CHAPTER

8 Ecosystem

INTRODUCTION

- Ecosystem is a functional unit of nature.
- Forest, grassland and desert are **terrestrial ecosystems**.
- Pond, lake, wetland, river and estuary are **aquatic**.
- Crop fields and an aquarium are **man-made ecosystems**.

ECOSYSTEM - STRUCTURE

- **Stratification:** Vertical distribution of different species occupying different levels, like trees at top vertical strata, shrubs second and herbs and grasses occupy bottom layers.

ECOSYSTEM - FUNCTIONS

Productivity

- **Primary production:** Amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.
- Expressed in terms of weight (gm^{-2}) or energy (K cal m^{-2}).
- Rate of biomass production is productivity, expressed as gm^{-2} yr^{-1} or (K cal m^{-2}) yr^{-1}. It can be divided into:
  - (*i*) **Gross primary productivity (GPP):** Rate of production of organic matter during photosynthesis.
  - (*ii*) **Net primary productivity (NPP):** Available biomass for the consumption to heterotrophs (herbivores and decomposers).

NPP = GPP - R (respiratory loss)

- Varies in different ecosystems:
  - Annual net primary productivity of whole biosphere is approximately = **170 billion tons** (dry wt.) of organic matter.
  - Productivity of oceans (70% of surface) = **55 billion tons**, rest is on land.
- **Secondary productivity:** Rate of formation of new organic matter by consumers.

DECOMPOSITION

- Breakdown of complex organic matter into inorganic substances like CO_2, water and nutrients.
- **Raw material:** Detritus, i.e., dead plant remains like leaves, bark, flowers and dead remains of animals, including fecal matter.

Table 1: Process of decomposition of detritus

DECOMPOSITION	
Fragmentation	Break down of detritus into smaller particles by detritivores (e.g., earthworm).
Leaching	Water soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
Catabolism	Bacterial and fungal enzymes degrade detritus into simpler inorganic substances.
Humification	Accumulation of dark, amorphous humus which is highly resistant to microbial action. Humus undergoes decomposition at an extremely slow rate in soil.
Mineralisation	Humus is further degraded by microbes to release inorganic nutrients.

ENERGY FLOW

- **Unidirectional** from sun to producers and then to consumers.

TROPHIC LEVELS IN AN ECOSYSTEM

- Amount of energy decreases at successive trophic levels.
- Only 10% of the energy is transferred to each trophic level from the lower trophic level (10% Law of energy transfer).

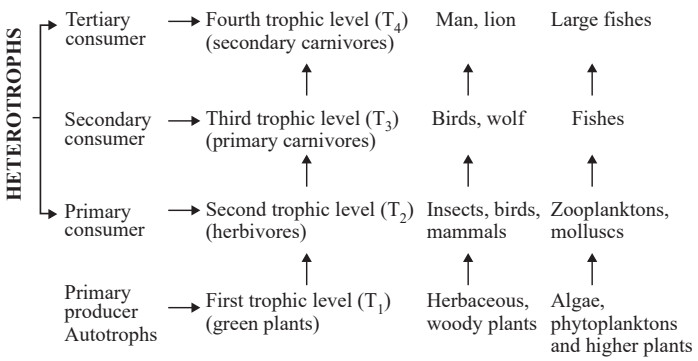

Table 2: Comparison of DFC and GFC

DETRITUS FOOD CHAIN	GRAZING FOOD CHAIN
❍ Begins with dead organic matter. ❍ Made up of decomposers which are **heterotrophic organisms**, mainly fungi and bacteria. ❍ Present in a terrestrial ecosystem.	❍ Sun is the source of energy. ❍ Autotrophs assimilate food using simple inorganic materials and radiant solar energy. ❍ The energy flows from autotrophs to heterotrophs as per the law of thermodynamics. ❍ Present in an aquatic ecosystem.

ECOLOGICAL PYRAMIDS

- Food or energy relationship between organisms at different trophic levels is expressed in terms of **number**, **biomass** or **energy**.
- Three types of ecological pyramids are usually studied: (*a*) pyramid of number (*b*) pyramid of biomass (*c*) pyramid of energy.
- Pyramid of energy is **always upright**.
- It assumes a simple food chain that never exists in nature. It does not accommodate a food web.
- Saprophytes are not given any place in ecological pyramids even though they play a vital role in the ecosystem.

Pyramid of Number

- Upright in most ecosystems.
- Inverted in tree ecosystem

Pyramid of Biomass

- usually upright.
- Inverted in sea ecosystem

ECOLOGICAL SUCCESSION

- **Ecological succession:** Gradual and fairly predictable change in the species composition of a given area.
- **Primary succession:** Starts in an area where no living organisms ever existed, like on bare rock, newly cooled larva, newly created pond or reservoir, so it is slow and can take several hundred to thousand years.
- **Secondary succession:** Takes place in areas that somehow lost all the living organisms that existed there, like abandoned farm lands, burned or cut forests, lands that have been flooded. Since some soil or sediment is present, succession is **faster** than primary succession. Climax reached more quickly.
- The species that invade a bare area are called **pioneer species**.
- After several more stages, ultimately a **stable climax forest** community is formed.
- Both hydrach and xerarch lead to medium water condition (mesic).

NUTRIENT CYCLING

- Nutrients which are never lost from the ecosystems, they are recycled time and again indefinitely, it is called **biogeochemical cycles** (**bio**-living organism, **geo**-rocks, air, water).
- **Two types:**
  (*a*) Gaseous (e.g., Nitrogen, carbon cycle)
  (*b*) Sedimentary (e.g., Sulphur, phosphorus cycle)

ECOSYSTEM SERVICES

- Robert Constanza tried to put price tags of average **US $33 trillion** a year for these ecosystem services, which is largely taken for granted, because they are free. This is nearly twice the value of global GNP of **US $18 trillion**.
- Out of the total cost soil formation accounts for about 50%, recreation and nutrient cycling less than 10% each and climate regulation and habitat for wildlife 6% each.