ECOLOGY

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Introduction

- Greek word “Oikos” meaning “home” and “logos” meaning “study”
- Ecology: The study of organisms in their natural habitat interacting with their surroundings
- Ecosystem: A self-regulating group of biotic communities of species interacting with one another and with their non-living environment exchanging energy and matter

Classification

- Classification of ecosystem
  - Natural ecosystem
    - Aquatic
      - Fresh water
        - *Running water*
        - *Standing water*
      - Marine
    - Terrestrial
      - Grassland
      - Forest
      - Desert
  - Artificial / Engineered ecosystem

Structural unit

- Abiotic
  - Physical
    - Climatic (Sunlight, temperature, humidity, rainfall, wind)
    - Edaphic (soil type, soil moisture, soil reaction)
    - Geographic (Latitude, longitude, Altitude)
  - Chemical
    - Major nutrients
    - Trace elements
    - Pollutants
    - Organic substances

Structural unit

- Biotic
  - Producers
    - Photo-autotrophs
    - Chemo-autotrophs (*Nitrosomonas*, Iron bacteria, Methanogens)
  - Consumers
    - Herbivores
    - Carnivores
    - Omnivores
    - Detritivores
  - Decomposers

Limiting Factors

- Factors which restrict the further growth of population
  - Availability of food
  - Water
  - Shelter
  - Space

Functional unit

- Food chain (sequence of eating and being eaten), food web, trophic structure
- Energy flow
- Cycling of nutrients

Food chain

- Grazing food chain
  - Grass → Rabbit → Fox
  - Algae → Water flea → Small fish → Big fish
- Detrius food chain
  - Dead organic matter → Fungi → Bacteria
- Food web: A network of food chain
- Significance of food chain
  - Energy flow
  - Nutrient cycles
  - Ecological balance (population size regulation)
  - Biomagnification

Ecological pyramids

- Pyramid of number

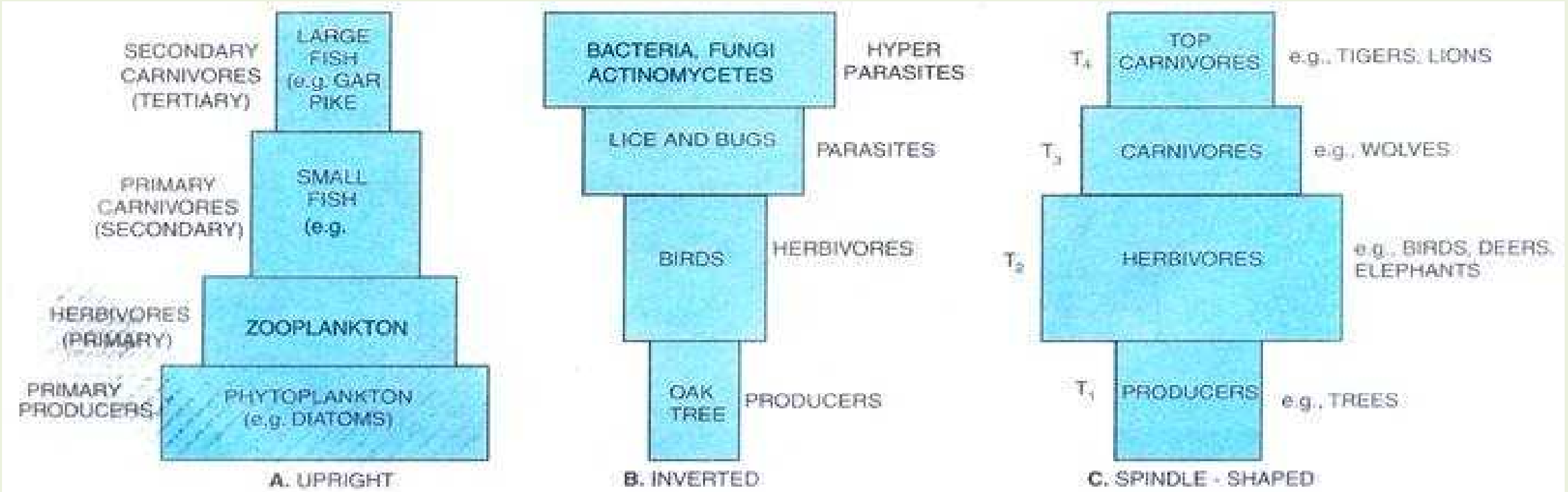
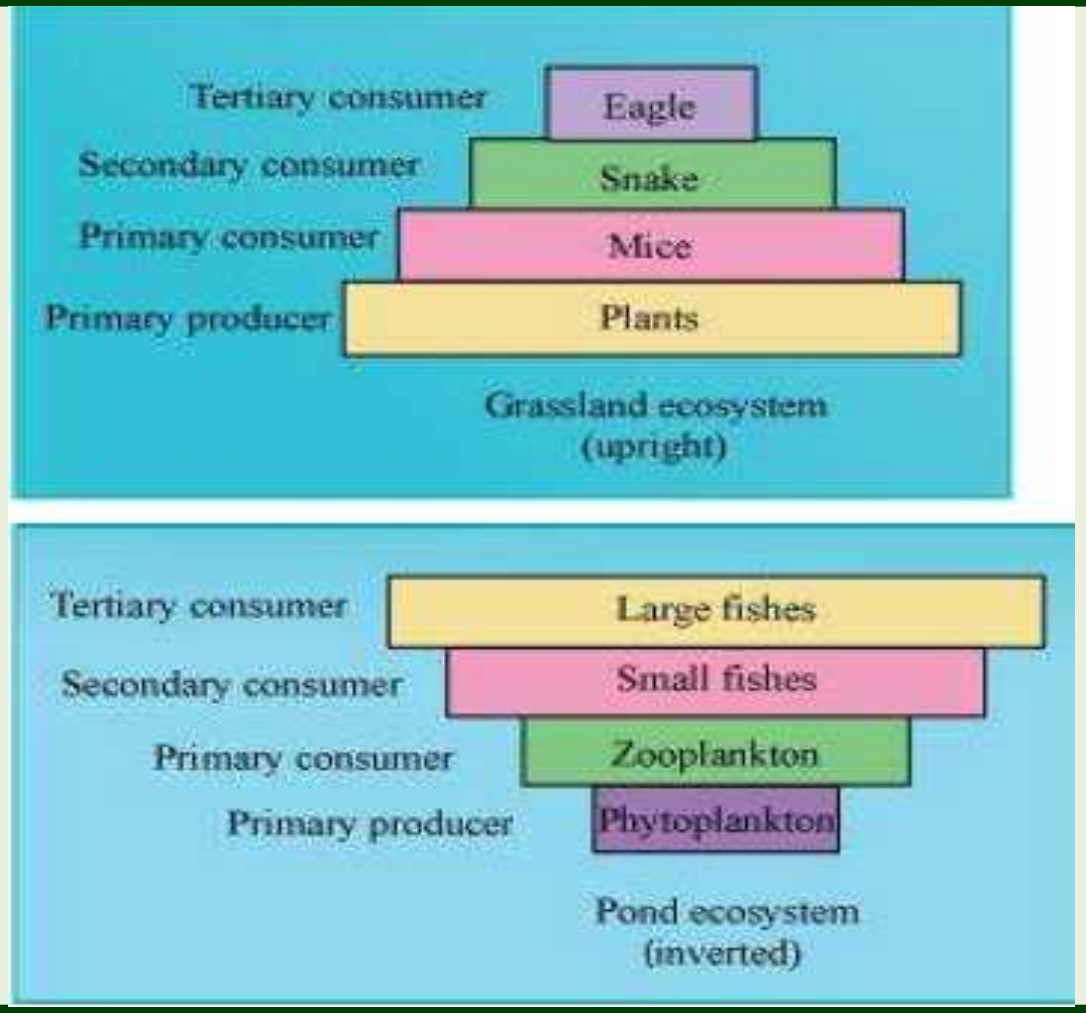


Fig. 14.15. Pyramids of numbers : A. In pond ecosystem; B. In parasitic food chain; C. Tree ecosystem.

Ecological pyramids

- Pyramid of biomass



Ecological pyramids

- Pyramid of energy

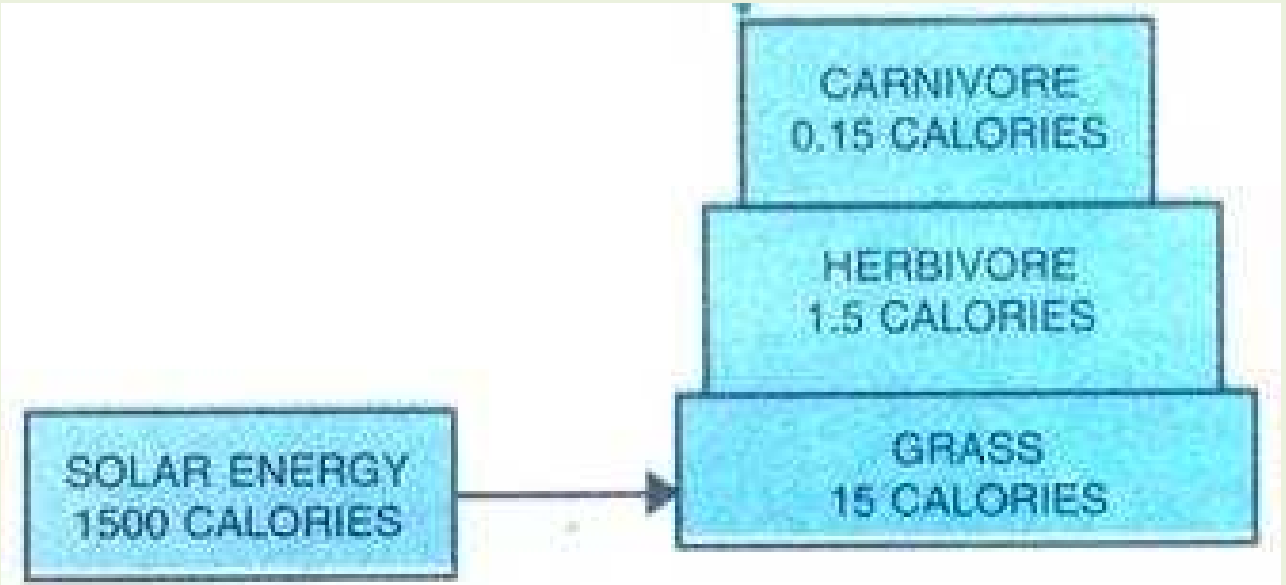


Fig. 14.18. Pyramid of energy.

Energy flow

- Universal energy flow model

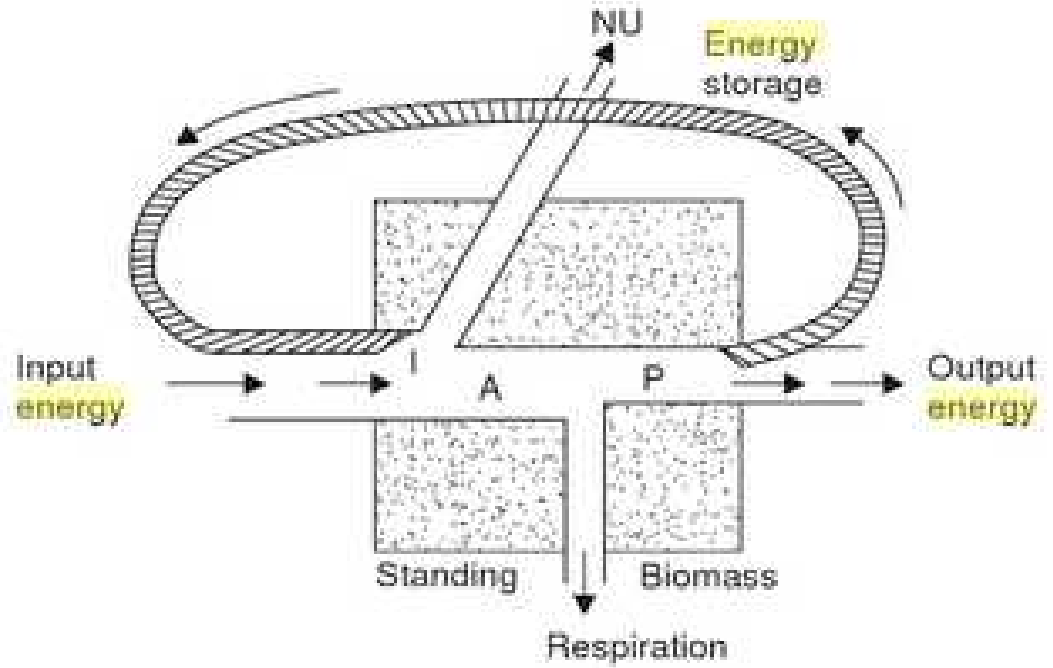


Fig. 3.8. Universal energy flow model applicable to all living components (I = Energy input; A : assimilated energy ; P = Production ; NU = Energy not used.

Energy flow

- Single channel energy flow model

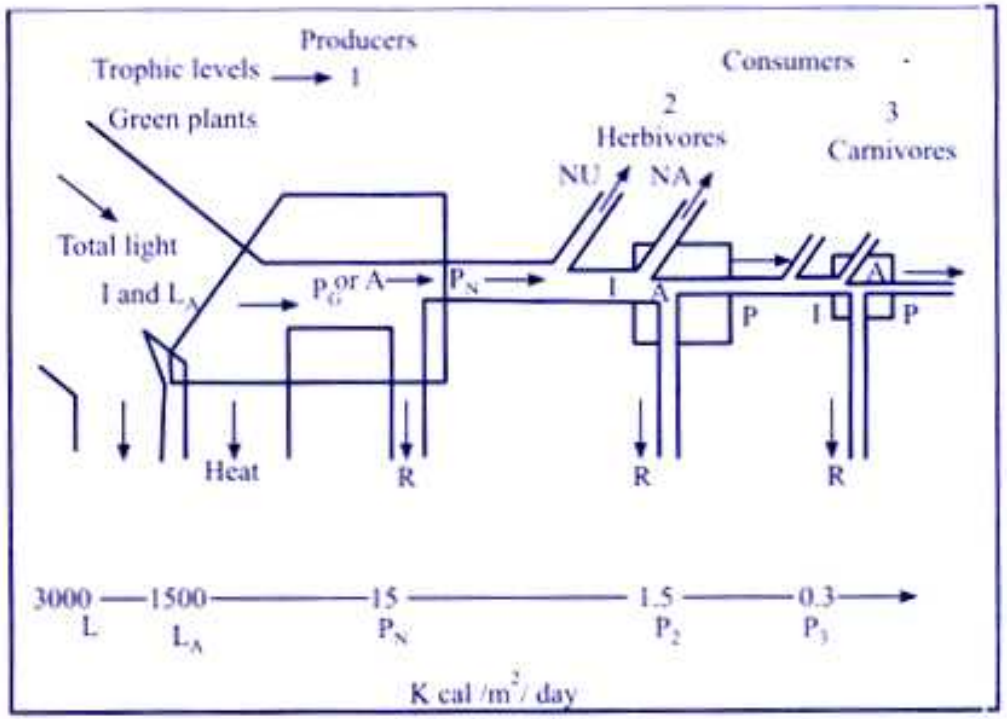


Fig. 1.4 A simplified energy flow diagram depicting three trophic levels

Energy flow

- Double channel or Y-shaped energy flow model

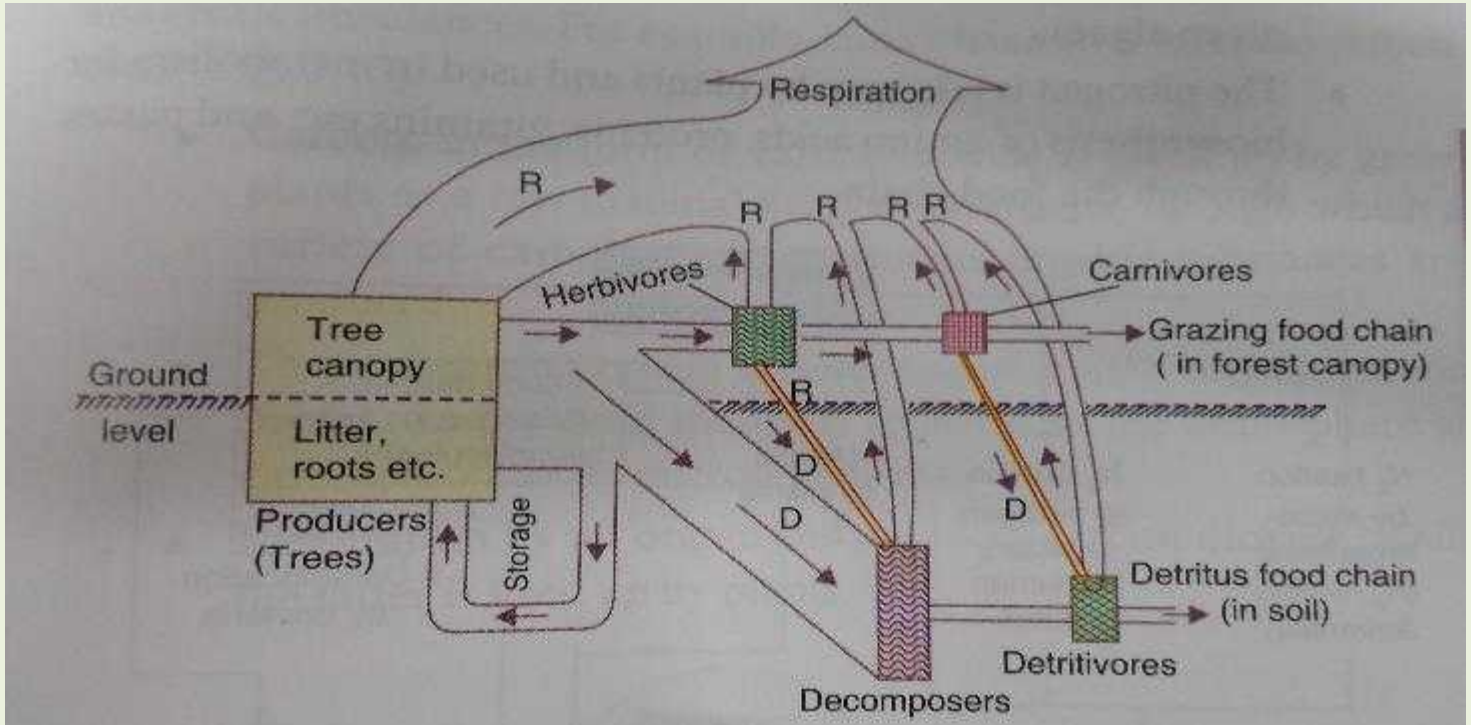
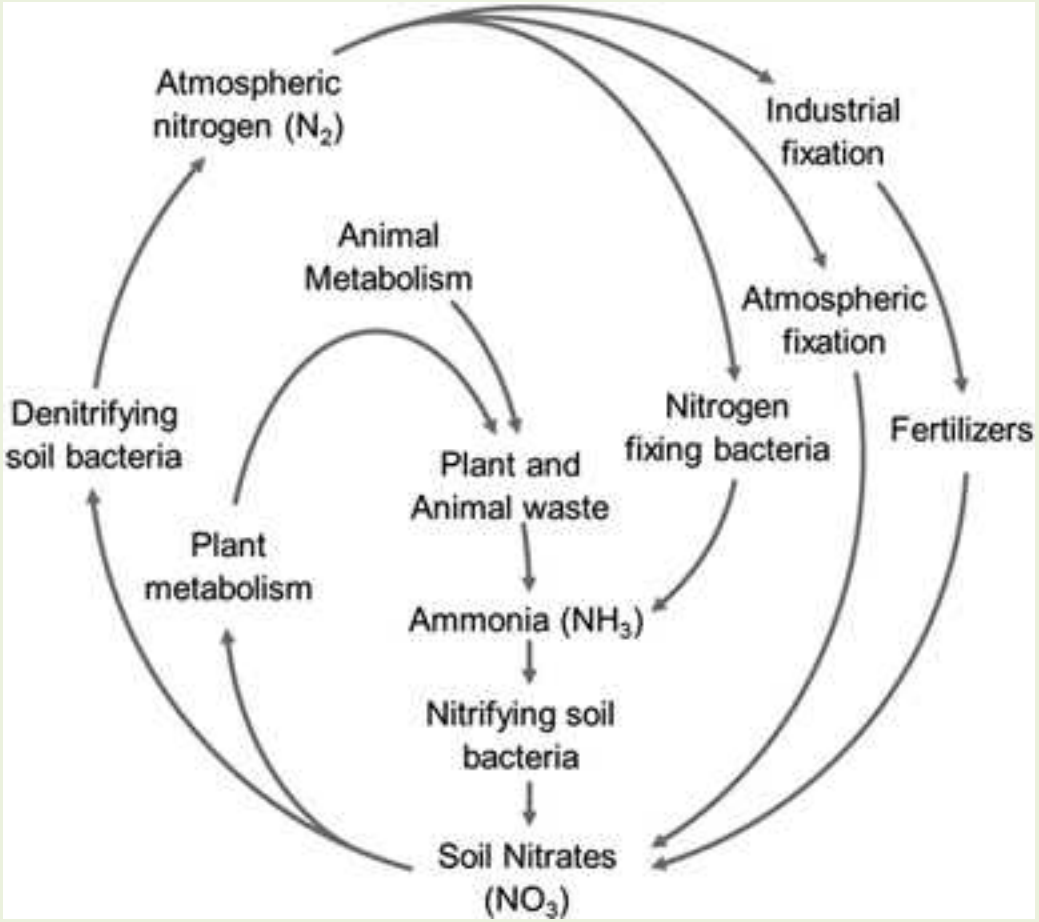


Fig. 3.13 Y-shaped or 2-channel energy flow model showing energy flow through the grazing food chain and the detritus food chain (R = Respiration, D = Detritus or dead matter).

Nutrient cycles

- Nitrogen



Nutrient cycles

- Carbon

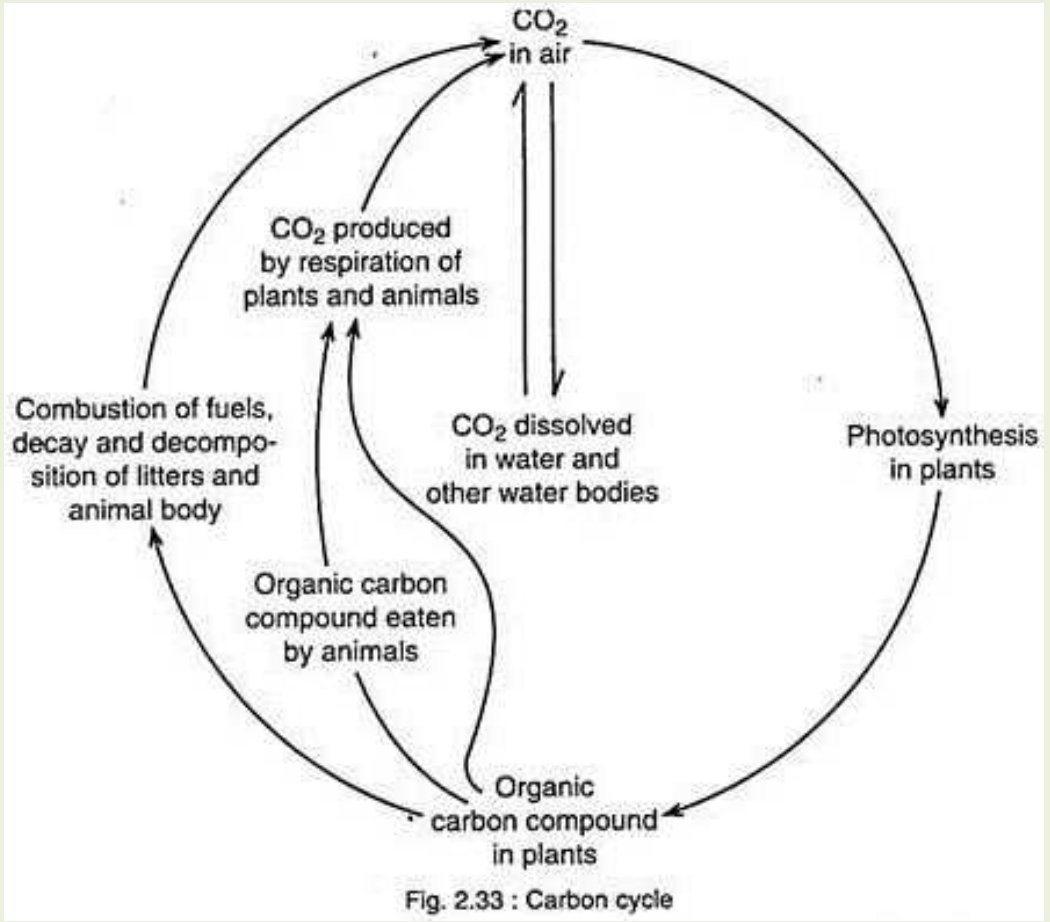
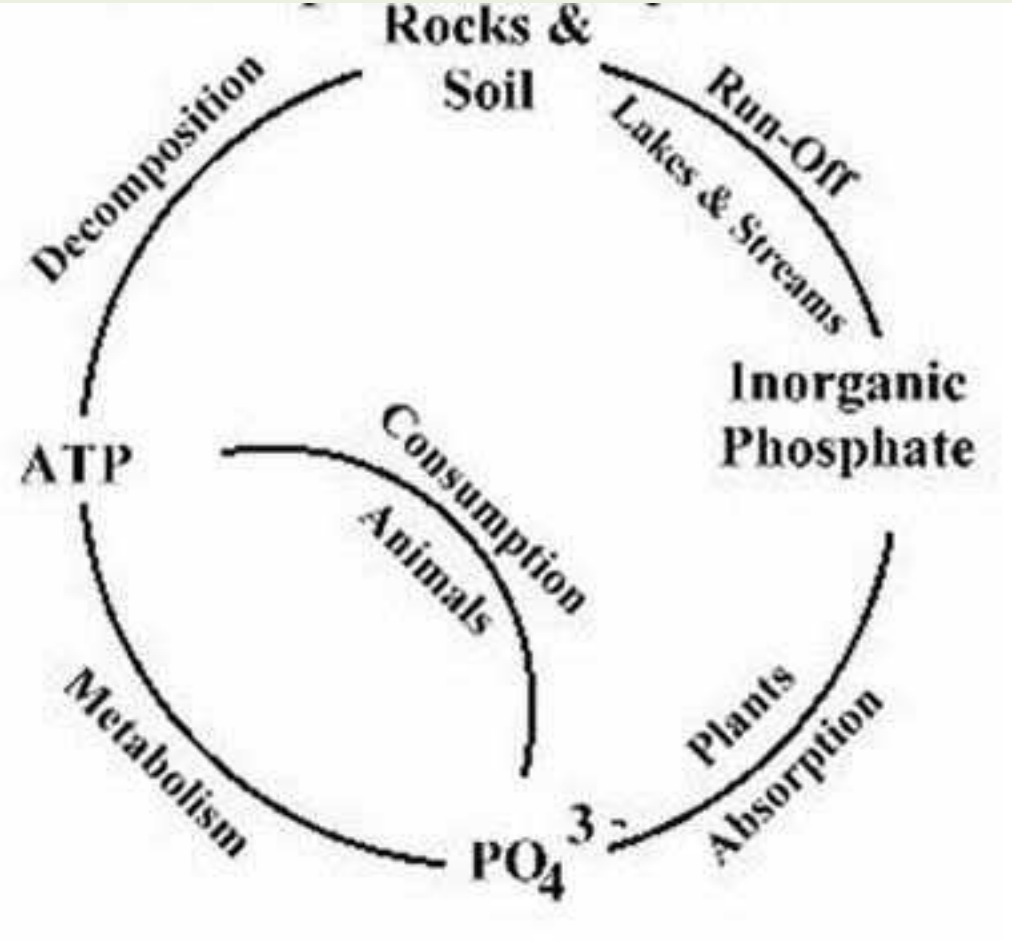


Fig. 2.33 : Carbon cycle

Nutrient cycles

- Phosphorus



Production of biomass

- Primary production
  - Biomass production using photosynthesis
- Secondary production
  - Biomass production by consuming producers

Homeostasis

- The ecosystem , by itself, tries to resist the change and maintain itself in equilibrium.
  - Positive feedback
  - Negative feedback

Succession

- Ecological succession is the gradual process by which ecosystems change and develop over time.
- It is therefore a series of predictable temporary communities or stages leading up to a climax community.
- Each stage/temporary community is called a successional stage or seral stage.
- Each step prepares the land for the next successional stage.
- All habitats are in the state of constant ecological succession.

- An established species and impact of external natural forces, which try to alter the environmental condition of that area. Ex. Hardwood tree replacing red pine
- Ecosystem is continuously changing and reorganizing as well as ecological succession refers to orderly that changes happening in composition or structure of ecosystem

Types of Succession

- Primary succession
  - Primary succession refers to a series of community changes which occur on an entirely new habitat which has never been colonized before. For example, a newly quarried rock face or sand dunes. (pioneer and climax community).
- Secondary succession
  - Secondary succession refers to a series of community changes which take place on a previously colonized, but disturbed or damaged habitat. For example, land obtained after felling trees in a woodland, land clearance, or fire.

Succession starting on different types of area

- Hydrarch / Hydrosere
  - Pond, swamp, bog
- Mesarch
  - Area with adequate moisture
- Xerarch / Xerosere
  - Lithosere: On bare rock
  - Psammosere: On sand
  - Halosere: On saline soil

Process of ecological succession

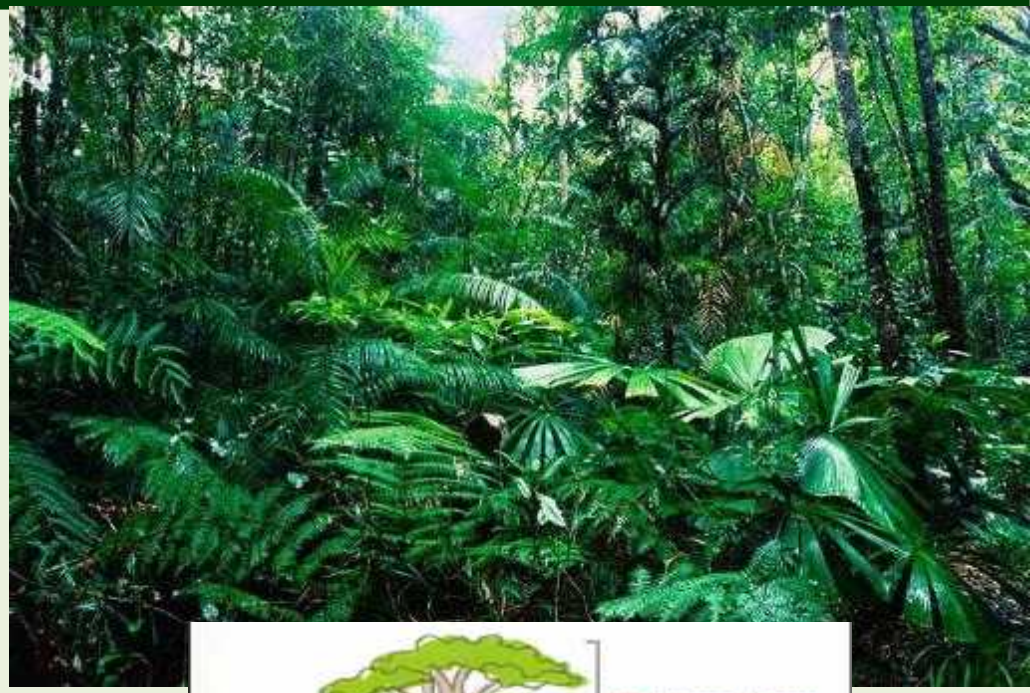
- Nudation
- Invasion
  - Migration (dispersal)
  - Ecesis (establishment)
  - Aggregation
- Competition
- Reaction
- Stabilization

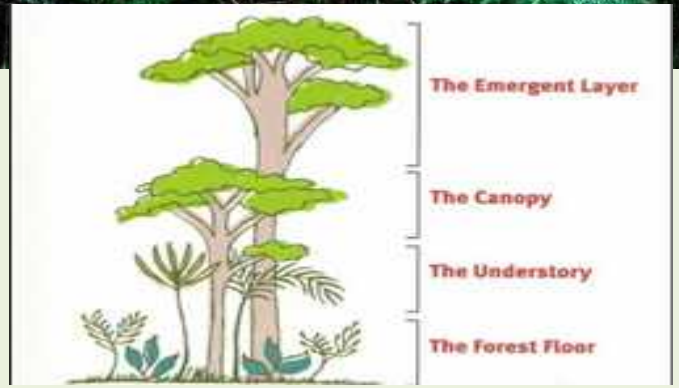
Forest ecosystem

- Abiotic Components
  - Inorganic and organic substances found in soil
  - Temperature, humidity, rainfall, light
  - Biogenic gases (CO_2, O_2)
- Biotic components
  - Producers: Large trees, herbs, lianas (climbers), Orchids
  - Primary consumer: Deer, Elephant, moles etc.
  - Secondary consumer: Snake, Lizards etc.
  - Tertiary consumers: Tiger, Lion etc.
  - Decomposers

Tropical rain forest

- Notable features:
  - Found in tropical region (near the equator).
  - High rainfall, humidity and temperature
  - Large leaves
  - Rich in biodiversity
  - Fauna of these rainforests includes the jaguar, tapir, okapi, boa constrictor, African grey parrot, keel-billed toucan, crowned eagle, three-toed sloth, spider monkey, large flying fox and more.
- Layers
  - Emergent layer
  - Canopy
  - Understory
  - Forest floor
- Example: Amazon Rainforest, Congo Rainforest, Southeast Asian Rainforest etc.





Tropical deciduous forest

- Notable features:
  - Tropical deciduous forests form a natural cover almost all over India.
  - They are of two types-moist and dry. Moist forests are found on the eastern slopes of Western Ghats, North eastern parts of the Peninsular Chhota Nagpur plateau and along the Shiwaliks.
  - They shed there leaves for a particular period of time.
  - They are economically very important because of timber like sal and teak.
  - The animals found here are tiger, wolves, rabbit etc.

Sub-tropical forest

- Notable features:
  - Subtropical forests are within or bordering the tropical zone.
  - temperatures may vary only slightly over a year
  - Subtropical rainforests occur in Central America, the West Indies, India, Madagascar, mainland Southeast Asia, and the Philippines.
  - Small deciduous trees and shrubs are found.

Temperate rain forest

- Notable features:
  - The world's largest temperate rain forests are found on the Pacific coast of North America.
  - Temperate rain forests are also found in coastal Chile, Norway, the United Kingdom, Japan, Australia and New Zealand.
  - The mild weather conditions
  - Adequate rainfall
  - Coniferous trees dominate the forest
  - tall evergreen trees are also found
  - Animals: black bears, lynx, wolves etc.

Temperate deciduous forest

- Notable features:
  - Located in the mid-latitude areas (between the polar regions and the tropics).
  - The temperature varies widely from season to season with cold winters and hot, wet summers.
  - During the fall, trees change color and then lose their leaves.
  - Most of the trees are broadleaf trees such as oak, maple, beech, hickory and chestnut.
  - Animals: toad, chipmunk, gray squirrel, Yellow-breasted chat etc.

Evergreen coniferous forest

- Notable features:
  - They are found just in south of arctic tundra
  - Winters are long, cold and dry
  - Sunlight is available for few hours only
  - Soil has less nutrient and acidic
  - Major trees are Pine, Fir, Cedar etc.
  - Animals: moose, deer, reindeer, squirrels, wolves, bears, foxes, owls, woodpeckers hawks etc.

Grassland ecosystem

- Abiotic components:
  - Inorganic elements (C, H, O, N, P, S)
  - Temperature, humidity, rainfall, light
- Biotic components:
  - Producers: Some scattered trees, Grass
  - Primary consumers: Grazing animals,

Tropical grassland

- Notable features:
  - Located near the equator, between the Tropic of Cancer and the Tropic of Capricorn.
  - Although these areas are overall very dry, they do have a season of heavy rain.
  - Dominated by grasses
  - May have some drought-resistant, fire-resistant trees
  - Animals: giraffes, zebras, buffaloes, kangaroos, mice, moles, gophers, ground squirrels, snakes, worms, termites, beetles, lions, leopards, hyenas, and elephants.
- Examples:
  - Savannas

Temperate grassland

- Notable features:
  - Trees and shrubs are completely absent or rare.
  - cold winters (-40°C) and hot summers (38°C)
  - Gentle slope
  - Animals: Rodents, bisons, wolves, hawks, owls etc.
- Examples:
  - Prairies (South America)
  - Pampas (Africa)
  - Velds (Central Europe)
  - Steppes (Asia)

Polar grassland

- Notable features:
  - Severe cold and strong wind
  - Arctic wolf, arctic fox, reindeer, migratory birds and insects are found.
- Examples:
  - Arctic Tundra
  - Permafrost: Permafrost is soil, rock or sediment that is frozen for more than two consecutive years. In areas not overlain by ice, it exists beneath a layer of soil, rock or sediment.

Desert ecosystem

- About 1/3rd of the worlds' land area is covered with desert
- Tropical desert
  - Notable features:
    - It is the driest and hottest place on earth.
    - Rainfall is sporadic and in some years no measurable precipitation falls at all.
  - Examples: Sahara, Kalahari, Thar, Mexican deserts, Great Australian desert.
- Temperate desert
  - Notable features:
    - Temperate deserts can be much colder than tropical deserts
    - The floor of the temperate desert is often covered by rocks and small pebbles
  - Examples: Mojave, Sonoran Deserts
- Cold desert
  - Notable features:
    - cold deserts occur in temperate regions at higher latitudes
    - hot summers but extremely cold winters.
  - Examples: Atacama,
  - Gobi, Great Basin, Namib, Iranian, Takla Makan, and Turkestan

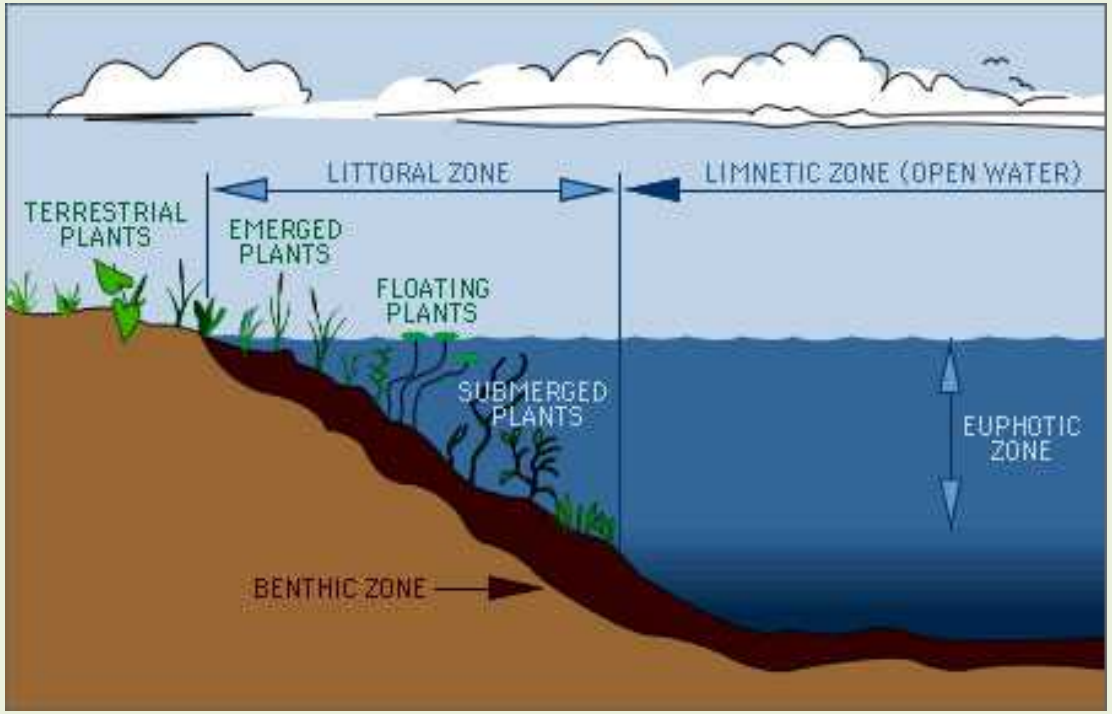
Pond ecosystem

- Notable features:
  - Small freshwater ecosystem
  - Water is stagnant
  - Can be seasonal
  - Exposed to anthropogenic activities

This PPT should be used as reference only. Reading books (mentioned in syllabus) is mandatory for the preparation of the examinations.

Lake ecosystem

- Organisms of aquatic ecosystem
  - Planktons (Algae, rotifers)
  - Nektons (Fishes)
  - Neustons (Water flea)
  - Benthos (Snail)
  - Periphytons (Crustaceane)
- Zonation (Stratification)
  - Epilimnion (Warm, lighter, circulating surface layer)
  - Hypolimnion (Cold, viscous, non-circulating bottom layer)

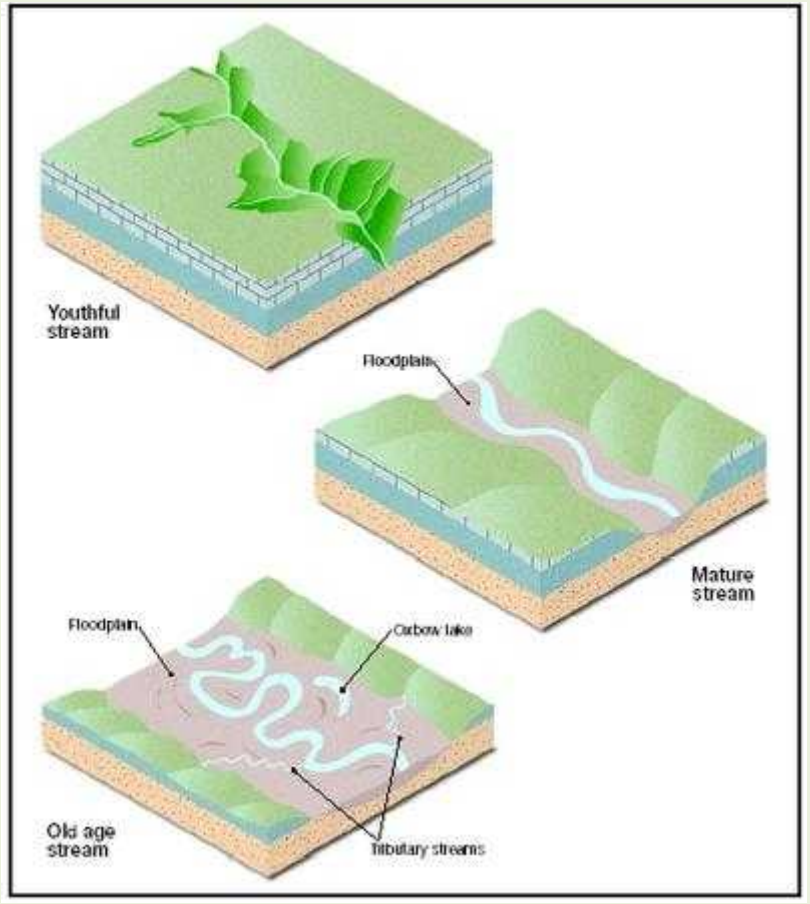


Types of lakes

- Oligotrophic lakes (Low nutrient content)
- Eutrophic lake (High nutrient content)
- Dystrophic lake (Low pH)
- Endemic lakes (Ancient, deep, having endemic fauna)
- Desert salt lakes (High salt content)
- Volcanic lakes
- Mermictic lakes (Permanently stratified)
- Artificial lakes

Streams

- Notable features:
  - Stages
    - Mountain highland (Young River)
    - Second phase (Middle Aged River)
    - Third phase (Old River)



Oceans

- Notable features:
  - Marine ecosystems support a great diversity of life and variety of habitats.
  - The ocean is a major influence on weather and climate.
  - Plants: seaweeds, or marine algae (brown, green, red), sea grasses, phytoplankton
  - Animals: protozoans, marine invertebrates (echinoderms, mollusks, segmented and non-segmented worms, jellies, coral, sea anemones, hyroids) marine vertebrates (fishes, birds, mammals), and zooplankton.
- Zones
  - Coastal zone
  - Open sea
    - Euphotic zone (Abundant sunlight, high photosynthetic activity)
    - Bathyal zone (Dim light)
    - Abyssal zone (Dark zone)