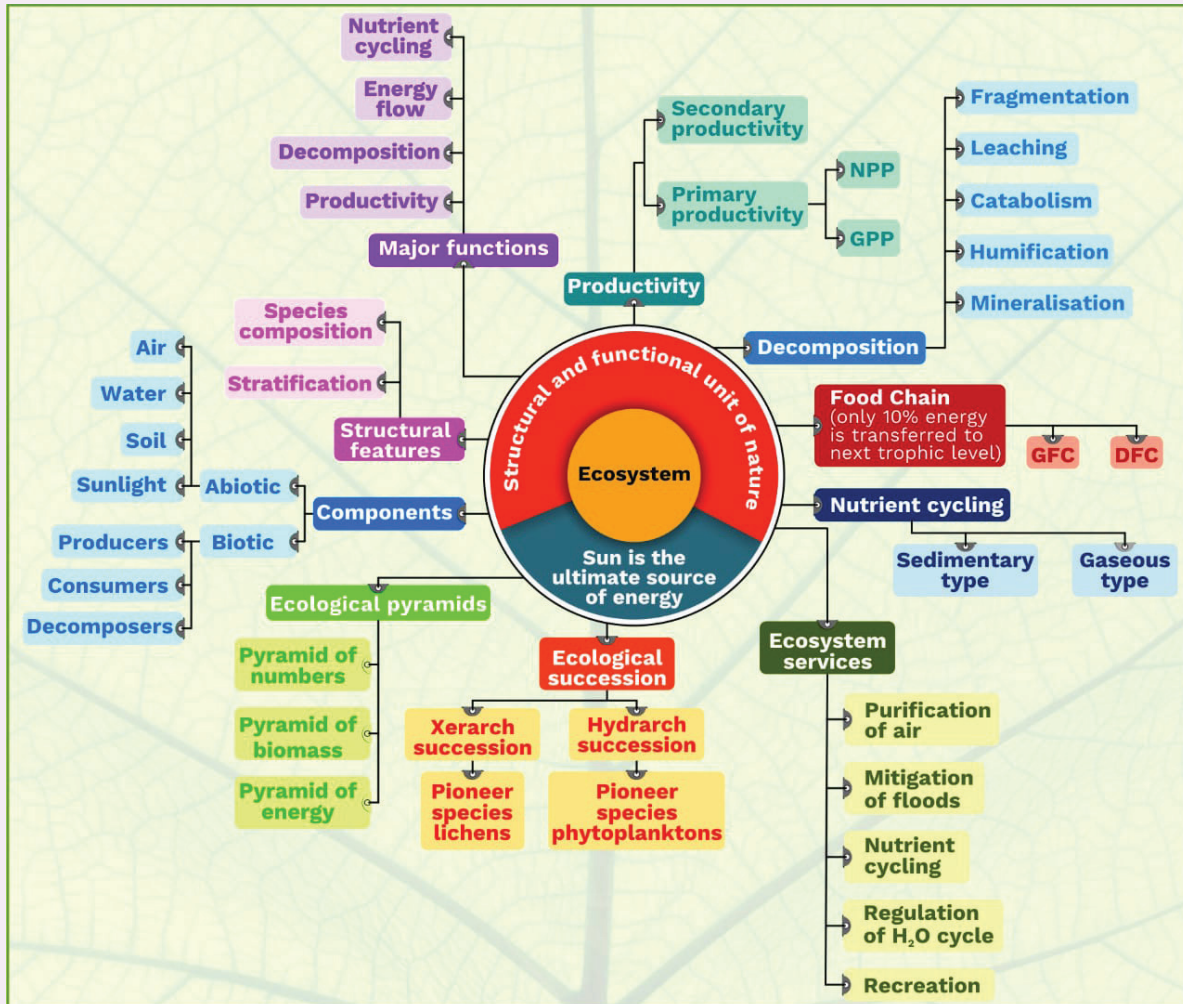
The word ecotone was coined by Alfred Russel Wallace in 1859. It is formed by the combination of ecology and tone, in Greek *tonos* or tension means a place where ecologies are in tension.

It is a transition area between two biological communities where the communities meet and integrate. The area of meeting can be a narrow stretch or a wide well-demarcated area. For example, change in the colour of foliage or height of the plants, etc.

If different animal species are able to survive in both the biomes, then ecotone is considered to be species rich.

Examples of ecotone are reed beds (common form of lakeside of ecotones), salt marshes, riparian zones, etc.

Summary



---

### Solved Exercise

**Q1**

**An ecosystem is**

- (1) Different communities of plants, animals and microbes together with their physicochemical environment.**
- (2) Different communities of plants and microbes along with their physicochemical environment.**
- (3) A localised assemblage of several plants and animals.**
- (4) An assemblage of plants, animals and their surroundings.**

**A1**

**(1)**

An ecosystem is a self-sustained unit where all the biotic components interact with each other as well as with their physicochemical environment.

**Q2**

**The importance of ecosystem lies in**

- (1) Cycling of materials**
- (2) Flow of energy**
- (3) Both (1) and (2)**
- (4) Its biomass**

**A2**

**(3)**

In an ecosystem, the decomposers help in nutrient cycling by making the simple inorganic components available to the plants after the decomposition of dead complex organic matter. The producers convert solar energy to chemical energy which is transferred to the primary consumers and then to the next trophic levels in the form of food.

**Q3**

**Which ones occurs at the same trophic level**

- (1) Crow and Cow**
- (2) Snake and Earthworm**
- (3) Tiger and Wild Boar**
- (4) Deer and Bee**



---

**A3 (4)**  
Deer feeds on plants and honey bee sucks nectar from the flowers so both belong to the second trophic level.

**Q4 Biotic components of an ecosystem include**  
**(1) Producers, consumers and decomposers**  
**(2) Producers and consumers**  
**(3) Producers only**  
**(4) Consumers only**

**A4 (1)**  
Biotic components mean all the living components of any system and in an ecosystem. These are all plants, animals, detritivores and microbes.

**Q5 Energy stored at the consumer level is**  
**(1) Gross primary productivity**  
**(2) Net primary productivity**  
**(3) Net productivity**  
**(4) Secondary productivity**

**A5 (4)**  
Secondary productivity means the formation of new organic matter by consumers.

**Q6 Pyramid of numbers in a pond ecosystem is**  
**(1) Irregular**  
**(2) Inverted**  
**(3) Upright**  
**(4) Spindle shaped**

**A6 (3)**  
In a pond, producers are aquatic plants (phytoplanktons, free-floating and

---

rooted plants) and generally the consumers are zooplanktons, small aquatic creatures, frogs, big freshwater fish. The number of producers is always more than the number of primary consumers and likewise, the number of organisms at successive levels is always less than the previous level. So, the Pyramid of numbers in a pond ecosystem is always upright.

**Q7** The correct sequence of the food chain is

- (1) grass → snake → insect → deer
- (2) grass → wolf → deer → buffalo
- (3) grass → insect → bird → snake
- (4) bacteria → grass → rabbit → wolf

**A7** (3)

In a terrestrial food chain, the first level is occupied by the producers and the second, third and fourth trophic levels by the herbivores, secondary and tertiary consumers respectively. So, grass → insect → bird → snake is the correct sequence given here.

**Q8** Lithosphere is a reservoir of

- (1) Carbon
- (2) Phosphorous
- (3) Nitrogen
- (4) Oxygen

**A8** (1)

The natural reservoir of phosphorus is rock which contains phosphorus in the form of phosphates.

**Q9** Sere means

- (1) The sequence of communities.
- (2) The entire sequence of communities that successively change in a given area.
- (3) The entire sequence of communities.
- (4) The whole communities that successively do not change in a given area.



---

**A9 (2)**

During ecological succession, there is always a sequential change in the communities. So, the entire sequence of communities that successively change in a given area is called sere(s).

**Q10 Food chain in which microorganisms breakdown the complex organic matter is**

- (1) Parasitic food chain**
- (2) Detritus food chain**
- (3) Consumer food chain**
- (4) Predator food chain**

**A10 (2)**

The detritus food chain begins with dead organic matter which is decomposed mainly by fungi and bacteria.

