CHAPTER 14

Ecosystem

14.0 Introduction

1. The term ecosystem was coined by
(a) E. Haeckel (b) E.Warming
(c) E.P. Odum (d) A. G. Tansley.
(NEET-I 2016)

14.1 Ecosystem – Structure and Function

2. Which one of the following is a characteristic feature of cropland ecosystem?
(a) Absence of weeds
(b) Ecological succession
(c) Absence of soil organisms
(d) Least genetic diversity *(NEET-I 2016)*

3. Vertical distribution of different species occupying different levels in a biotic community is known as
(a) zonation (b) pyramid
(c) divergence (d) stratification.
(2015 Cancelled)

4. Which one of the following is not a functional unit of an ecosystem?
(a) Energy flow (b) Decomposition
(c) Productivity (d) Stratification *(2012)*

5. Which one of the following is one of the characteristics of a biological community?
(a) Stratification (b) Natality
(c) Mortality (d) Sex-ratio *(2010)*

6. Which of the following is the most stable ecosystem?
(a) Mountain (b) Ocean
(c) Forest (d) Desert *(1995)*

14.2 Productivity

7. 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 less than Net primary productivity.
(b) Gross primary productivity is always more than Net primary productivity.
(c) Gross primary productivity and Net primary productivity are one and same.
(d) There is no relationship between Gross primary productivity and Net primary productivity.
(NEET 2020)

8. The mass of living material at a trophic level at a particular time is called
(a) net primary productivity
(b) standing crop
(c) gross primary productivity
(d) standing state. *(2015 Cancelled)*

9. In an ecosystem the rate of production of organic matter during photosynthesis is termed as
(a) secondary productivity
(b) net productivity
(c) net primary productivity
(d) gross primary productivity. *(2015 Cancelled)*

10. Secondary productivity is rate of formation of new organic matter by
(a) consumers (b) decomposers
(c) producers (d) parasites.
(NEET 2013)

11. 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. *(Mains 2012)*

12. Mass of living matter at a trophic level in an area at any time is called
(a) standing crop (b) detritus
(c) humus (d) standing state. *(2011)*

13. 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. *(2010)*

14. 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 *(2007)*

15. 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) *(2004)*

16. The rate at which light energy is converted into chemical energy of organic molecules is the ecosystem's
(a) net secondary productivity
(b) gross primary productivity
(c) net primary productivity
(d) gross secondary productivity. *(1998)*

17. Which of the following ecosystem has the highest gross primary productivity?
(a) Mangroves (b) Rainforest
(c) Grassland (d) Coral reef *(1997)*

18. Maximum solar energy is trapped by
(a) planting trees
(b) cultivating crops
(c) growing algae in tanks
(d) growing grasses. *(1993)*

19. A very efficient converter of solar energy with net productivity of 204 kg/m^2 or more is the crop
(a) wheat (b) sugarcane
(c) rice (d) bajra. *(1989)*

14.3 Decomposition

20. Which one of the following processes during decomposition is correctly described?
(a) Catabolism – Last step in the decomposition under fully anaerobic condition
(b) Leaching – Water soluble inorganic nutrients rise to the top layers of soil
(c) Fragmentation – Carried out by organisms such as earthworm
(d) Humification – Leads to the accumulation of a dark coloured substance humus which undergoes microbial action at a very fast rate. *(NEET 2013)*

21. The breakdown of detritus into smaller particles by earthworm is a process called
(a) humification (b) fragmentation
(c) mineralisation (d) catabolism. *(Mains 2011)*

22. The slow rate of decomposition of fallen logs in nature is due to their
(a) anaerobic environment around them
(b) low cellulose content
(c) low moisture content
(d) poor nitrogen content. *(2008)*

23. Plant decomposers are
(a) monera and fungi
(b) fungi and plants
(c) protista and animalia
(d) animalia and monera. *(2001)*

24. Which of the following acts as "nature's scavengers"?
(a) Insects (b) Microorganisms
(c) Man (d) Animals *(1997)*

25. If we completely remove the decomposers from an ecosystem, its functioning will be adversely affected, because
(a) mineral movement will be blocked
(b) the rate of decomposition will be very high
(c) energy flow will be blocked
(d) herbivores will not receive solar energy. *(1995)*

14.4 Energy Flow

26. 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-II 2016)*

27. Most animals that live in deep oceanic waters are
(a) tertiary consumers
(b) detritivores
(c) primary consumers
(d) secondary consumers. *(2015)*

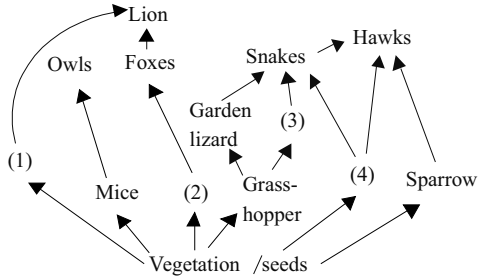
28. If 20 J of energy is trapped at producer level, then how much energy will be available to peacock as food in the following chain?
Plant → Mice → Snake → Peacock
(a) 0.02 J (b) 0.002 J
(c) 0.2 J (d) 0.0002 J *(2014)*

29. Which of the following is a primary consumer in maize field ecosystem?
(a) Grasshopper (b) Wolf
(c) Phytoplankton (d) Lion
(Karnataka NEET 2013)

30. When man eats fish which feeds on zooplanktons which have eaten small plants, the producer in this chain is
(a) small plants (b) fish
(c) man (d) zooplankton.
(Karnataka NEET 2013)

31. Identify the possible link "A" in the following food chain.
Plant → Insect → Frog → "A" → Eagle
(a) Rabbit (b) Wolf
(c) Cobra (d) Parrot *(2012)*

32. Identify the likely organisms (1), (2), (3) and (4) 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

(Mains 2012)

33. Of the total incident solar radiation the proportion of PAR is
(a) about 70% (b) about 60%
(c) less than 50% (d) more than 80%.
(2011)

34. 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 *(Mains 2011)*

35. 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 *(2009)*

36. Consider the following statements concerning food chains.
A. Removal of 80% tigers from an area resulted in greatly increased growth of vegetation.
B. Removal of most of the carnivores resulted in an increased population of deers.
C. The length of food chains is generally limited to 3-4 trophic levels due to energy loss.
D. The length of food chains may vary from 2 to 8 trophic levels.
Which two of the above statements are correct?
(a) A, D (b) A, B
(c) B, C (d) C, D *(2008)*

37. 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) *(2002)*

38. Which is the reason for highest biomass in aquatic ecosystem?
(a) Nano plankton, blue green algae and green algae
(b) Sea grass and slime moulds
(c) Benthic and brown algae
(d) Diatoms *(2000)*

39. Energy transfer from one trophic level to other, in a food chain, is
(a) 10% (b) 20% (c) 1% (d) 2%.
(1999)

40. In a terrestrial ecosystem such as forest, maximum energy is in which trophic level?
(a) T_3 (b) T_4 (c) T_1 (d) T_2 *(1998)*

41. The 10% energy transfer law of food chain was given by
(a) Lindemann (b) Tansley
(c) Stanley (d) Weismann. *(1996)*

42. In a biotic community, the primary consumers are
(a) detritivores (b) herbivores
(c) carnivores (d) omnivores.
(1995)

43. The dominant second trophic level, in a lake ecosystem, is
(a) phytoplankton (b) zooplankton
(c) benthos (d) plankton. *(1994)*

44. 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. *(1991)*

45. Pick up the correct food chain.
(a) Grass → Chameleon → Insect → Bird
(b) Grass → Fox → Rabbit → Bird
(c) Phytoplankton → Zooplankton → Fish
(d) Fallen leaves → Bacteria → Insect larvae
(1991)

46. Upper part of sea/aquatic ecosystem contains
(a) plankton
(b) nekton
(c) plankton and nekton
(d) benthos. *(1988)*

47. What is true of ecosystem?
(a) Primary consumers are least dependent upon producers.
(b) Primary consumers out-number producers.
(c) Producers are more than primary consumers.
(d) Secondary consumers are the largest and most powerful. *(1988)*

48. In an ecosystem, which one shows one-way passage?
(a) Free energy (b) Carbon
(c) Nitrogen (d) Potassium *(1988)*

14.5 Ecological Pyramids

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

(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)	(ii)	(iii)	(iv)	(i)
(b)	(iii)	(ii)	(i)	(iv)
(c)	(iv)	(iii)	(ii)	(i)
(d)	(i)	(ii)	(iii)	(iv)

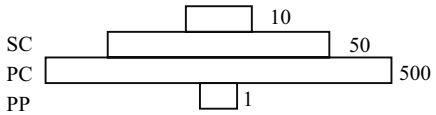
(NEET 2020)

50. Which of the following ecological pyramids is generally inverted?
(a) Pyramid of biomass in a sea
(b) Pyramid of numbers in grassland
(c) Pyramid of energy
(d) Pyramid of biomass in a forest *(NEET 2019)*

51. What type of ecological pyramid would be obtained with the following data?
Secondary consumer : 120 g
Primary consumer : 60 g
Primary producer : 10 g
(a) Inverted pyramid of biomass
(b) Pyramid of energy
(c) Upright pyramid of numbers
(d) Upright pyramid of biomass *(NEET 2018)*

52. Which ecosystem has the maximum biomass?
(a) Grassland ecosystem
(b) Pond ecosystem
(c) Lake ecosystem
(d) Forest ecosystem *(NEET 2017)*

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

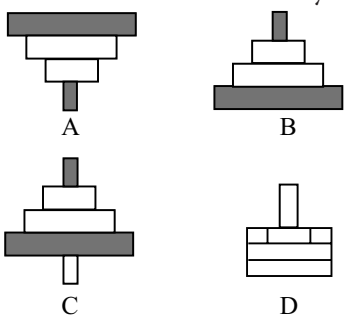


(a) Level PC is "insects" and level SC is "small insectivorous birds".
(b) Level PP is "phytoplanktons" in sea and level TC is "whale" on top level.
(c) Level one PP is "*pipal* trees" and the level SC is "sheep".
(d) Level PC is "rats" and level SC is "cats". *(2012)*

54. The upright pyramid of number is absent in
(a) pond (b) forest
(c) lake (d) grassland. *(2012)*

55. Which one of the following statements for the pyramid of energy is incorrect ?
(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. *(2011)*

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



(a) D (b) A
(c) B (d) C *(Mains 2010)*

57. 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 *(2006)*

58. 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. *(1993)*

59. Pyramid of numbers in a pond ecosystem is
(a) irregular (b) inverted
(c) upright (d) spindle shaped. *(1993)*

14.6 Ecological Succession

60. Which of the following would appear as the pioneer organisms on bare rocks?
(a) Mosses (b) Green algae
(c) Lichens (d) Liverworts *(NEET-I 2016)*

61. During ecological succession
(a) the numbers and types of animals remain constant
(b) the changes lead to a community that is in near equilibrium with the environment and is called pioneer community
(c) the gradual and predictable change in species composition occurs in a given area
(d) the establishment of a new biotic community is very fast in its primary phase. *(2015)*

62. Secondary succession takes place on/in
(a) newly created pond
(b) newly cooled lava
(c) bare rock
(d) degraded forest. *(2015 Cancelled)*

63. The second stage of hydrosere is occupied by plants like
(a) *Azolla* (b) *Typha*
(c) *Salix* (d) *Vallisneria*.
(Mains 2012)

64. Which one of the following statements is correct for secondary succession?
(a) It begins on a bare rock.
(b) It occurs on a deforested site.
(c) It follows primary succession.
(d) It is similar to primary succession except that it has a relatively fast pace. *(2011)*

65. Both hydrarch and xerarch successions lead to
(a) medium water conditions
(b) xeric conditions
(c) highly dry conditions
(d) excessive wet conditions. *(Mains 2011)*

66. 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*. *(2009)*

67. 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. *(2004)*

68. The primary succession refers to the development of communities on a
(a) forest clearing after devastating fire
(b) newly-exposed habitat with no record of earlier vegetation
(c) freshly cleared crop field
(d) pond, freshly filled with water after a dry phase. *(1995)*

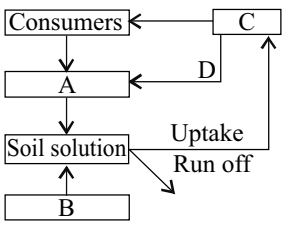
14.7 Nutrient Cycling

69. In which of the following both pairs have correct combination?

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

(2015)

70. Given below is a simplified model of phosphorus cycling in a terrestrial ecosystem with four blanks (A-D). Identify the blanks.



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

(2014)

71. Natural reservoir of phosphorus is
(a) rock (b) fossils
(c) sea water (d) animal bones.
(NEET 2013)

72. 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 *(2012)*

73. About 70% of total global carbon is found in
(a) oceans (b) forests
(c) grasslands (d) agroecosystems.
(2008)

74. Which of the following pairs is a sedimentary type of biogeochemical cycle?
(a) Phosphorus and nitrogen
(b) Phosphorus and sulphur
(c) Oxygen and nitrogen
(d) Phosphorus and carbon dioxide *(1995)*

14.8 Ecosystem Services

75. Match the following and select the correct option.

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)

(2014)

ANSWER KEY

1.	(d)	**2.**	(d)	**3.**	(d)	**4.**	(d)	**5.**	(a)	**6.**	(b)	**7.**	(b)	**8.**	(b)	**9.**	(d)	**10.**	(a)
11.	(b)	**12.**	(a)	**13.**	(a)	**14.**	(d)	**15.**	(c)	**16.**	(b)	**17.**	(b)	**18.**	(c)	**19.**	(b)	**20.**	(c)
21.	(b)	**22.**	(d)	**23.**	(a)	**24.**	(b)	**25.**	(a)	**26.**	(b)	**27.**	(b)	**28.**	(a)	**29.**	(a)	**30.**	(a)
31.	(c)	**32.**	(a)	**33.**	(c)	**34.**	(a)	**35.**	(a)	**36.**	(c)	**37.**	(a)	**38.**	(c)	**39.**	(a)	**40.**	(c)
41.	(a)	**42.**	(b)	**43.**	(b)	**44.**	(b)	**45.**	(c)	**46.**	(a)	**47.**	(c)	**48.**	(a)	**49.**	(a)	**50.**	(a)
51.	(a)	**52.**	(d)	**53.**	(a)	**54.**	(b)	**55.**	(c)	**56.**	(b,d)	**57.**	(a)	**58.**	(c)	**59.**	(c)	**60.**	(c)
61.	(c)	**62.**	(d)	**63.**	(d)	**64.**	(b)	**65.**	(a)	**66.**	(a)	**67.**	(a)	**68.**	(b)	**69.**	(c)	**70.**	(c)
71.	(a)	**72.**	(b)	**73.**	(a)	**74.**	(b)	**75.**	(d)										

Hints & Explanations

1. (d) : The term ecosystem was coined by A.G. Tansley in 1935.

2. (d) : Cropland ecosystem is an artificial or man-made terrestrial ecosystem which is created and maintained by human beings for their maximum benefits. Therefore, they will have least genetic diversity.

3. (d)

4. (d) : Four important functional aspects of the ecosystem are productivity, decomposition, energy flow and nutrient cycling.

5. (a) : The characteristics of biological community are dominance, species diversity, trophic organisation, stratification, dynamism and stability. Organisms are not uniformly distributed throughout a community. They usually occur in definite zones. This spatial arrangement of populations is called stratification. Structurally a community may be divided horizontally into subcommunities. This horizontal division constitutes the zonation in the community. Natality, mortality, age structure and sex ratio are the basic characteristics of a population.

6. (b) : Of all the ecosystems, ocean is the largest and most stable ecosystem. Aquatic life is protected from vigorous climates and weather that are climatic conditions, problem of water supply, food, fire and artificial forces such as industrialization, farming and grazing are lacking in the oceans. The sea is continuous and not separated as land and freshwater habitats.

7. (b) : Gross primary productivity (GPP) is the rate of production of organic matter during photosynthesis. A considerable amount of GPP is utilised by plants in respiration. GPP minus respiration losses (R) is the net primary productivity GPP – R = NPP.
Therefore, GPP is always more than NPP.

8. (b) : Standing crop is the total amount of living material in a specified population at a particular time, expressed as biomass (standing biomass) or its equivalent in terms of energy. The standing crop may vary at different times of the year; for example, in a population of deciduous trees between summer and winter.

9. (d) : The amount of energy accumulation in green plants as biomass or organic matter per unit area over a time period is known as primary productivity. The rate

of total capture of energy, or the rate of total production of organic material (biomass), is known as gross primary productivity.

10. (a) **11. (b)**

12. (a) : Standing crop is the total amount of living material in a specified population at a particular time, expressed as biomass (standing biomass) or its equivalent in terms of energy. The standing crop may vary at different times of the year; for example, in a population of deciduous trees between summer and winter.

13. (a) : The total organic matter synthesised by the producers in the process of photosynthesis per unit time and area is known as gross primary productivity. Net primary productivity is equal to the rate of organic matter created by photosynthesis minus the rate of respiration and other losses. It is actually the biomass available for consumption by the herbivores and the decomposers.

14. (d) : Net primary productivity is the total organic matter stored by producers per unit area per unit time. Gross primary productivity is the total organic matter synthesised by producers in the process of photosynthesis per unit area per unit time. So,

Net primary productivity = Gross productivity – Respiration and other losses

Tropical rainforests occur over equatorial/subequatorial regions with abundant warmth and rainfall. Diversity and productivity are maximum as compared to other regions.

15. (c) : Productivity is rate of accumulation of energy containing organic matter by an ecosystem per unit area per unit time. It is of two types- primary and secondary. Productivity at producer level is known as primary productivity. It is two types: Gross primary productivity is primary productivity including that amount which is utilized in respiration and other metabolic activities. Net primary productivity (NPP) is primary productivity in excess to that which is utilised in respiration and other metabolic activities.

NPP = GP – Respiration

Secondary productivity is productivity at consumer level. Since gross production includes total production including the amount utilized in respiration and other metabolic activities so it is more than other forms of productivity.

16. (b)

17. (b) : Gross primary productivity is the total rate of photosynthesis, including the organic matter used up in respiration during the measurement period. Tropical evergreen/rainforests occur over equatorial/subequatorial regions with abundant warmth and rainfall (200–350 cm/yr) almost throughout the year. The forests are impenetrable (= jungle) with maximum diversity, *e.g.*, 200 types of trees in one hectare, 70–80% of all insects 80–85% of all birds. Productivity is maximum here, 12000 kcal/m2/yr.

18. (c) : Maximum solar energy is trapped by growing algae in tanks. The light spectrum of red and blue light are most effective in performing photosynthesis for growing algae.

19. (b)

20. (c) : Decomposition is the process in which decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients. The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralisation. Detritivores (*e.g.*, earthworm) break down detritus into smaller particles. This process is called fragmentation. By the process of leaching, water-soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts. Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism. Humification and mineralisation occur during decomposition in the soil. Humification leads to accumulation of a dark coloured amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. The humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as mineralisation.

21. (b) : Detritivores (*e.g.*, earthworm) break down detritus into smaller particles. This process is called fragmentation.

22. (d) : Decomposition is largely an oxygen-requiring process. The rate of decomposition is controlled by chemical composition of detritus and climatic factors. In a particular climatic condition, 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 sugar. Temperature and soil moisture are the most important climatic factors that regulate decomposition through their effects on the activities of soil microbes. Warm and moist environment favour decomposition whereas low temperature and anaerobiosis inhibit decomposition resulting in build up of organic materials.

23. (a) : Microorganisms (bacteria and fungi) are decomposers of the ecosystem. They feed upon dead decaying living organisms (both plant and animals) and break them into simpler compounds. These are released free in the atmosphere and are utilized by producers for the synthesis of their food materials. They mainly belong to Kingdom Monera and Fungi.

24. (b) : Microorganisms (bacteria and mould) are decomposers of the ecosystem. They feed upon dead decaying organisms (both plant and animals) and break them into simpler compounds. They are called nature's scavengers as they are consumers of dead matter.

25. (a) : Decomposers are saprotrophs which decompose the organic remains by secreting extracellular digestive enzymes. They are also known as mineralisers

as they release minerals trapped in organic remains. So in the absence of microorganisms the flow of minerals will stop.

26. (b) : Hydrothermal vents are cracks in the ocean floor that emit jets of hot water loaded with minerals and chemosynthetic bacteria. These bacteria are autotrophs that oxidise hydrogen sulphide in vent water to obtain energy which is used to produce organic material. These chemosynthetic bacteria are the primary producers and form the base of vent food webs. All vent animals ultimately depend on bacteria for food.

27. (b) : Benthos is the community of organisms which live on, in, or near the sea bed, also known as the benthic zone. As no light is available at this zone of sea, the energy source for deep benthic ecosystems is often organic matter from higher up in the water column which drifts down to the depths. This dead and decaying matter sustains the benthic organisms, and therefore, most organisms in benthic zone, *i.e.*, in deep oceanic waters, are scavengers or detritivores.

28. (a) : Herbivores are eaten by primary carnivores. Only 10% of the herbivores productivity is utilized for raising productivity of primary carnivores. The rest is consumed in ingestion, respiration, maintenance of body heat and other activities. Higher carnivores similarly are able to retain only 10% of energy present in primary carnivores. It is called 10% law which was proposed by Lindemann. Accordingly, if plant trapped 20 J of energy, mice will have 2 J, snake will have 0.2 J and hence, peacock will have 0.02 J of energy.

29. (a) : Primary consumers are herbivorous organisms that feed on producers. Carnivores are termed secondary, tertiary, etc., consumers depending upon their position in food chain. In food chain on land, grasshopper is a herbivore (primary consumer) while wolf and lion are carnivores. Phytoplanktons are producers in aquatic food chains.

30. (a) : The transfer of food energy from producers to consumers through a series of organisms with repeated eating and being eaten is known as food chain. Green plants are always the first link of food chain because they alone are capable of synthesising organic food by using light energy by photosynthesis. The logical sequence of a food chain is :

Producer → Consumers → Decomposer

Small plants	→	Zooplanktons	→	Fish	→	Man
(Primary producer)		(Primary consumer)		(Secondary consumer)		(Tertiary consumer)

31. (c) **32. (a)**

33. (c) : The source of energy in all ecosystem is solar energy. About 50% of the solar energy incident over earth is present in PAR (Photosynthetically active radiation). About 1–5% of incident solar radiation or 2 – 10% of PAR is captured by the photosynthetic organisms in the synthesis of organic matter (gross primary productivity). Roughly 20% of it is consumed in respiration so that net capture of energy (net primary productivity) is 0.8 – 4% of incident radiation or 1.6 – 8% of PAR.

34. (a) : Sparrow can be herbivorous (eating seeds and fruits) or carnivorous (eating insects).

35. (a) : A single species may occupy more than one trophic level. In pond, fish occupy more than one trophic level. Small fishes act as secondary consumer. They feed on primary consumer. Large fishes act as tertiary consumer. They feed on smaller fish.

36. (c) : Removal of 80% tigers (*i.e.*, tertiary consumer) from an area resulted in decreased growth of vegetation because there will be increased numbers of primary consumers which feeds on green plant. Removal of most of the carnivores resulted in an increased population of deers on which carnivores depends. The length of food chain is generally limited to 3-4 trophic level due to energy loss because all the food available at one level is neither eaten nor used by animals at the next level and a lot of the energy is lost in respiration to drive the organisms metabolism, so less energy is left to support higher trophic level.

37. (a) : Trophic structure of ecosystem is a type of producer-consumer arrangement, in which each food level is called trophic level and the graphical representation of trophic structure of ecosystem constitutes ecological pyramids. The green plants are producers and represent the first trophic level (T_1). So bamboo plant is the first trophic level (T_1).

38. (c) : The benthic region includes all the sea floor from the wave-washed shore-line to the greatest depths. Depending upon the penetration of light it is subdivided into two main zones : the lighted or littoral zone and the deep sea system. Due to abundance of light, water, oxygen, carbon dioxide and less salinity of water, the tidal zone is characterized by exhorbitant growth of plants. The dense growth of vegetation, on the other hand, provides shelter and food for animals. A wide variety of algae, few grasses and animals of every phylum of animal kingdom are represented in this region.

39. (a) : Herbivores are eaten by primary carnivores. Only 10% of the herbivores productivity is utilized for raising productivity of primary carnivores. The rest is consumed in ingestion, respiration, maintenance of body heat and other activities. Higher carnivores similarly are able to retain only 10% of energy present in primary carnivores. It is called 10% law which was proposed by Lindemann. Accordingly, if plant trapped 20 J of energy, mice will have 2 J, snake will have 0.2 J and hence, peacock will have 0.02 J of energy.

40. (c) : In a terrestrial ecosystem maximum energy is in trophic level I because the organisms which trap solar energy are primary producers and they have got

maximum energy. Only 10% energy is transferred from one trophic level to next trophic level.

41. (a) **42. (b)**

43. (b) : Trophic level is a step or division of food chain which is characterized by the method of obtaining its food. The two fundamental trophic levels are producers and consumers. Producers belong to the first trophic level. In a lake the producers are mainly some rooted or floating plants and phytoplanktons.

Primary consumers form the second trophic level. They feed on living plants or plant parts. The primary consumers are zooplanktons.

44. (b) : The dead organic matter of plants or animals is called as detritus. While a part of it remains on the soil surface as litter, the other part enters the soil. Many animals such as protozoans, nematodes, insects, etc., depend on detritus and hence they are called as detritivores. Even the human beings are detritivores when they eat cooked food. From detritus, the chain proceeds to detritivores, then to carnivores and finally to top carnivores.

45. (c) : The process of transfer of energy from producers through a series of organisms, *i.e.*, from primary consumers to secondary consumers and from secondary consumers to tertiary consumers by process of eating and being eaten constitute a food chain. The correct food chain is :

Phytoplankton → Zooplankton → Fish

46. (a) : Planktons are passively floating in upper water, nektons are actively swimming while benthos lead sedentary life upon the sea bottom. Planktons are producers and are present in large number.

47. (c) : An ecosystem may be defined as a structural and functional unit of the biosphere comprising living organisms and their non-living environment that interact by means of food chains and chemical cycles resulting in energy flow, biotic diversity and material cycling to form a stable, self supporting system. The organisms in an ecosystem are classified into 3 main categories-producers, consumers and decomposers. The consumers utilise materials and energy stored by the producers. Decomposers obtain their food molecules from the organic materials of dead producers and consumers. In a true ecosystem, producers are more than consumers (herbivores and carnivores).

48. (a) : The behaviour of energy in ecosystem can be termed energy flow due to unidirectional flow of energy. Flow of energy is only in one direction *i.e.*, from solar radiation → producers → herbivores →carnivores.

This energy cannot pass in the reverse direction. There is decrease in the content and flow of energy with rise in trophic level.

49. (a)

50. (a) : Pyramid of biomass in an aquatic ecosystem (*e.g.*, pond, sea) is usually inverted because the biomass of fishes exceeds the biomass of phytoplanktons.

51. (a) : The given data depicts the inverted pyramid of biomass, usually found in aquatic ecosystem. This can be understood by taking an example of a pond in which phytoplankton (10g) represents the producer. Small fishes (60g) feeding upon these phytoplankton represent primary consumers which are further eaten by the big fishes (120g) representing secondary consumers.

52. (d) **53. (a)**

54. (b) : In forest, a single tree can support a large number of birds thus base showing producers in a pyramid of number will be narrower than the next slab showing primary consumers. Hence an upright pyramid of number is not formed in a forest ecosystem.

55. (c) : Pyramid of energy is always upright, can never be inverted, because when energy flows from a particular trophic level to the next trophic level, some energy is always lost as heat at each step.

56. (b,d)

57. (a) : Ecological pyramids may be of three general types : pyramid of number, pyramid of biomass and pyramid of energy. Pyramid of number is graphic representation of number of individuals per unit area of various trophic levels stepwise with producers being trophic levels stepwise with producers being kept at the base and top Carniveres at the tip. The kept at the base and top carnivers at the tip. The total amount of dry weight of living or organise matter in an ecosystem at any time is called biomass. The pyramid of biomass indicates the decrease or the gradual reduction in biomass at each trophic levels from base to apex. Fresh weight is not used in ecological pyramids. Pyramid of energy is the graphic representation of amount of energy trapped per unit time and area indifferent trophic levels of a food chain.

58. (c) : Pyramid of numbers is an ecological pyramid which employs the number of individuals per unit area at various trophic levels sequence wise with producers at the base and various consumers at successively higher levels. Pyramid of number assumes different shapes in different ecosystems. The pyramid of number in pond ecosystem is also upright. In forest ecosystem the pyramid of number is intermediate. Here, the number of primary consumers is more than producers as well as top consumers. In parasitic food chain the pyramid of number is inverted.

59. (c)

60. (c) : The bare rocky habitat is extremely hostile to living beings. There is no water, as the substratum does not absorb rain water. There is no nutrient holding mechanism. Plants cannot grow on these rocks. The first inhabitants or pioneers of such a habitat are usually lichens as they are resistant to desiccation and extreme temperature.

61. (c) : Biotic or ecological succession is the natural development of a series of biotic communities at the same site, one after the other till a climax community develops which does not change further because it is in perfect harmony with the environment of the area. The change is orderly and sequential. There is a parallel change in the physical environment.
During an ecological succession, the number and types of animals goes on increasing with time.
The community that is in near equilibrium with the environment is called climax community. The establishment of a new biotic community is slow in its primary phase but gradually becomes fast in its secondary phase.

62. (d) : Secondary succession (subsere) is the biotic succession that occurs in an area which become secondarily bare due to the destruction of community previously present there. Secondary succession starts from previously built up substrata with already existing living matter. The action of any external force, such as a sudden change in climatic factors, biotic intervention, fire, etc., had resulted in the destruction of previous community. Thus, area became devoid of living matter but its substratum, is built up. It has organic matter, so is biologically fertile and thus the successions are comparatively more rapid.

63. (d) : Series of biotic communities that develop one after the other in a newly formed pond or lake is called hydrosere. It starts as soon as the muddy water becomes clear. The pioneer stage of hydrosere is plankton stage. Death and decomposition of planktons in the first seral stage of hydrosere produces organic matter which mixes up with clay and silt at the bottom to form soft mud which is favourable for growth of submerged hydrophytes in the next seral stage. Hence, the second stage of hydrosere is occupied by submerged hydrophytes like *Vallisneria*.

64. (b) : Secondary succession begins in areas where natural biotic communities have been destroyed such as in abandoned farm lands, burned or cut forests (deforested site), lands that have been flooded, etc.

65. (a) : Hydrarch succession takes place in wetter areas and the successional series progress from hydric to the mesic condition . Xerarch succession takes place in dry areas and the series progress from xeric to mesic condition. Hence, both hydrarch and xerarch succession leads to medium water conditions (mesic).

66. (a) : Hydrosere,originating in water (pond, pools, lakes, etc.) and starts with the colonization of some phytoplanktons which form the pioneer plant community, and finally terminates into a forest, which is a climax community together with their chief components of vegetation.
The various stages together with their components of plant species of a hydrosere are phytoplankton stage,rooted submerged stage,rooted floating stage, reed swamp stage, marsh or sedge meadow stage, woodland stage and climax forest stage. *Volvox* is phytoplankton, *Hydrilla* is rooted submerged plant, *Pistia* is rooted floating plant, *Scirpus* is reed swamp plant, *Lantana* is sedge meadow plant and oak is woody tree.

67. (a) : Stability can be defined as the power of a system to be in their state against unfavourable factors and resilience is the capability of regaining its original shape or position after being deformed.

68. (b) : When succession begins on an area which has not been previously being occupied by a community, *e.g.*, a new exposed rock area, sand dunes, new islands, deltas, shore or recent lava flow, it is known as primary succession. The first group of organisms (plants or animals) which become established in such an area is termed the pioneer community.

69. (c) : Biogeochemical cycles are of two types: gaseous and sedimentary. In gaseous nutrient cycles, the materials involved in circulation between biotic and abiotic components of biosphere are gases or vapours and the reservoir pool is atmosphere or hydrosphere, *e.g.*, carbon, hydrogen, oxygen, nitrogen, water. In sedimentary nutrient cycles, materials involved in circulation between biotic and abiotic components of biosphere are non-gaseous and the reservoir pool is lithosphere, *e.g.*, phosphorus, calcium, magnesium. Sulphur has both sedimentary and gaseous nutrient cycles.

70. (c)

71. (a) : The reservoir pool of phosphorus is in phosphate rocks while the cycling pool is soil and water for terrestrial and aquatic ecosystems respectively. Small amount of phosphate is always being added to the cycling pool through weathering of rocks. Phosphate is generally found in soil in combination with calcium, iron and aluminium. Atmosphere or gaseous cycle is absent. Phosphate circulates in the abiotic environment in lithosphere as well as hydrosphere.

72. (b) : *Refer to answer 69.*

73. (a) : Carbon constitutes 49% of dry weight of organism and is next only to water. Among the total quantity of global carbon 71% is found in oceans in dissolved form whereas only 1% is found in atmosphere. Carbon cycling occurs through atmosphere, ocean and living or dead organism.

74. (b) : *Refer to answer 69.*

75. (d)

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