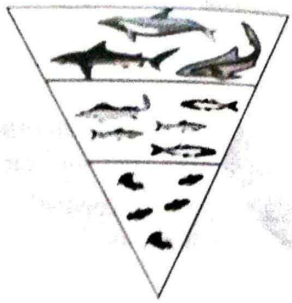
CHAPTER

12 Ecosystem



12.1. Ecosystem-Structure and Function

1. Which of the following statement(s) is incorrect?

(A) Biomass decreases from first to fourth trophic level.

(B) Energy content gradually increases from first to fourth trophic level.

(C) Number of individuals decreases from first trophic level to fourth trophic level.

(D) Energy content gradually decreases from first to fourth trophic level. **[NEET Oct. 2020]**

2. Which ecosystem has the maximum biomass?

(A) Forest ecosystem

(B) Grassland ecosystem

(C) Pond ecosystem

(D) Lake ecosystem **[NEET 2017]**

3. The term ecosystem was coined by:

(A) A.G. Tansley (B) E. Haeckel

(C) E. Warming (D) E.P. Odum.

[NEET Phase-I 2016]

4. Which one of the following is a characteristic feature of cropland ecosystem?

(A) Least genetic diversity

(B) The absence of weeds

(C) Ecological succession

(D) The absence of soil organisms

[NEET Phase-I 2016]

5. Vertical distribution of different species occupying different levels in a biotic community is known as:

(A) divergence (B) stratification

(C) zonation (D) pyramid.

[AIPMT Cancelled 2015]

6. Which one of the following is one of the characteristics of a biological community?

(A) Stratification (B) Natality

(C) Mortality (D) Sex-ratio

[AIPMT Screening 2010]

7. Upper part of sea/aquatic ecosystem contains:

(A) plankton (B) nekton

(C) plankton and nekton (D) benthos. **[AIPMT 1998]**

12.2. Productivity

8. In an ecosystem if the Net Primary Productivity (NPP) of first trophic level is $100x\ (kcal\ m^{-2})\ yr^{-1}$, what would be the GPP (Gross Primary Productivity) of the third trophic level of the same ecosystem?

(A) $x\ (kcal\ m^{-2})\ yr^{-1}$

(B) $10x\ (kcal\ m^{-2})\ yr^{-1}$

(C) $\frac{100x}{3x}\ (kcal\ m^{-2})\ yr^{-1}$

(D) $\frac{x}{10}\ (kcal\ m^{-2})\ yr^{-1}$ **[NEET 2024]**

9. In the equation,

$$GPP - R = NPP$$

GPP is Gross Primary Productivity

NPP is Net Primary Productivity

R here is..... .

(A) Respiratory quotient

(B) Respiratory loss

(C) Reproductive allocation

(D) Photosynthetically active radiation **[NEET 2023]**

10. In relation to Gross primary productivity and Net primary productivity of an ecosystem, which one of the following statements is correct?

(A) Gross primary productivity is always more than net primary productivity.

(B) Gross primary productivity and Net primary productivity are one and same.

(C) There is no relationship between Gross primary productivity and Net primary productivity.

(D) Gross primary productivity is always less than net primary productivity. **[NEET 2020]**

11. In an ecosystem the rate of production of organic matter during photosynthesis is termed as:
(A) net primary productivity
(B) gross primary productivity
(C) secondary productivity
(D) net productivity. **[AIPMT Cancelled 2015]**

12. Secondary productivity is rate of formation of new organic matter by:
(A) producer
(B) parasite
(C) consumer
(D) decomposer. **[NEET 2013]**

13. 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. **[AIPMT Mains 2012]**

14. 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.
[AIPMT Screening 2010]

15. 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 rainforest **[AIPMT 2007]**

16. 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) **[AIPMT 2004]**

17. The rate at which light energy is converted to the chemical energy of organic molecules in the ecosystem's:
(A) net primary productivity
(B) gross primary productivity
(C) net secondary productivity
(D) gross secondary productivity. **[AIPMT 1998]**

12.3. Decomposition

18. Identify the correct statements:
(I) Detrivores perform fragmentation.
(II) The humus is further degraded by some microbes during mineralization.
(III) Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.
(IV) The detritus food chain begins with living organisms.
(V) Earthworms break down detritus into smaller particles by a process called catabolism.
Choose the correct answer from the options given below:
(A) (III), (IV), (V) only
(B) (IV), (V), (I) only
(C) (I), (II), (III) only
(D) (II), (III), (IV) only **[NEET 2023]**

19. Given below are two statements:
Statement I: Decomposition is a process in which the detritus is degraded into simpler substances by microbes.
Statement II: Decomposition is faster if the detritus is rich in lignin and chitin.
In the light of the above statements, choose the correct answer from the options given below:
(A) Both statement I and statement II are incorrect.
(B) Statement I is correct but statement II is incorrect.
(C) Statement I is incorrect but statement II is correct.
(D) Both statement I and statement II are correct.
[NEET 2022]

20. Detritivores breakdown detritus into smaller particles. This process is called:
(A) fragmentation
(B) humification
(C) decomposition
(D) catabolism. **[NEET 2022]**

21. The rate of decomposition is faster in the ecosystem due to following factors except:
(A) detritus rich in sugars
(B) warm and moist environment
(C) presence of aerobic soil microbes
(D) detritus richer in lignin and chitin.
[NEET Oct. 2020]

22. Which one of the following processes during decomposition is correctly described?
(A) Humification- Leads to the accumulation of a dark coloured substance humus which undergoes microbial action at very fast rate.
(B) Catabolism- Last step of 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. **[NEET 2013]**

23. If we completely remove the decomposers from an ecosystem, its functioning will be adversely affected, because:

(A) energy flow will be blocked

(B) herbivores will not receive solar energy

(C) mineral movement will be blocked

(D) rate of decomposition will be very high

[AIPMT 1995]

12.4. Energy Flow

24. Match the trophic levels with their correct species examples in grassland ecosystem.

Column I	Column II
(a) Fourth trophic level	(i) Crow
(b) Second trophic level	(ii) Vulture
(c) First trophic level	(iii) Rabbit
(d) Third trophic level	(iv) Grass

Select the correct option.

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

[NEET Sept. 2020]

25. The primary producers of the deep-sea hydrothermal vent ecosystem are:

(A) green algae (B) chemosynthetic bacteria

(C) blue-green algae (D) coral reefs.

[NEET Phase-II 2016]

26. The mass of living material at a tropic level at a particular time is called:

(A) gross primary productivity

(B) standing state

(C) net primary productivity

(D) standing crop. **[AIPMT Cancelled 2015]**

27. 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?

Plant → Mice → Snake → Peacock

(A) 0.02 J (B) 0.002 J

(C) 0.2 J (D) 0.0002 J **[AIPMT 2014]**

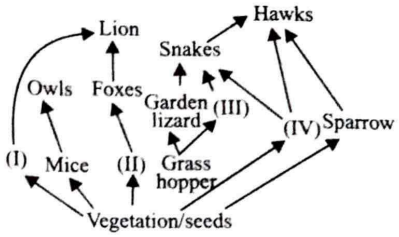
28. Which of the following is a primary consumer in maize field ecosytem?

(A) Grasshopper (B) Wolf

(C) Phytoplankton (D) Lion

[NEET Karnataka 2013]

29. Identify the likely organisms (I), (II) (III) and (IV) in the food web shown below:



	(I)	(II)	(III)	(IV)
(A)	Deer	Rabbit	Frog	Rat
(B)	Dog	Squirrel	Bat	Deer
(C)	Rat	Dog	Tortoise	Crow
(D)	Squirrel	Cat	Rat	Pigeon

[AIPMT Mains 2012]

30. Which one of the following types of organisms occupy more than one trophic level in a pond ecosystem?

(A) Phytoplankton (B) Fish

(C) Zooplankton (D) Frog

[AIPMT Screening 2009]

31. Consider the following statements concerning food chains.

(I) Removal of 80% tigers from an area resulted in greatly increased growth of vegetation.

(II) Removal of most of the carnivores resulted in an increased population of deer.

(III) The length of food chains is generally limited to 3-4 trophic levels due to energy loss.

(IV) The length of food chains may vary from 2 to 8 trophic levels.

Which two of the above statements are correct?

(A) (II) and (III) (B) (III) and (IV)

(C) (I) and (IV) (D) (I) and (II)

[AIPMT Screening 2008]

32. Photosynthetic Active Radiation (PAR) has the following range of wavelengths:

(A) 340-450 nm (B) 400-700 nm

(C) 500-600 nm (D) 450-950 nm.

[AIPMT 2005]

33. If a bamboo plant is growing in a far from 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) **[AIPMT 2002]**

34. In an ecosystem, which one shows one-way passage?

(A) Free energy (B) Carbon

(C) Nitrogen (D) Potassium **[AIPMT 1998]**

35. In a food chain, the largest population is that of:

(A) decomposers (B) producers

(C) primary consumers (D) tertiary consumers.

[AIPMT 1996, 94]

36. In a biotic community, the primary consumers are:

(A) carnivores (B) omnivores

(C) detritivores (D) herbivores **[AIPMT 1995]**

37. 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. **[AIPMT 1994]**

38. Food chain in which microorganisms breakdown the food formed by primary producers is:

(A) parasitic food chain

(B) detritus food chain

(C) consumer food chain

(D) predator food chain. **[AIPMT 1991]**

39. Pick up the correct food chain.

(A) Grass → Chamelion → Insect → Bird

(B) Grass → Fox → Rabbit → Bird

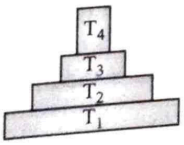
(C) Phytoplankton → Zooplankton → Fish

(D) Fallen leaves → Bacteria → Insect larvae

[AIPMT 1991]

12.5. Ecological Pyramids

40. Consider the pyramid of energy of an ecosystem given below:



If T_4 is equivalent to 1000 J, what is the value at T_1?

(A) $\frac{10000}{10}$ J (B) $\frac{10000}{10} \times 4$ J

(C) 10000 J (D) 10,00,000 J

[Re-NEET 2024]

41. Which one of the following is not a limitation of ecological pyramids?

(A) Saprophytes are not given any place in ecological pyramids.

(B) It assumes a simple food chain, that almost never exists in nature.

(C) It accommodates a food web.

(D) It does not take into account the same species belonging to two or more trophic levels.

[Re-NEET 2024]

42. Which of the following statements is not correct?

(A) Pyramid of biomass in sea is generally inverted.

(B) Pyramid of biomass in sea is generally upright.

(C) Pyramid of energy is always upright.

(D) Pyramid of numbers in a grassland ecosystem is upright. **[NEET 2021]**

43. Which of the following ecological pyramids is generally inverted?

(A) Pyramid of energy

(B) Pyramid of biomass in a forest

(C) Pyramid of biomass in a sea

(D) Pyramid of numbers in grassland

[NEET National 2019]

44. Most animals that live in deep oceanic water are:

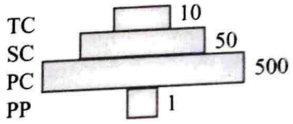
(A) primary consumers

(B) secondary consumers

(C) tertiary consumers

(D) detritivores. **[AIPMT Latest July 2015]**

45. Given 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.

[AIPMT Screening 2012]

46. Which one of the following statements for pyramid of energy is incorrect, whereas the remaining three are correct?

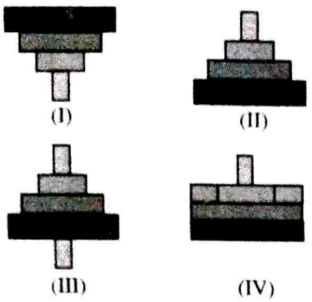
(A) It shows energy content of different trophic level organisms.

(B) It is inverted in shape.

(C) It is upright in shape.

(D) Its base is broad. **[AIPMT Screening 2011]**

47. Which of the following representations shows the pyramid of numbers in a forest ecosystem?



(A) (IV) (B) (I)
(C) (II) (D) (III)

[AIPMT Mains 2010]

48. Which one of the following is not used for construction of ecological pyramids?
(A) Fresh weight
(B) Dry weight
(C) Number of individuals
(D) Rate of energy flow **[AIPMT 2006]**

49. Pyramid of numbers deals with number of:
(A) species in an area
(B) individuals in a community
(C) individuals in a trophic-level
(D) subspecies in a community. **[AIPMT 1993]**

50. Pyramid of numbers in a pond ecosystem is:
(A) irregular (B) inverted
(C) upright (D) spindle shaped.

[AIPMT 1993]

51. Pyramid of numbers in a grassland/true ecosystem is:
(A) always inverted (B) always upright
(C) both (A) and (B) (D) spindle-shaped.

[AIPMT 1991, 90]

SOLUTIONS

1. (B) According to the Lindeman's 10% law, only 10% of the available energy is passed to next trophic level. Rest is used for metabolic processes or as heat. Hence, energy gradually decreases with each level. Biomass is the total mass of organisms at a trophic level. Usually with the increase in trophic level, the number of organisms decrease and hence the biomass at that trophic level.

Related Theory

An organism does not always occupy the same trophic level, depending on the food web. For example, humans are omnivore, meaning they can eat both plants and animals. So, they may be considered both primary and secondary consumers. Similarly, the arrows in a food web always travel from the prey to the predator. The arrows in a food web or food chain point towards direction of energy flowing.

Caution

Students usually get confused and select option (A) Biomass decrease from first to fourth trophic level, comprehending the fact that the organisms at higher levels are bigger than those at lower levels. They are unable to understand the concept of biomass in the context.

2. (A) Biomass refers to the amount of living organic matter. Pond and lake ecosystem occupy very little area when compared to forest and grassland ecosystem. And hence the biomass in lake and pond ecosystem will be less. When compared to the forest, grassland has only a few trees or shrubs and characterized by mixed herbaceous (non-woody) vegetation cover and is dominated by grasses or grass-like plants. The biomass is maximum in a forest ecosystem because of their size and longevity of trees. Forest ecosystem has formed the most massive and complex ecosystems of the earth. Even though the animal biomass of the forest is small, the total amount of plant biomass per hectare is high.

Related Theory

Biomass is considered a good measure of plant dominance on a site because it reflects the amount of sunlight, water and minerals a plant is able to capture and turn into plant mass. Biomass decreases with each trophic level. There is always more biomass in lower trophic levels than in higher ones. Thus, there are always more autotrophs than herbivores and more herbivores than carnivores in a healthy food web.

3. (A) The term ecosystem was coined by A.G. Tansley. E. Haeckel gave recapitulation theory. E. Warming contributed his knowledge in plant ecology. E.P. Odum explained the importance of ecosystem.

4. (A) Cropland ecosystem is the largest anthropogenic ecosystem characterised by less diversity (as only few types of plants and animals are found in the area) and high productivity (as farming is usually done on commercial basis). Besides the crops, weeds are usually grown in the crop field. Microorganism in soil plays the important role in enriching it with natural fertilisers.

Related Theory

Man has been doing his best in modifying the croplands to get maximum benefit out of them. A cropland ecosystem may be illustrated by crops like wheat, maize, rice, sugarcane, etc. It has following components.

(1) ***Producers:*** *A crop along with the weeds growing in the field is the producers of a cropland ecosystem.*

(2) ***Consumers:*** *Herbivores are the primary consumers of the cropland ecosystem.*

(3) ***Decomposers and transformers:*** *Bacteria and fungi are decomposers.*

5. (B) Stratification refers to the vertical layering of a habitat; the arrangement of vegetation in layers. Zonation is the horizontal categorisation of biomass into zones based on their distribution of arrangement in habitat, determined by their climatic factors.

Related Theory

In stratification, trees occupy the topmost vertical layer of a forest, shrubs occupy the second layer and herbs and grasses occupy the bottommost or base layers. There are 5 vertical subdivision as: subterranean, forest floor, herbaceous vegetation, shrubs and trees.

6. (A) Stratification is structural component of biological community. Depending upon the physical and physiological requirement of the diverse species in a biological community, the organisms are organised in a recognizable structure or pattern called stratification. For *e.g.*, a forest ecosystem can be stratified into the upper canopy, the middle understory and the lower ground levels. Natality (the ratio of number of births to the size of population), mortality (the number of deaths in a given area or period) and sex ratio (number of males per thousand females in the population of a community) are the characteristics of population in a community.

7. (C) Nektons are aquatic creatures that have the ability to swim and move through the water without the aid of currents. Since they prefer the sun-lit zone, planktons and nektons are found in the upper portion of an aquatic/marine ecosystem.

8. (B) NPP at the first trophic level is the GPP for the second trophic level and NPP at 2nd trophic level is the GPP for the third trophic level.

According to Lindeman's 10% law, 90% of energy is lost as respiration (R).

At the first trophic level, NPP = $100x$ (given), which is the GPP of the second trophic level.

Now, if GPP of second trophic level is $100x$, then NPP of the second trophic level is 10% of GPP at the same trophic level

$$= 100x \times \frac{10}{100} = 10x$$

GPP of the third trophic level would be $10x$, since it is the same as NPP of the 2nd trophic level.

9. (B) In the equation GPP – R = NPP, R refers to respiratory loss.

Gross Primary Productivity (GPP) refers to the total amount of carbon fixed by photosynthesis in an ecosystem or plant, while Net Primary Productivity (NPP) is the amount of carbon fixed by photosynthesis that is available for plant growth and other functions after subtracting the amount of carbon lost through respiration by the plants themselves.

Caution

Students usually select incorrect options when it is asked about the reference or full forms. They should know about the full forms of the letters asked in the equations or formulae.

10. (A) The overall rate of production of organic matter during photosynthesis is referred to as gross primary productivity.

It cannot be a lower than Net primary productivity. Gross Primary productivity is always more than Net primary productivity.

$$GPP - R = NPP$$

11. (B) GPP refers to the rate of production of organic matter by the process of photosynthesis, per unit area. Secondary productivity is the rate of formation of organic matter by the consumers. Net productivity is the amount of energy trapped in organic matter during a specified interval at a given trophic level less that lost by the respiration of the organisms at that level.

Related Theory

Biomass is simply the amount of matter that is stored in the bodies of a group of organisms. Productivity can be defined for any trophic level or other group, and it may take units of either energy or biomass. Plants typically capture and convert solar energy that reaches Earth's surface and use about a quarter of the captured energy for metabolism and maintenance. So, around only 1%, of the solar energy reaching Earth's surface (per unit area and time) ends up as net primary productivity.

12. (C) Secondary productivity is the accumulation of energy at the consumer's level. It keeps moving from one organism to another, unlike primary productivity. This process occurs as a result of organic materials being transferred between various trophic levels. It is also referred to as the rate of increase in the biomass of heterotrophs.

Related Theory

Primary Productivity refers to the generation of biomass from autotrophic organisms such as plants. Photosynthesis is the primary step for the creation of organic material from inorganic compounds such as carbon dioxide and water.

13. (B) The productivity at consumer level is called secondary productivity and rabbit is consumer. The amount of energy accumulated in green plants through the process of photosynthesis is known

as primary productivity. It may gross PP (*i.e.*, the total organic matter synthesized) or Net PP (*i.e.*, the weight of organic matter stored).

Related Theory

Productivity is the rate at which energy is added to the bodies of organisms in the form of biomass. Productivity is a rate function, and is expressed in terms of dry matter produced or energy captured per unit area of land, per unit time.

14. (A) Net primary productivity is the difference between the gross primary productivity and the loss due to respiration. It represents stored biomass which is transferred from one trophic level to another trophic level.

Or, $NPP = GPP - R$

Standing crop represents the mass of living material (biomass) at a particular time.

Related Theory

The rate of assimilation and formation of new organic matter by consumer is called secondary productivity. The factor which affect productivity in an ecosystem are:
(1) Nitrogen in marine ecosystem.
(2) Light which decreases with increasing depth of water.

15. (D) Productivity of tropical rainforests is the highest. The tropical rainforests covering an area of 3,00,000 km^2 contain more than 50% of the total flora and fauna of the world. They are found in the equatorial regions rainfall exceeds 140 cm. The warm humid climate supports broad leaved evergreen plants. Productivity is very high and the vegetation show stratification into two or more well defined layers.

16. (C) Gross primary productivity is the amount of carbon fixed during photosynthesis by all producers in the ecosystem. Net primary production (NPP) is the rate at which material is accumulated in excess of respiration.

$$NPP = GPP - \text{respiration losses (R)}$$

Related Theory

The amount of new biomass (weight) that is produced by meat eating animals (carnivores) in a given period of time is called tertiary production.

17. (B) Net primary productivity refers to the total amount of biomass available for consumption by heterotrophic organisms, whereas gross primary productivity refers to the rate at which organic matter is created by photosynthesis.

18. (C) Detrivores can perform fragmentation. Fragmentation is a process by which large pieces of dead organic matter are broken down into smaller fragments by physical means. This process can be performed by physical agents such as wind, water, and temperature changes, but also by the actions of detrivores such as earthworms, millipedes, and isopods. Humus is a stable form of organic matter that is formed by the decomposition of dead organic material. During mineralization, some microbes further degrade humus to release inorganic nutrients like nitrogen and phosphorus, which can then be used by plants.

Water soluble inorganic nutrients go down into the soil and get precipitated by a process called leaching.

Related Theory

The type of food chain known as a detritus food chain begins with decomposed organic matter. Microorganisms break down the decayed organic materials. Detritivores, also called decomposers, are organisms that consume detritus, or dead organic materials. Predators later consume these detritivores. The discharged products of one organism are used by another in the detritus food chain.

19. (B) The decomposition process is slowed down by the presence of large complex polymers in the detritus, like lignin and chitin.

20. (A) The process of breakdown of complex organic matter into inorganic substances like CO_2, water and nutrients is called decomposition. Humification leads to accumulation of a dark coloured amorphous substance called humus. Fragmentation refers to the breakdown of detritus by detritivores, catabolism refers to the breakdown of detritus into simple inorganic components by bacterial and fungi enzymes.

21. (D) Due to presence of lignin and chitin in detritus, decomposition rates becomes slow and retarded. The rate of decomposition is faster in the ecosystem rich in nitrogen and water-soluble substances like sugar. Warm and moist environments, along with the presence of high temperature and aerobic microbes in the soil favours the decomposition process.

Related Theory

In the ecosystem, decomposition process is a nature's way of recycling the nutrients back to the soil. The decaying and dead animals and plants serve as the raw materials which, on the breakdown, produces nutrients, carbon dioxide, and water, etc. Detritus are the raw materials such as dead animals, plants and their remains. Microbes then process this detritus which are collectively known as saprophytes.

22. (D) Detritivores (such as earthworms) use the process of fragmentation to reduce debris to tiny pieces.

Humification causes the accumulation of humus, an amorphous dark-coloured substance that is extremely resistant to microbial action and decomposes at a very slow rate.

Under aerobic conditions, catabolism is the breakdown of detritus into more basic inorganic substances by bacterial and fungal enzymes.

Water-soluble inorganic nutrients are leached into the soil horizon and then precipitate as salts that are inaccessible to plants.

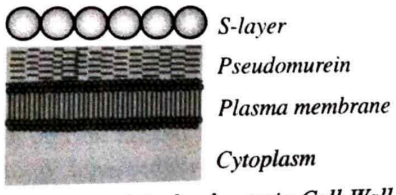
23. (C) Complex organic matter is broken down by the decomposers into inorganic elements like carbon dioxide, water and nutrients. They are crucial to the cycle of minerals. The ecosystem's function's ability will suffer if the decomposers are entirely eliminated because the mineral cycle will be disrupted.

24. (D) In grassland ecosystem, grass is the producer (first trophic level). Rabbit is the primary consumer (second trophic level). Crow is the secondary consumer (third trophic level). Vulture is the tertiary consumer (fourth trophic level).

25. (B) Archaebacteria are found in extreme conditions, like deep sea hydrothermal vent. Such bacteria are chemosynthetic bacteria which use hydrogen sulphide from the vents to produce organic material through the process of chemosynthesis. Other organisms and eubacteria cannot withstand such conditions.

Related Theory

Archaebacterial cell wall have a proteinaceous S-layer. The S-layer can be made of either protein or glycoprotein, often anchored into the plasma membrane of the cell. The proteins form a two-dimensional crystalline array with a smooth outer surface. While archaea lack peptidoglycan, a few contain pseudomurein and instead of NAM, it contains N-acetyltalosaminuronic acid linked to NAG, with peptide inter-bridges to increase strength.



Structure of Archaebacteria Cell Wall

26. (D) Standing crop represents the mass of living material (biomass) at a trophic level at a particular time. The total amount of nutrient like carbon, phosphorus, calcium, *etc.*, present in soil at any time is called standing state. Gross Primary Production (GPP) is the total rate at which material is produced and Net Primary Production (NPP) is the rate at which material is accumulated in excess of respiration.

$$NPP = GPP - R$$

27. (A) According to 10% law, the total amount of energy transferred to next trophic level is 10%. Hence,

$$\text{Plant} \rightarrow \text{Mice} \rightarrow \text{Snake} \rightarrow \text{Peacock}$$
$$20\ \text{J} \rightarrow 2\ \text{J} \rightarrow 0.2\ \text{J} \rightarrow 0.02\ \text{J}$$

Related Theory

According to Lindeman's law of 10% energy, The amount of energy flow decrease with successive trophic levels as only 10% of energy is transferred from one trophic level to the next successive level. The energy is lost in the form of respiration and other vital activities to maintain life. If more trophic levels are present, the residual energy will be limited and decreased to such an extent that it cannot further support any trophic level by the flow of energy. So, the food chain is generally limited to 3-4 trophic levels only.

28. (A) Maize field ecosystem starts with the grass. Grass is a primary producer which synthesize its own food. Primary consumers are herbivorous organisms, that feed on producers. In a food chain, grasshoppers are primary consumers (hervivores), phytoplankton are producers of aquatic ecosystem, and wolf and lions are secondary and tertiary consumers respectively.

29. (A) Producers utilize the radiant energy of sun which is transformed to chemical form during photosynthesis. Thus, green plants occupy the first trophic level. The herbivores constitute the secondary trophic level and the carnivores constitute third trophic level. Deer is herbivores, rabbit and rat are also herbivores but frog eats the grasshoppers.

Related Theory

Food chain is referred to the transfer of energy (food) from the producers through a series of consumers. Each energy step or level in a food chain is a called a trophic level. The ecological pyramid assumes in simple food chain and does not accommodate food webs. Thereby it does not take into account the fact that species may belong to two or more trophic levels at a time. Also saprophytes despite their vital role in ecosystem are given no place in the ecological pyramids.

30. (B) In an aquatic ecosystem, fishes can consume phytoplanktons and other producers. In such a system, fishes will be primary carnivores or primary consumers or herbivores as compared to the grazing food chain. Some bigger fishes can consume smaller fishes. In this case, bigger fishes will act as secondary consumers or secondary carnivores feeding on primary carnivores. Phytoplanktons will always be producers and zooplanktons will always be primary consumers. The frog will always act as secondary consumer feeding on primary consumers *i.e.*, insects. A single species can occupy more than one trophic level in the same ecosystem at the same time. Fish in a pond can be found at multiple trophic levels.

Related Theory

The pyramid of biomass is inverted in a pond ecosystem because the biomass of fish (top consumer) is larger than the producers (phytoplankton).

31. (A) Removal of tigers from an area will lead to an increase in number of herbivores and hence there will be decreased growth of vegetation in that particular area. The number of trophic levels in a food chain does not reach 8 rather there are only 3 or 4 trophic levels.

32. (B) Photosynthetically Active Radiation (PAR) is the amount of light available for photosynthesis, which is light in the 400 to 700 nanometer wavelength range. Rate of photosynthesis is maximum at 647-660 nm while 690-700 nm is insufficient for photosynthesis.

33. (A) The bamboo is found in the first trophic level or the producer level that can obtain its food by the process of photosynthesis. Second, third and fourth trophic level represents primary, secondary and tertiary consumer respectively.

34. (A) In an ecosystem, free energy shows a one-way passage that means the flow of energy is non-reversible. In an ecosystem, the amount of energy that flows from one trophic level to another trophic level is known as energy flow. The energy flows only in one direction. This energy cannot be passed back.

Related Theory

The free energy from the sun flows only in one direction i.e., from the sun it flows to producers then from producers it flows to the primary consumers to secondary consumers then to tertiary consumers, and finally to the decomposers.

35. (B) Generally in the food chain of terrestrial and aquatic ecosystem the largest population is that of producers. The number of organisms in each trophic level of a food chain depend upon the availability of food and energy. As producers form the base of the energy pyramid, they are generally the largest population. And since energy is lost at each trophic level as heat, the pyramid tapers, indicating a reduction in biomass and hence numbers as you go up the levels.

Related Theory

Autotrophs (producers) are the organism which are larger in the number in the food chain. It supports the large numbers of herbivores.

36. (D) The main consumer is the primary consumer in a food chain to receive energy from producers. Animals that eat sugars are the main consumers since plants supply the sugars needed for energy. Every animal is a consumer. Many people eat plants or plant products. They also go by the name "herbivores." Grazers include animals like cows, horses, elephants, deer, and rabbits. They consume grass as well as bushes' and leaves of trees.

37. (B) Lindeman proposed 10% law of energy. According to this law, if 1 tonne (1000 kg) biomass is present in grass, only 10% of it means 100 kg will go into deer and in tiger the biomass will be only 10 kg, *i.e.*, 10% of deer's biomass.

38. (B) Detritus Food Chain (DFC) refers to the food chain in which microorganisms break down the food made from primary products. Dead organic stuff is where DFC starts (called detritus). In this, the primary source of energy is dead organic matter, that is leaves, plant parts and dead animals. The primary consumers are called as detritivores. These include bacteria, fungi, protozoans. They are saprophytes. They break down the energy rich compound synthesized by producers.

39. (C) A food chain is the series of creatures through which energy is transferred from producers to consumers, or from primary consumers to secondary consumers and from secondary consumers to tertiary consumers, through the processes of eating and being eaten.

40. (D) If T_4 is equivalent to 1000 J then the value of T_1 is 10,00,000 J. According to the 10 percent law which states that each trophic level in an ecosystem only gives 10% of its energy to the trophic levels above it. While rest is utilised by organisms to carry out their own metabolic functions.

41. (C) The statement "It accommodates a food web" is not the limitation of ecological pyramids, as it does not accommodate food web.

42. (B) The pyramid of biomass in sea is inverted because biomass of fish exceeds that of phytoplankton and in this scenario the biomass of trophic level depends on the reproductive potential and the longevity of the member. Marine environment have inverted biomass pyramids.

Related Theory

An inverted pyramid of numbers can also be found in an ecosystem where the community contains parasites.

Caution

The pyramid of energy is always upright as the energy flow in a food chain is always unidirectional. In an ecosystem, food is passed from one trophic level to the next higher trophic level.

43. (C) The pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton and the number of big fishes eating the small fishes is also greater than the small ones. Pyramid of energy is always upright as the energy transferred decrease with trophic levels.

Related Theory

Pyramid of energy is never inverted when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step. Each bar in the energy pyramid indicated the amount of energy present at each trophic level in a given time.

Caution

Students should remember that in pyramid of number on a tree, the number of insects feeding on a big tree is far greater than the tree. The number of small birds depending on the insect and the number of larger birds eating the smaller ones also increases in the order.

44. (D) The deep ocean is very cold, under high pressure, and always dark because sunlight cannot get down that far. Less life can survive in the deep ocean than in other parts of the ocean because of these conditions. Most animals in deep oceanic waters are detritivores. They act as scavengers which feeds on dead organic matter in the deep oceans. They are mostly benthic in nature. *E.g.*, crustaceans, polychaetes and other microorganisms. The undissolved material from the decomposition of organic remains is called detritus. It often settles on the ocean bottom.

45. (A) The given figure shows spindle-shaped pyramid of number in single tree ecosystem. Here, a single large sized tree provides food to a large number of herbivores which support a few carnivores and the later are eaten by small number of top carnivores. So, here PP is used for producer, *i.e.*, single tree, PC is Primary Consumers, *i.e.*, large number of insects, SC is Secondary Consumers, *i.e.*, small insectivorous birds and TC is Top Consumers which may be eagles or falcon, *etc.*

Related Theory

➥ *The pyramid of biomass is upright at the first two trophic levels because the biomass of a single tree is much more than total population of insects whereas the pyramids of numbers is inverted at the first two trophic levels because the number of insects is much more than the number of tree.*

46. (B) Pyramid of energy gives a graphic representation of the amount of energy trapped by different trophic levels per unit area. It is always upright because during transfer of energy from one trophic level to the next some energy is always lost at each level.

47. (D) Pyramid of number in a forest ecosystem is partially upright or spindle shaped. The producers in a forest ecosystem are large in size which are less in numbers. This make the base of the forest pyramid. The primary consumers (herbivores) include horse, deer, elephants are always less in number than primary producers. Thus, they are placed above primary producers. In this way, at each successive level the number goes down.

Related Theory

➥ *The pyramid of biomass in sea is generally inverted because the biomass of fishes far exceeds that of phytoplankton and the number of big fishes eating the small fishes is also greater than the small ones. Also, in pyramid of number, the number of insects feeding on a big tree is far greater than the tree. Now the number of small birds depending on the insect and the number of larger birds eating the smaller ones also increases in the order.*

48. (A) Ecological pyramids are the graphical representation of the trophic structure and function at successive trophic levels. The three parameters used are:

(1) Number of individuals in a trophic level.

(2) Biomass (dry weight) of individual in a trophic level.

(3) Rate of flow of energy in a trophic level.

49. (C) The number of people in a trophic level is represented by a pyramid of numbers in a food chain. In the pond/grassland ecosystem, it is upright. In this, the energy is most at the producer level, then at the level of the primary consumer (herbivores), and then at the level of the secondary consumer (carnivores). The producers in an ecosystem are represented by the bottom of the number pyramid.

50. (C) The number pyramid in the pond ecosystem is always upright. It shows how many people are present at each trophic level because the level of the pyramid is occupied by the producers. *i.e.*, the phytoplanktons which are the highest in number in the pond. Then come the primary consumers followed by the secondary consumers. Hence, there is gradual decrease in the number of individuals in the successive trophic level.

51. (B) Pyramids can be inverted or upright. The number of producers, primarily grasses, is always at its highest level in a grassland ecosystem, followed by decreasing numbers of herbivores at the second and third trophic levels and the least amount of predators at the top. As a result, the pyramid of number in the grassland ecosystem is upright.