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For
Undergraduate Students (B.Sc. Zoology)

Prepared by

DR. BRAJ KISHOR GUPTA

Assistant Professor,
Department of Zoology
Indira Gandhi Govt. PG College, Bangarmau, Unnao.
(CSJM University, Kanpur, UP)

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Ecology

The essence of biological understanding is to know how organisms, while remaining an individual, interact with other organisms and physical habitats as a group and hence behave like organized wholes, i.e., population, community, ecosystem or even as the whole biosphere. Ecology explains to us all this. Ramdeo Misra is known as the Father of Ecology in India. Born on 26 August 1908, various levels of biological organisation—macromolecules, cells, tissues, organs, individual organisms, population, communities and ecosystems and biomes.

Ecology is a subject which studies the interactions among organisms and between the organism and its physical (abiotic) environment. Ecology is basically concerned with four levels of biological organisation – organisms, populations, communities and biomes. At the organismic level is essentially physiological ecology which tries to understand how different organisms are adapted to their environments in terms of not only survival but also reproduction. the physico-chemical (abiotic) components alone do not characterize the habitat of an organism completely; the habitat includes biotic components also – pathogens, parasites, predators and competitors of the organism with which they interacts constantly. Ecology is the study of the relationships of living organisms with the abiotic (physico-chemical factors) and biotic components (other species) of their environment.

The word ecology is derived from the Greek word Oikos, meaning household/habitat and logos, meaning study. So the study of environmental habitat and the functional aspects of organisms that make them for survive in it is ecology.

History of Ecology

The word ecology is first proposed by the German biologist Ernst Haeckel in 1869. In the early 1700s Antony Van Leeuwenhoek performed study of food chains and population regulations. English botanist Richard Bradley studied on biological productivity.

Levels of biological organization: It is concerned with four levels of biological organization-

1. Organisms,
2. Populations
3. Communities and
4. Biomes.

Ecological studies are based on the environmental habitat, taxonomic group and levels of biological organization. Based on ecological units as individual or group of organisms, the ecological levels of organization is divided into two major groups..

1. Autoecology
2. Synecology

1. Autoecology: It is also called ecology of individual. In this group of ecology the interactions between individuals and its surrounding environment is studied. In other words how an organism or a particular species interacts with its natural environment. For example: The influence of the change in temperature of the surrounding environment can highly affect life cycle and developmental stages of individuals of a species. The hatching of eggs of lizards, crocodiles and several other reptiles is determined by the temperature of surrounding environment at the time of hatching.

The other example includes the adaptation of organism to higher altitudes. At higher altitudes, due to less availability of oxygen and high pressure, the individual adapt to it by developing higher number of RBCs. So that RBCs can effectively and with high affinity bind to the oxygen molecules though hemoglobin. While the individuals living in low altitudes where oxygen is sufficient, are susceptible to sudden change in oxygen levels and pressure.

Ecosystem : Structure and Function

An ecosystem is a structural and functional unit of nature where living organisms (biotic components) interact with the physical environment (abiotic components) as a system. The term ecosystem was coined by A.G. Tansley (1935). Ecosystems may be small (pond) or large (forest, ocean, biosphere). An ecosystem is a self-sustaining unit consisting of a community of living organisms and their non-living environment interacting through energy flow and nutrient cycling.

Components of an Ecosystem

Ecosystem components are broadly divided into Abiotic and Biotic components.

A. Abiotic Components

These are non-living physical and chemical factors:

1. Light
2. Temperature
3. Water
4. Air
5. Soil
6. Minerals and nutrients (N, P, C, etc.)
7. pH and humidity

B. Biotic Components

These include all living organisms and are classified into:

1. Producers (Autotrophs)

- Green plants, algae, phytoplankton
- Prepare food by photosynthesis
- Form the base of the food chain

2. Consumers (Heterotrophs)

- Primary consumers – Herbivores (deer, rabbit)
- Secondary consumers – Carnivores (frog, lizard)
- Tertiary consumers – Top carnivores (lion, eagle)

3. Decomposers

- ✓ Bacteria and fungi
- ✓ Break down dead organic matter
- ✓ Recycle nutrients back to the environment

4. Types of Ecosystems

A. Natural Ecosystems

- A. Terrestrial ecosystems
 - B. Forest
 - C. Grassland
 - D. Desert
- E. Aquatic ecosystems
 - F. Freshwater (pond, lake, river)
 - G. Marine (sea, ocean)

B. Artificial Ecosystems

- A. Crop fields
- B. Garden
- C. Aquarium

D. Urban ecosystems

5. Structure of an Ecosystem

- ✓ The structure of an ecosystem includes:
- ✓ Species composition
- ✓ Trophic levels
- ✓ Food chains and food webs
- ✓ Standing crop and standing state

Trophic Levels: Each feeding level in a food chain is called a trophic level:

- Producers
- Primary consumers
- Secondary consumers
- Tertiary consumers

6. Energy Flow in an Ecosystem

- Energy enters the ecosystem through sunlight
- Flows unidirectionally from producers to consumers
- Follows Lindeman's 10% Law:
- Only 10% of energy is transferred from one trophic level to the next
- Energy flow occurs through:
- Food chains
- Food webs

7. Food Chain and Food Web

Food Chain: A linear sequence of organisms where energy is transferred.

Example: Grass → Deer → Lion

Food Web: A complex network of interconnected food chains that provides ecosystem stability.

8. Ecological Pyramids: Graphical representation of trophic levels.

Types of Ecological Pyramids

1. Pyramid of Numbers
2. Pyramid of Biomass
3. Pyramid of Energy (always upright)

9. Nutrient Cycling (Biogeochemical Cycles)

Nutrients circulate between biotic and abiotic components.

Major Cycles

- A. Carbon cycle
- B. Nitrogen cycle
- C. Phosphorus cycle
- D. Water cycle

These cycles maintain ecosystem balance and productivity.

10. Functions of an Ecosystem

- ✓ Primary production
- ✓ Energy flow
- ✓ Nutrient cycling
- ✓ Decomposition
- ✓ Regulation of climate
- ✓ Maintenance of biodiversity

11. Importance of Ecosystem

1. Supports life on Earth
2. Provides food, oxygen, and shelter
3. Maintains environmental balance
4. Offers ecosystem services (pollination, soil fertility, water purification)

An ecosystem is the fundamental unit of ecology that integrates living organisms with their environment. Understanding ecosystem structure and function is essential for biodiversity conservation and sustainable development.

MCQs: Ecosystem

1. The term “ecosystem” was coined by

- a) Odum
- b) Darwin
- c) **Tansley**
- d) Haeckel

Answer: c) Tansley

2. An ecosystem is best defined as

- a) A group of plants in an area
- b) A biological community only
- c) **Interaction between living organisms and their environment**
- d) A population of animals

Answer: c) Interaction between living organisms and their environment

3. Which of the following is an abiotic component of an ecosystem?

- a) Bacteria
- b) Fungi
- c) Plants
- d) **Temperature**

Answer: d) Temperature

4. Primary producers in an ecosystem are

- a) Herbivores
- b) Carnivores
- c) **Green plants**
- d) Decomposers

Answer: c) Green plants

5. Which organisms are called decomposers?

- a) Algae
- b) Herbivores
- c) Carnivores
- d) **Bacteria and fungi**

Answer: d) Bacteria and fungi

6. Energy in an ecosystem flows

- a) Cyclically
- b) Randomly
- c) **Unidirectionally**
- d) Bidirectionally

Answer: c) Unidirectionally

7. According to Lindeman's law, the percentage of energy transferred from one trophic level to the next is

- a) 1%
- b) 5%
- c) **10%**
- d) 50%

Answer: c) 10%

8. Which of the following is always upright?

- a) Pyramid of numbers
- b) Pyramid of biomass
- c) **Pyramid of energy**
- d) Pyramid of consumers

Answer: c) Pyramid of energy

9. A food web is

- a) A linear feeding relationship
- b) **A network of interconnected food chains**
- c) A pyramid of energy
- d) A nutrient cycle

Answer: b) A network of interconnected food chains

10. Which ecosystem is an artificial ecosystem?

- a) Forest
- b) Pond
- c) Grassland
- d) **Aquarium**

Answer: d) Aquarium

11. In a grazing food chain, the first trophic level is occupied by

- a) Herbivores
- b) Carnivores
- c) **Producers**
- d) Decomposers

Answer: c) Producers

12. Which biogeochemical cycle does NOT have a gaseous phase?

- a) Carbon cycle
- b) Nitrogen cycle
- c) Oxygen cycle
- d) **Phosphorus cycle**

Answer: d) Phosphorus cycle

13. Standing crop refers to

- a) Energy flow
- b) **Amount of living matter at a given time**
- c) Nutrient storage
- d) Rate of decomposition

Answer: b) Amount of living matter at a given time

14. Which trophic level has the maximum energy?

- a) Primary consumers
- b) Secondary consumers
- c) Tertiary consumers
- d) **Producers**

Answer: d) Producers

15. Which of the following is a freshwater ecosystem?

- a) Ocean
- b) Sea
- c) **Lake**
- d) Estuary

Answer: c) Lake

16. The role of decomposers in an ecosystem is to

- a) Produce food
- b) Store energy
- c) **Recycle nutrients**
- d) Transfer energy to producers

Answer: c) Recycle nutrients

17. Which of the following regulates climate and supports biodiversity?

- a) Population
- b) Community
- c) **Ecosystem**
- d) Species

Answer: c) Ecosystem

18. The top carnivores in a food chain are called

- a) Producers
- b) Primary consumers
- c) Secondary consumers
- d) **Tertiary consumers**

Answer: d) Tertiary consumers

19. Which ecosystem has the highest productivity?

- a) Desert
- b) Grassland
- c) **Tropical rainforest**
- d) Tundra

Answer: c) Tropical rainforest

20. The ultimate source of energy in most ecosystems is

- a) Wind
- b) Water
- c) Food
- d) **Sun**

Answer: d) Sun
