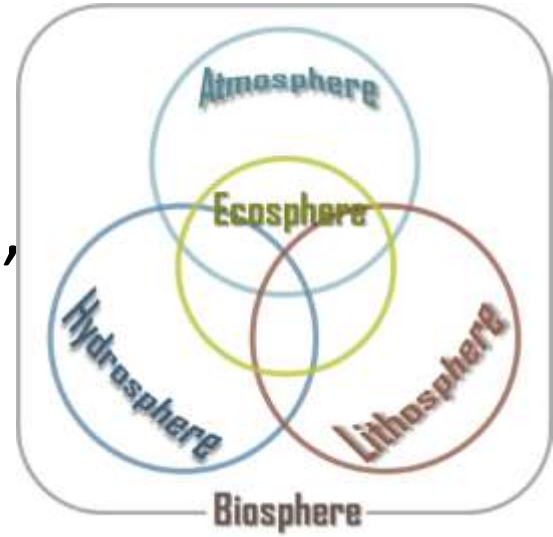
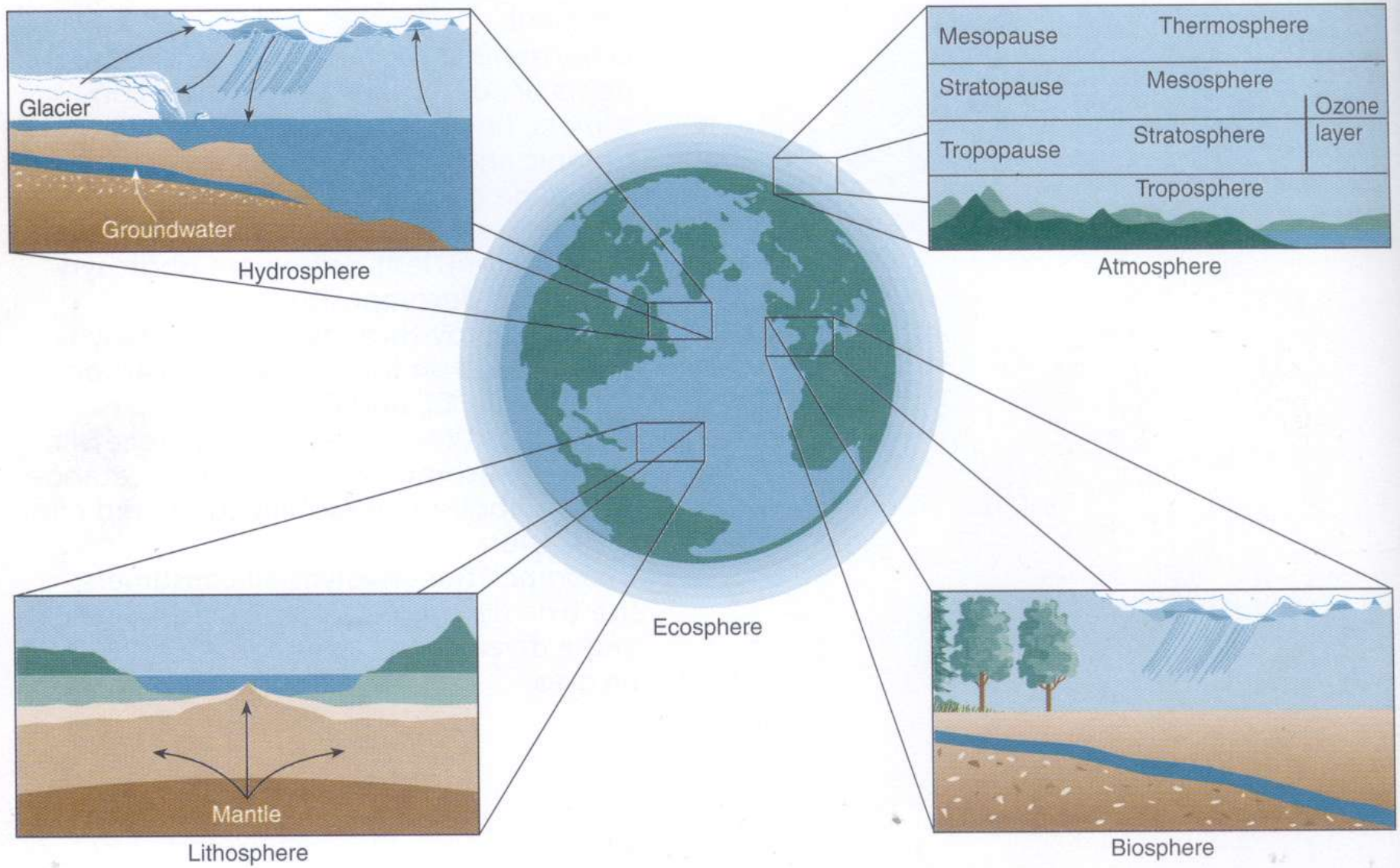
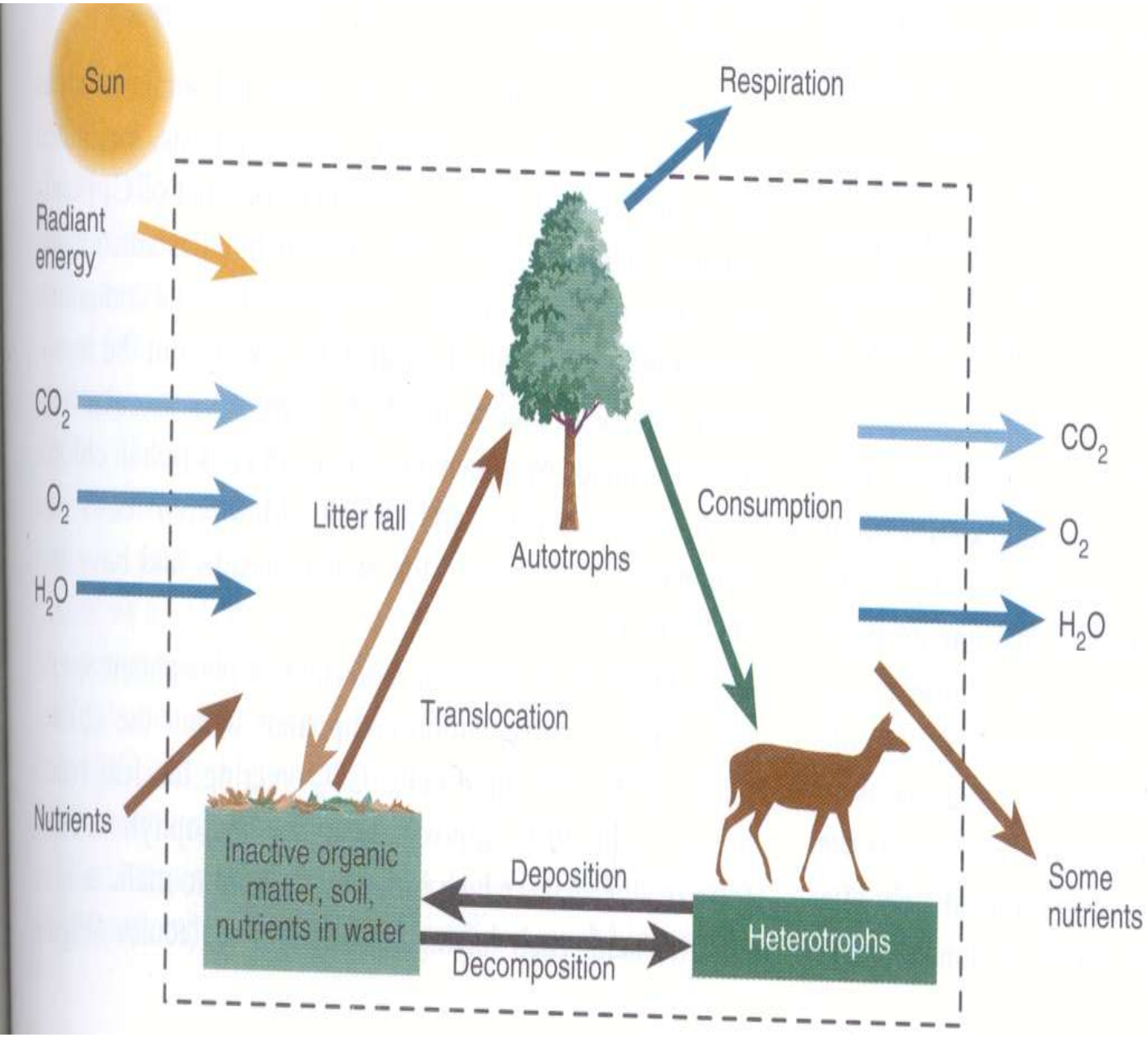
ECOSYSTEM

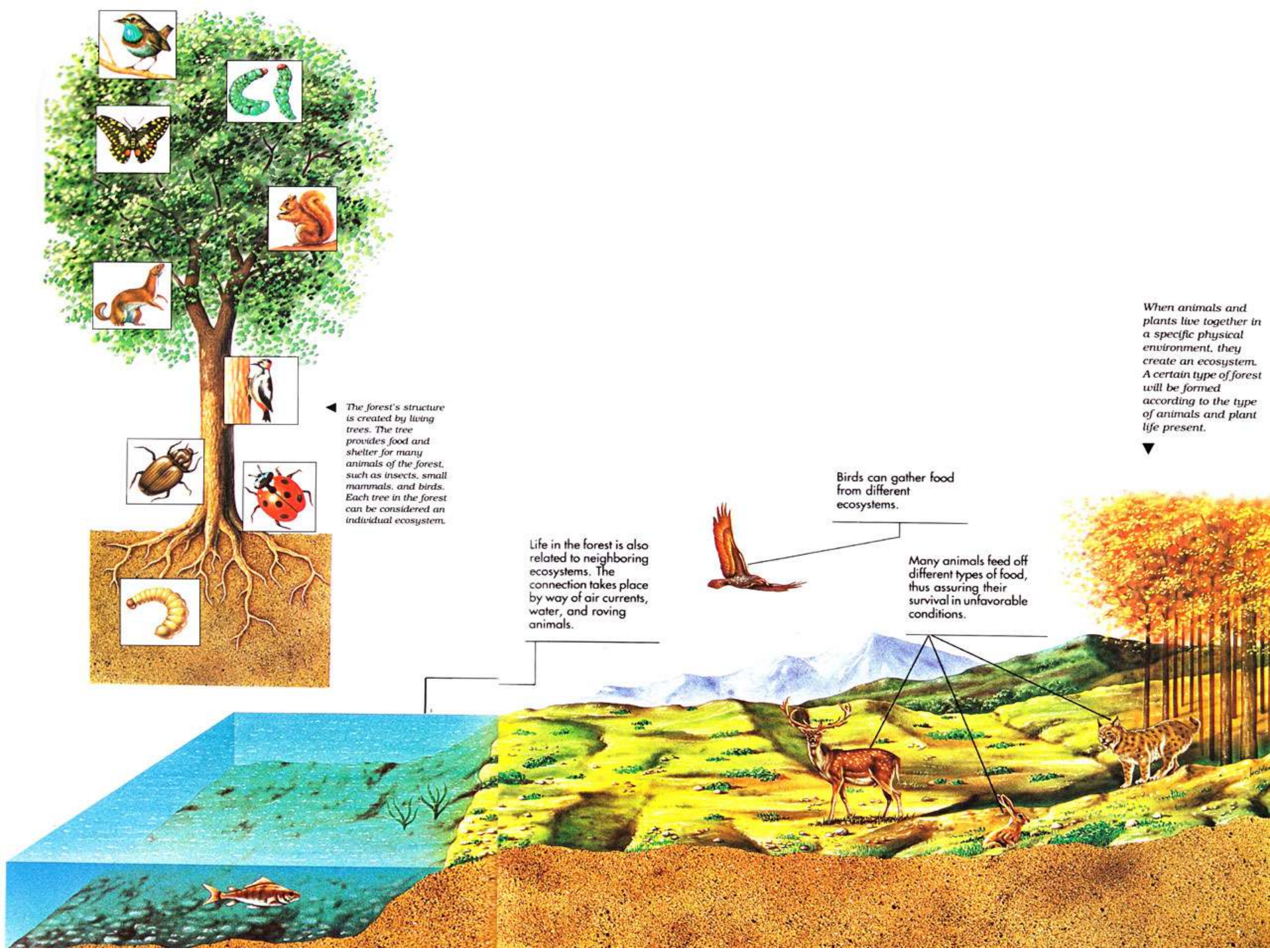
- Ecosphere – Hydrosphere, Atmosphere, lithosphere, Biosphere
- Ecosystem – Energy processing, nutrient regenerating system
- Biotic & Abiotic factors
- Components
  - Producers
  - Consumers- Consumers & decomposers
  - Organic & Inorganic matter



Structural features of the outer part of Earth. The atmosphere, the biosphere, the lithosphere, and the hydrosphere are often collectively called the ecosphere.



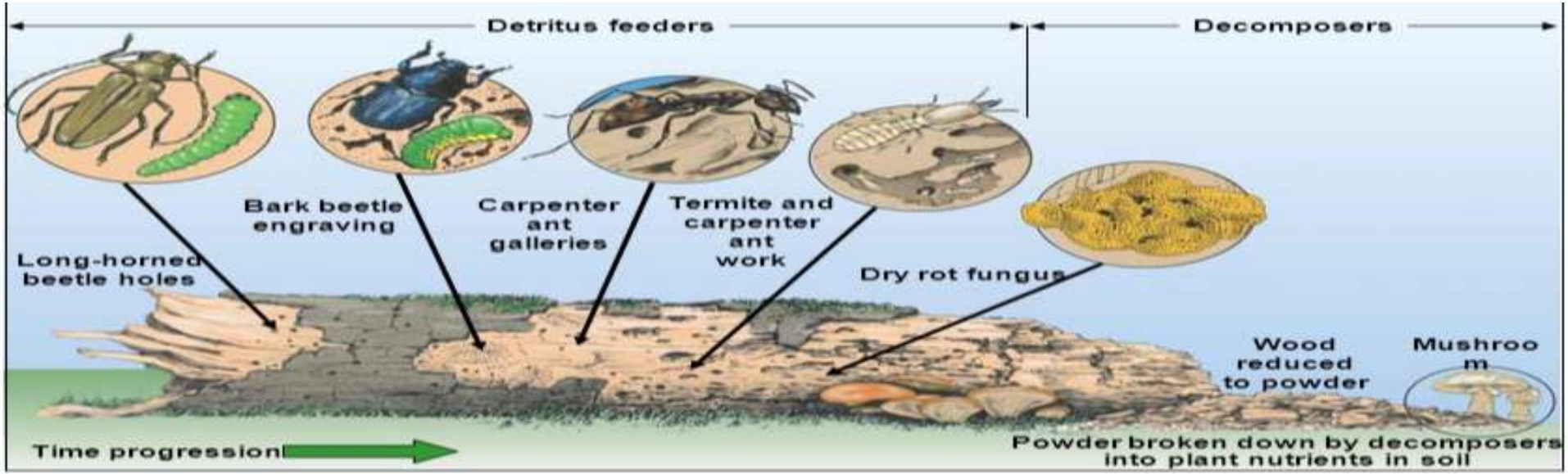

Sun
Respiration
Radiant energy
CO_2
O_2
H_2O
Litter fall
Autotrophs
Consumption
CO_2
O_2
H_2O
Translocation
Nutrients
Inactive organic matter, soil, nutrients in water
Deposition
Decomposition
Heterotrophs
Some nutrients



◀ *The forest's structure is created by living trees. The tree provides food and shelter for many animals of the forest, such as insects, small mammals, and birds. Each tree in the forest can be considered an individual ecosystem.*

When animals and plants live together in a specific physical environment, they create an ecosystem. A certain type of forest will be formed according to the type of animals and plant life present. ▼

- Processes
- Photosynthesis
  - C_3 plants , C_4 plants , CAM (Crassulacean Acid Metabolism)
- Losses
  - Respiration,Herbivory, Litterfall
- Decomposition
  - Decomposers
    - Microflora – Bacteria, Fungi
    - Fermentation
- Detritivores
  - Protozoa, mites, nematodes snails,



- Stages of decomposition
  - Leaching
  - Fragmentation
  - Catabolism
  - Mineralization
  - Anabolism – Nutrient immobilization (Ca, K, N_2)
    - Rhizoshpere
- Factors
  - Temperature
  - Moisture
- Decomposition in aquatic ecosystem
  - Particulate organic matter (POM)
  - Dissolved organic matter (DOM)

- Primary Production
  - Gross primary productivity
  - Net primary productivity
    - Distribution of biomass between different parts of plants
    - Concentration of energy in plant parts-Mast year
- Energy Allocation
  - Growth
  - Storage – Reserve formation
  - Accumulation
  - Recycling
- Biomass Distribution
  - Aquatic System
  - Forest System
- Photosynthetic efficiency of forests
  - Degree of canopy closure
  - Effect of light intensity

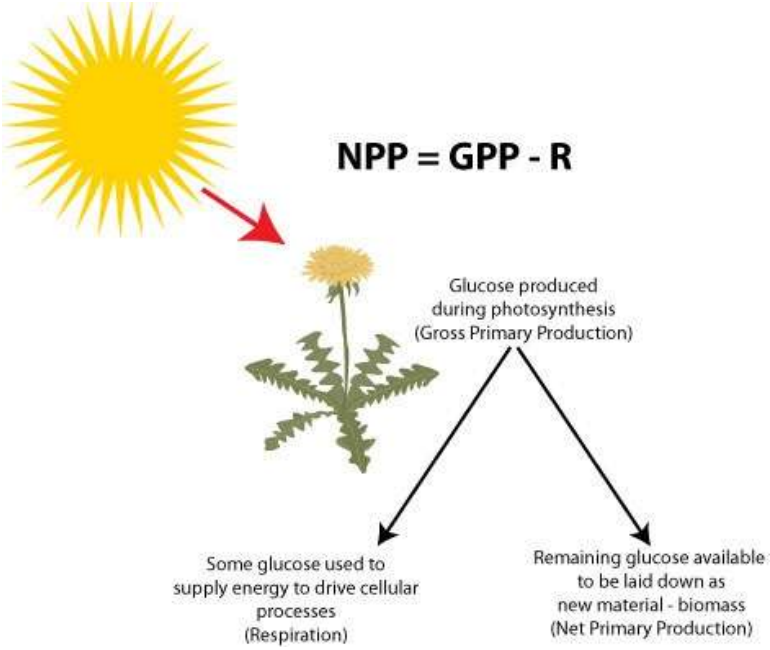
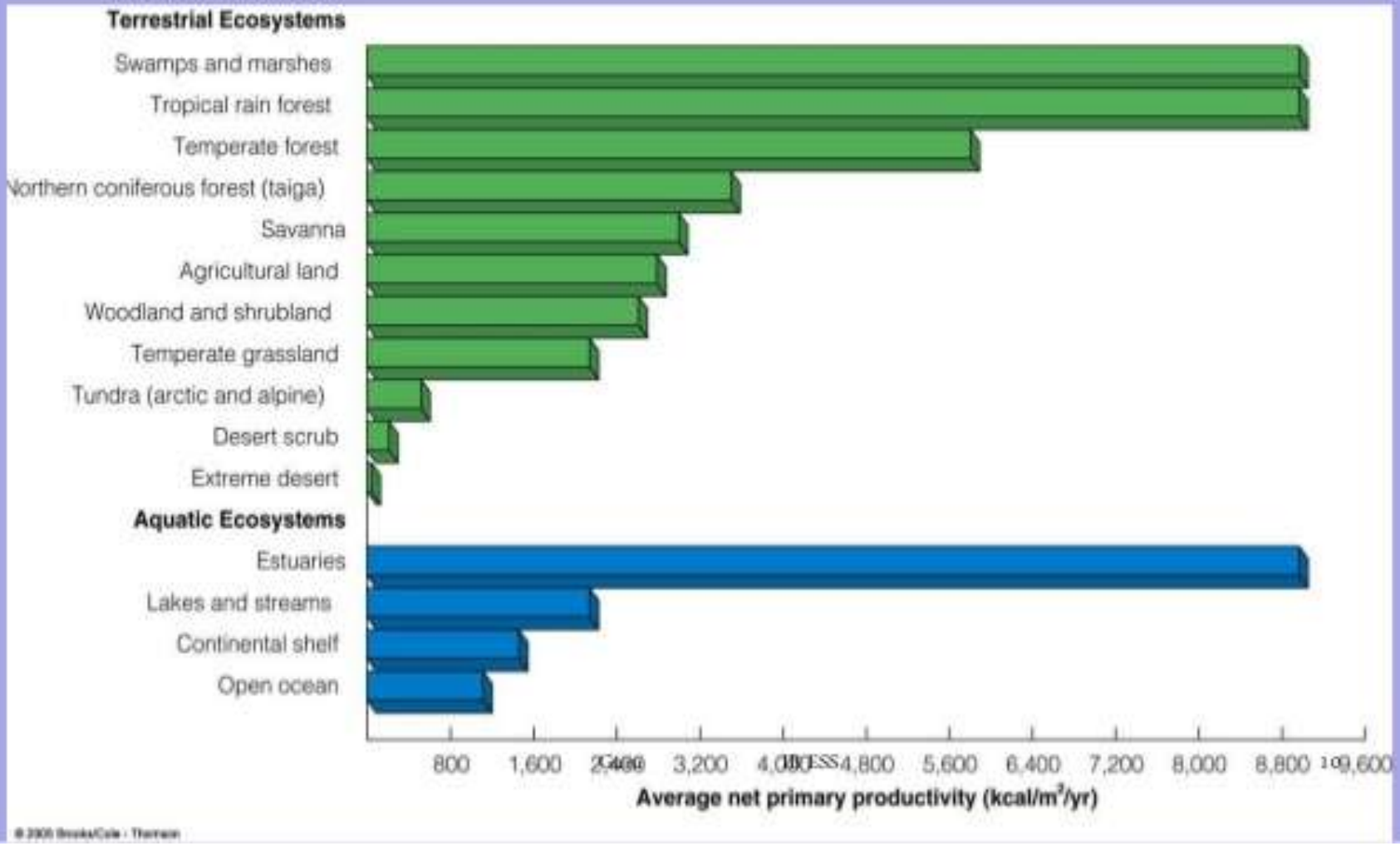


Chart of Net Primary Productivity for biomes

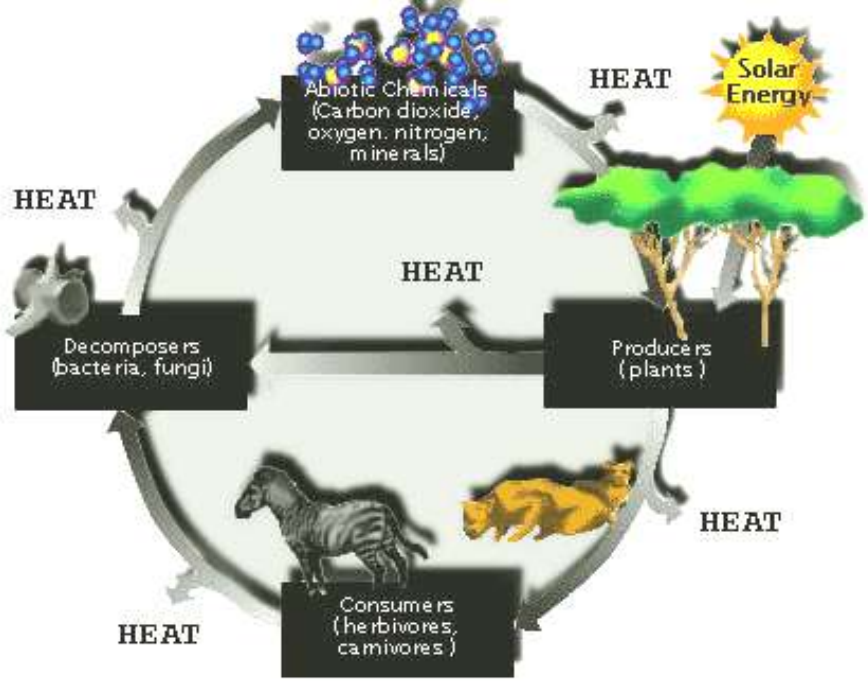


Net Primary Productivity and Plant Biomass of World Ecosystems

Ecosystems (in Order of Productivity)	Area (10^6 km^2)	Mean Net Primary Productivity per Unit Area (g/m^2/yr)	World Net Primary Productivity (10^9 mtr/yr)	Mean Biomass per Unit Area (kg/m^2)
CONTINENTAL				
Tropical rain forest	17.0	2000.0	34.00	44.00
Tropical seasonal forest	7.5	1500.0	11.30	36.00
Temperate evergreen forest	5.0	1300.0	6.40	36.00
Temperate deciduous forest	7.0	1200.0	8.40	30.00
Boreal forest	12.0	800.0	9.50	20.00
Savanna	15.0	700.0	10.40	4.00
Cultivated land	14.0	644.0	9.10	1.10
Woodland and shrubland	8.0	600.0	4.90	6.80
Temperate grassland	9.0	500.0	4.40	1.60
Tundra and alpine meadow	8.0	144.0	1.10	0.67
Desert shrub	18.0	71.0	1.30	0.67
Rock, ice, sand	24.0	3.3	0.09	0.02
Swamp and marsh	2.0	2500.0	4.90	15.00
Lake and stream	2.5	500.0	1.30	0.02
Total continental	149.0	720.0	107.09	12.30
MARINE				
Algal beds and reefs	0.6	2000.0	1.10	2.00
Estuaries	1.4	1800.0	2.40	1.00
Upwelling zones	0.4	500.0	0.22	0.02
Continental shelf	26.6	360.0	9.60	0.01
Open ocean	332.0	127.0	42.00	1.00
Total marine	361.0	153.0	55.32	0.01
World total	510.0	320.0	162.41	3.62

Source: Adapted from Whittaker and Likens 1973.

- Ecosystem Productivity
  - Harvesting
- Secondary Production
  - Energy Consumed (C)
  - Energy Assimilated (A)
  - Energy Lost (U) (Feces + Nitrogenous waste)
  - Respiration
- Energy flow in managed forests
  - Depends on silvicultural system
  - Redistribution of forest biomass
    - Biomass removal, slash, underground biomass
  - Change in detritus food web energy flow
  - Change in grazing food web energy flow



Ecological energetics

- Source of energy
- Energy for growth, reproduction
- Abundance, productivity, distribution determined by energy
- Forests are complex physical-chemical organization.
- Foresters should manipulate energy to achieve management objectives.

Prerequisites for management of forest ecosystem

- Recognition that functional organization is largely a matter of energy transfers and storage.
- Appreciation of pathways and magnitude of energy transfers.
- Identification of the factors that determine the storage and dynamics of energy within and between various components of the system

Tropic levels

- Autotrops (Primary producers)
  - Photoautotrops
  - Chemoautotrops
    - Ecological role-Sulfur oxidizing bacteria-sulphuric acid-leaching heavy metal-water quality-pollution of aquatic ecosystem.
    - Conversion of ammonium ions to nitrate
- Heterotrophs (Consumers)
  - Herbivores (Primary consumers)
  - Carnivores (Secondary, tertiary consumers)
  - Omnivores
  - Saprophytes (Decomposers, detrivores)

- Tropic chains
  - Grazing tropic chains
  - Detritus tropic chains
- Tropic webs
- Ecological pyramids
  - Pyramid of numbers
  - Pyramid of biomass
  - Energy flow pyramid

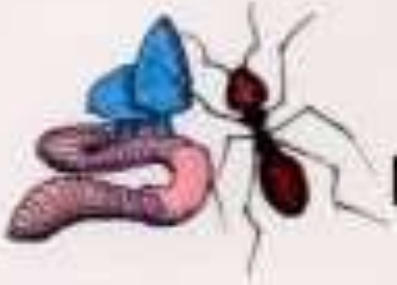
Food Chain

Producer

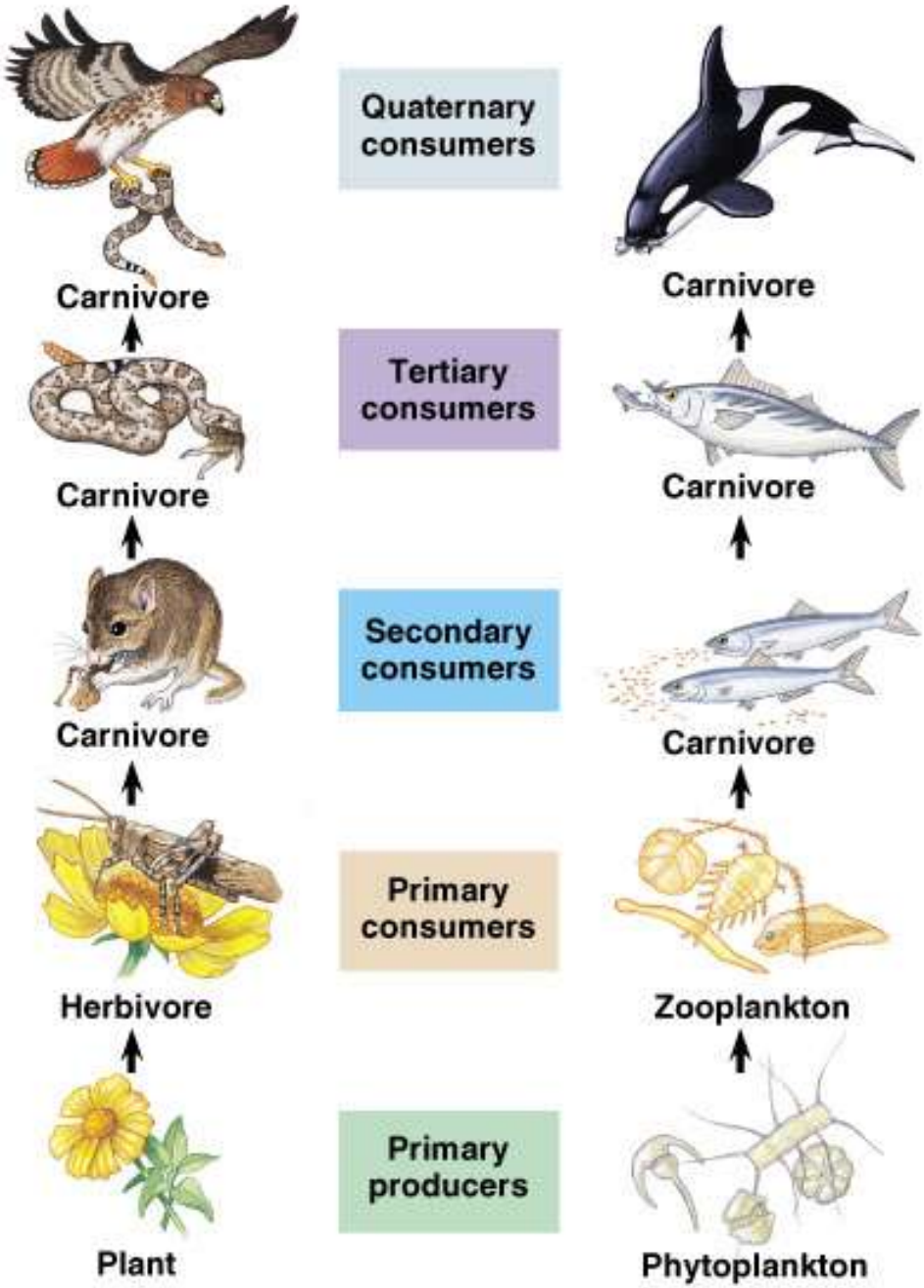
Primary Consumer

Secondary Consumer

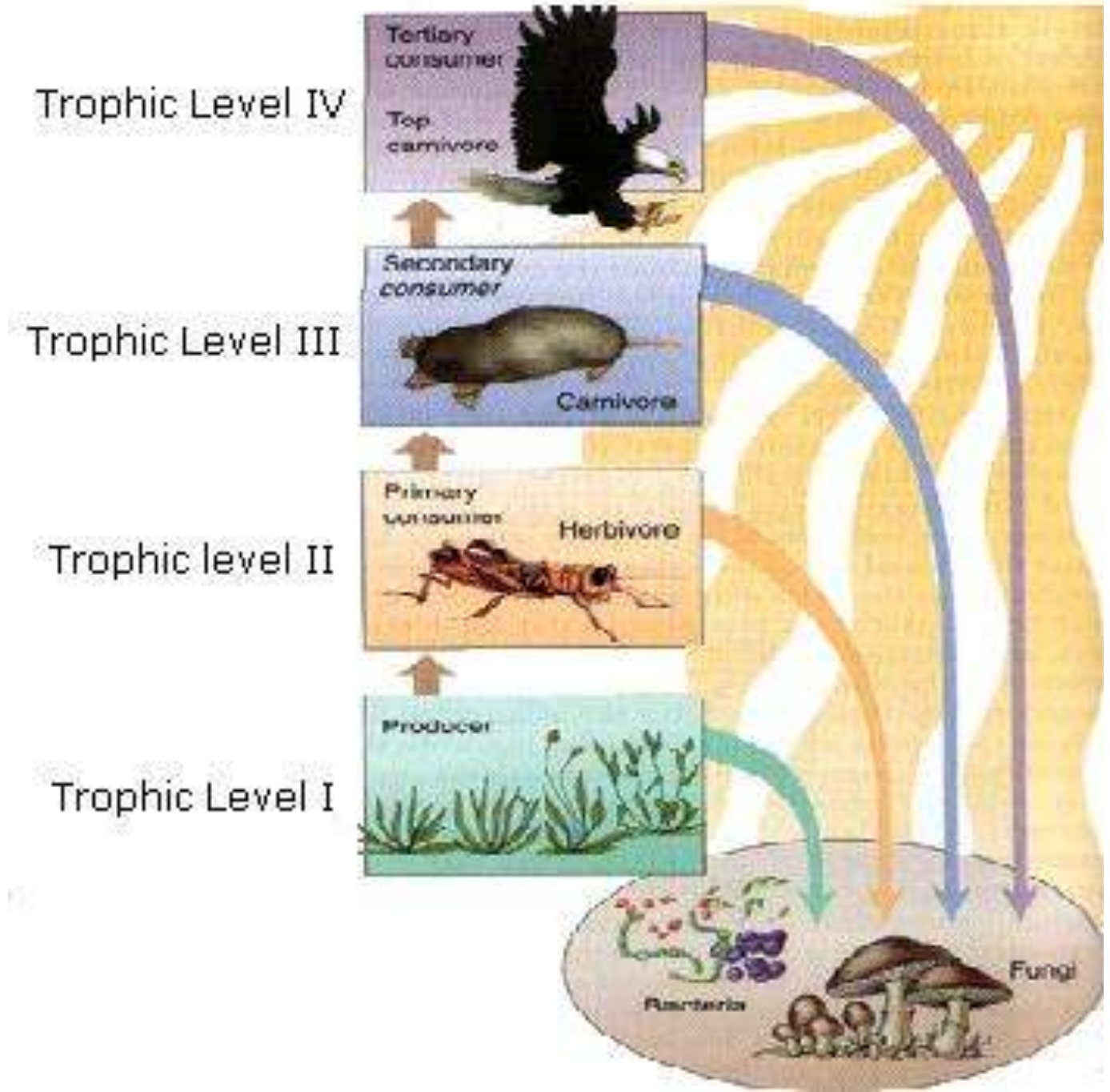
Tertiary Consumer

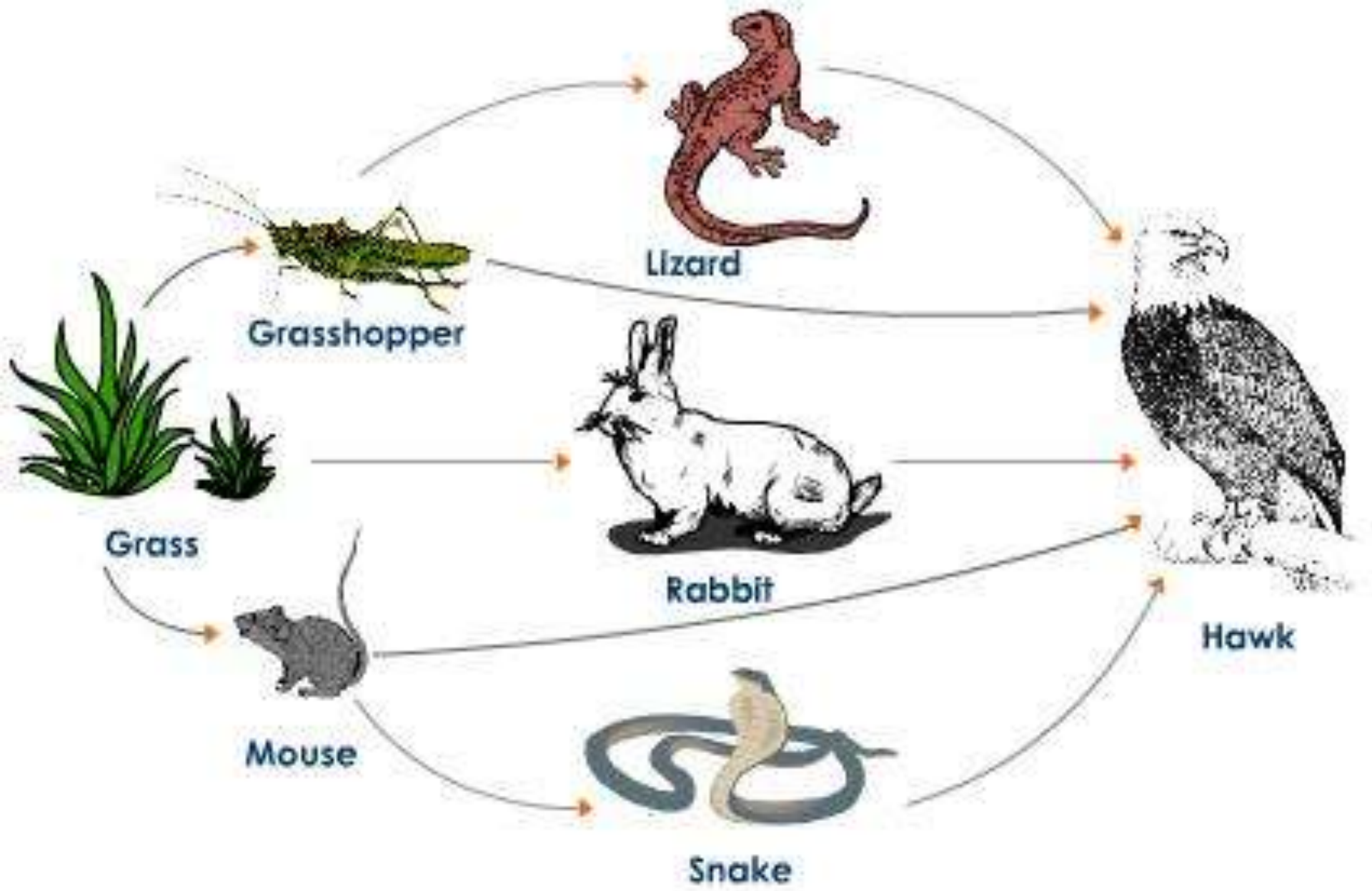


Decomposers



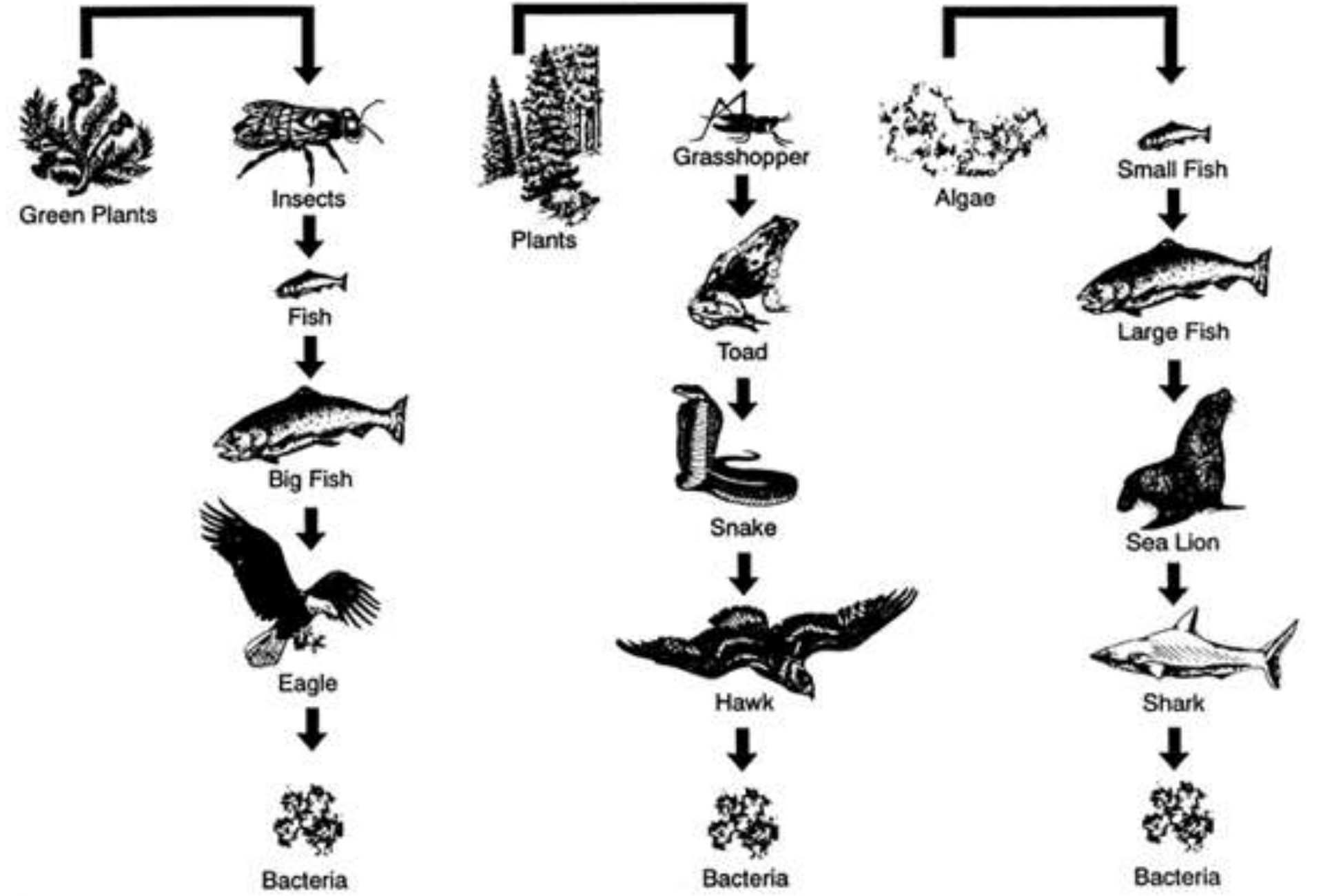
A terrestrial food chain **A marine food chain**

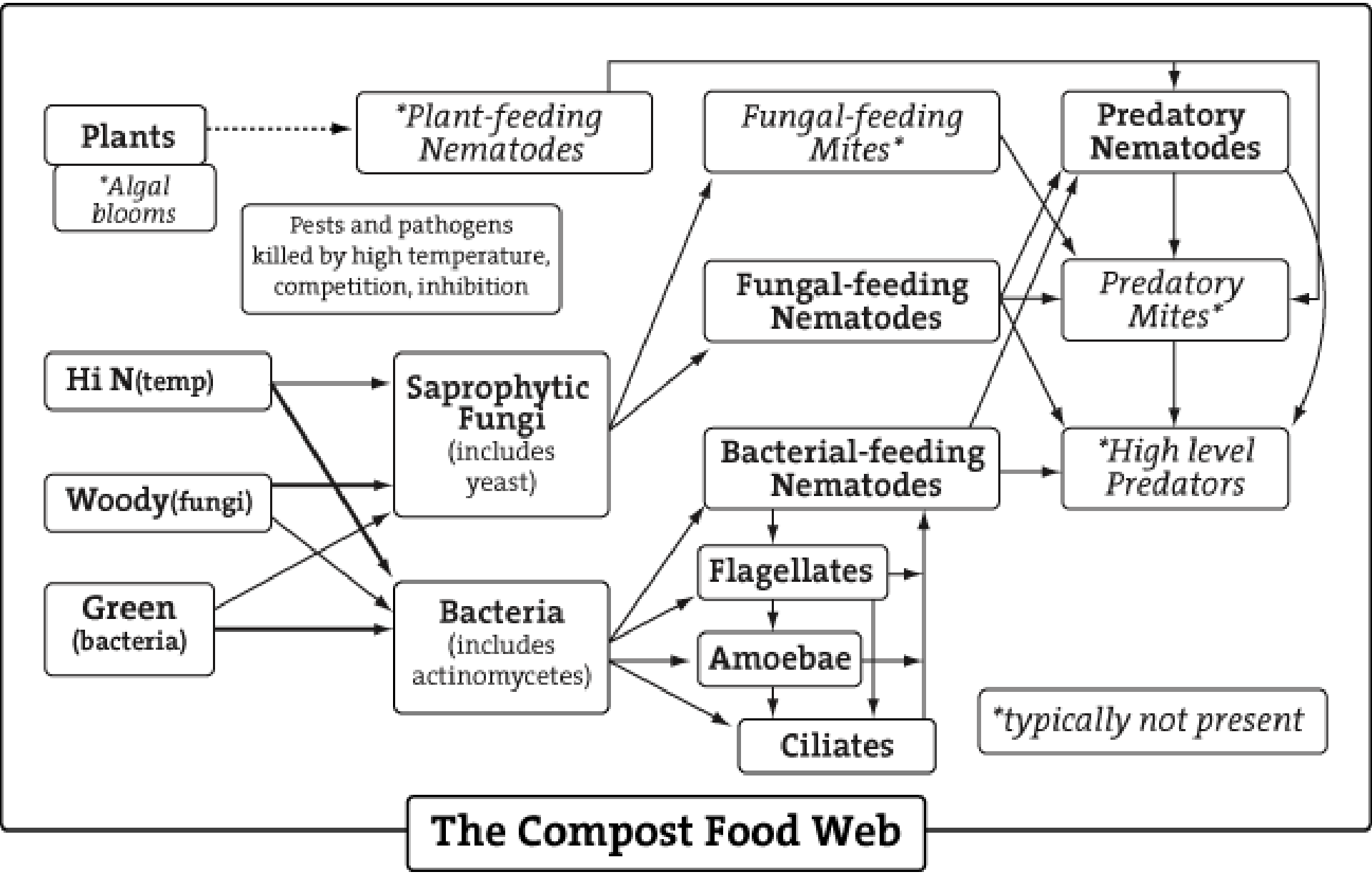

Trophic Level IV
Trophic Level III
Trophic level II
Trophic Level I
Tertiary consumer
Top carnivore
Secondary consumer
Carnivore
Primary consumer
Herbivore
Producer
Fungi



A Food Web in a Grassland Ecosystem With Five Possible Food Chains

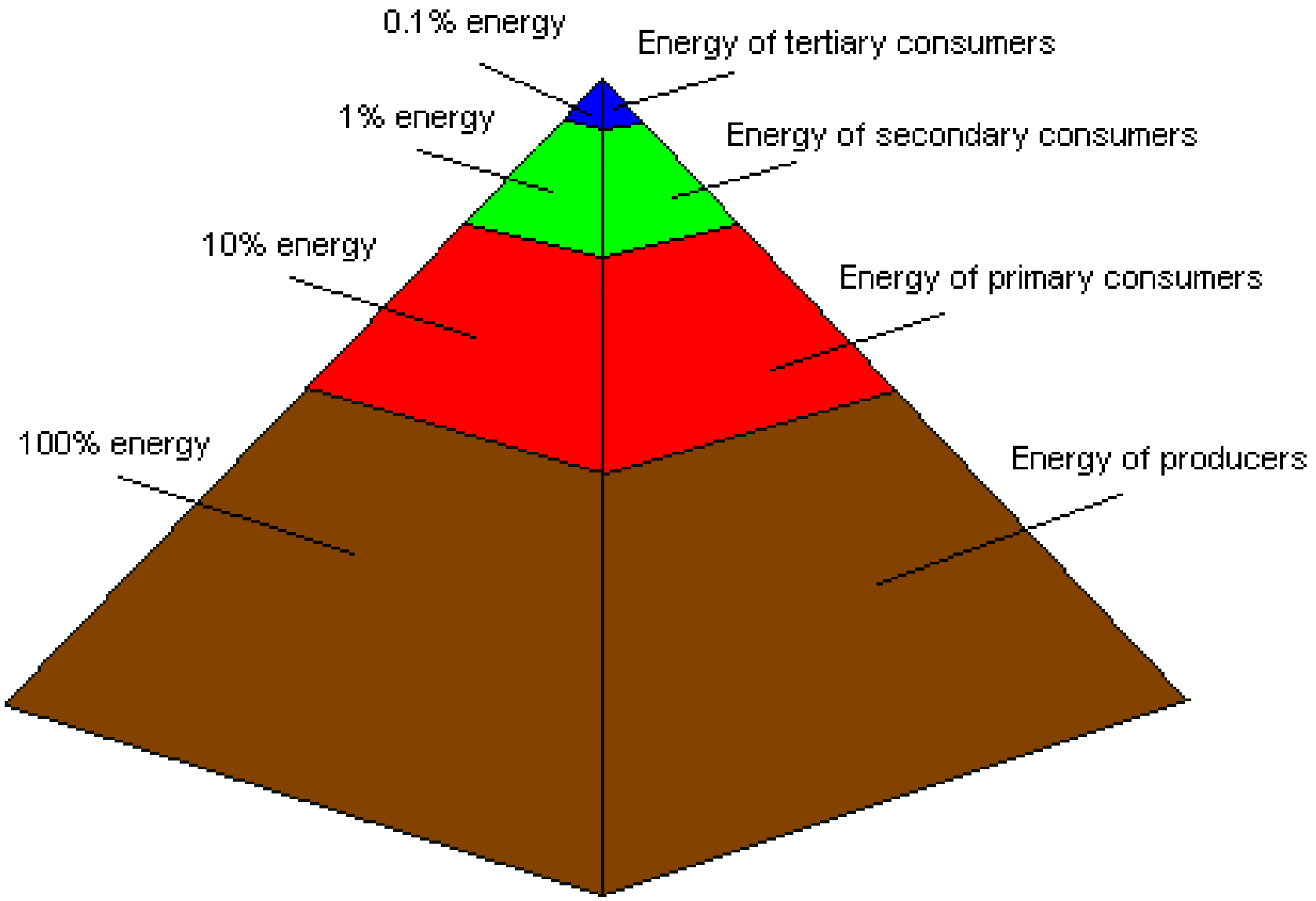
FOOD CHAINS


Green Plants
Insects
Fish
Big Fish
Eagle
Bacteria
Plants
Grasshopper
Toad
Snake
Hawk
Bacteria
Algae
Small Fish
Large Fish
Sea Lion
Shark
Bacteria



The Compost Food Web

Ecological Pyramid



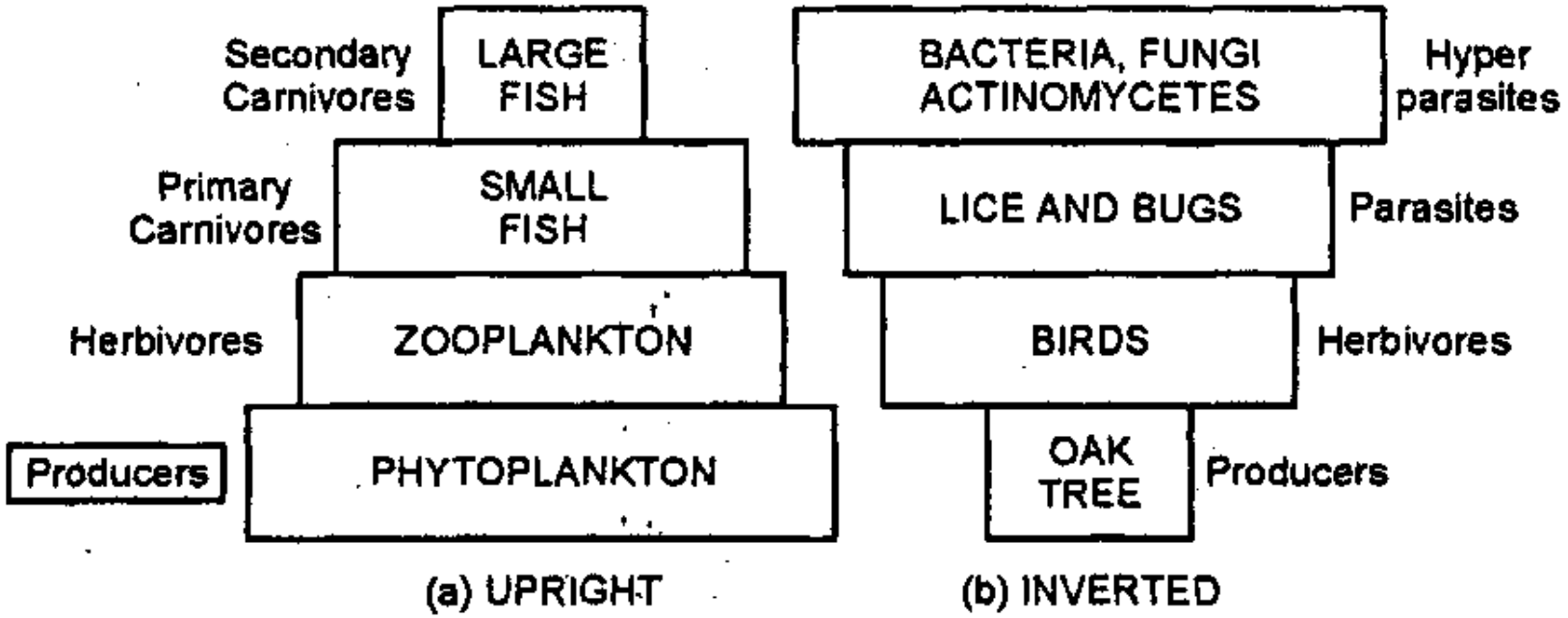
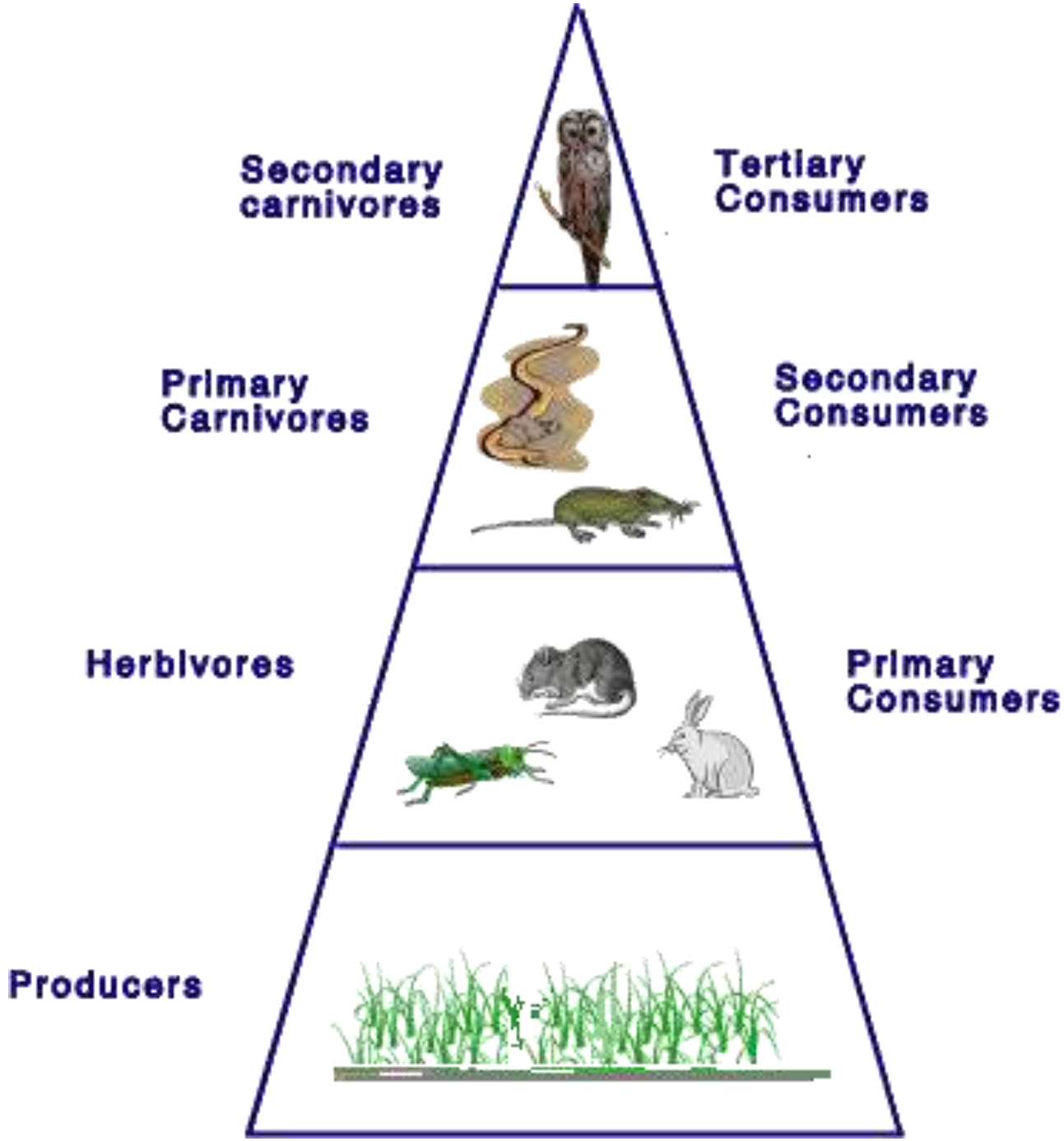


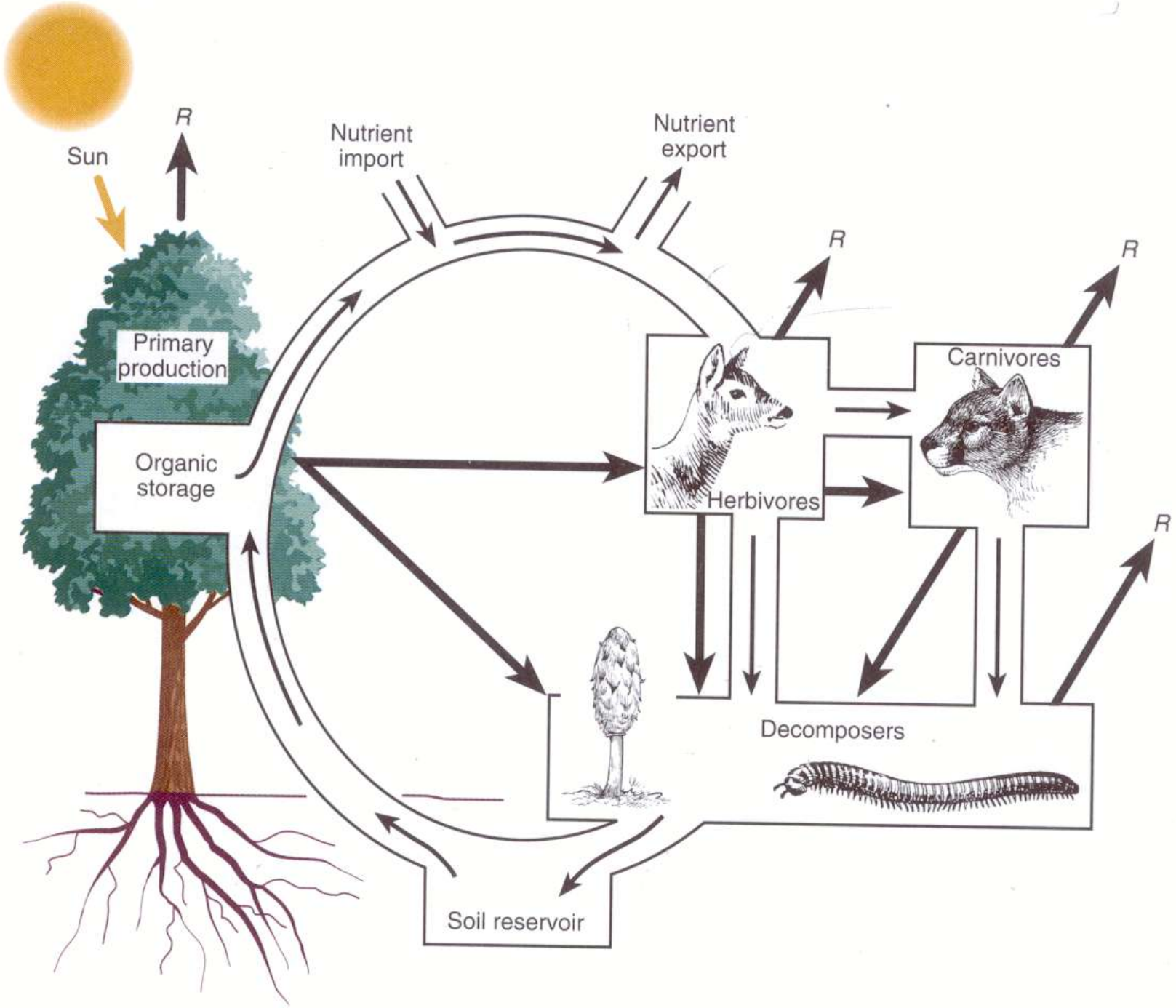
FIGURE 14.9. Pyramids of numbers (A) in pond ecosystem (B) in parasitic food chain.


Secondary carnivores
Tertiary Consumers
Primary Carnivores
Secondary Consumers
Herbivores
Primary Consumers
Producers

- Variation in ecological pyramids
  - Grazing vs. Detritus tropic web
    - Mature forests-less hervores -more litterfall- detrivores activity very high
  - Effect of organism size
    - Size and metabolic relationship
    - Community of smaller organism have higher rate of energy flow than with a community of larger organism.
    - For a given energy flow a community of smaller organism will have a smaller biomass than a community of larger organism
    - Ecological significance-Forest harvesting
  - Effect of energy imports/exports

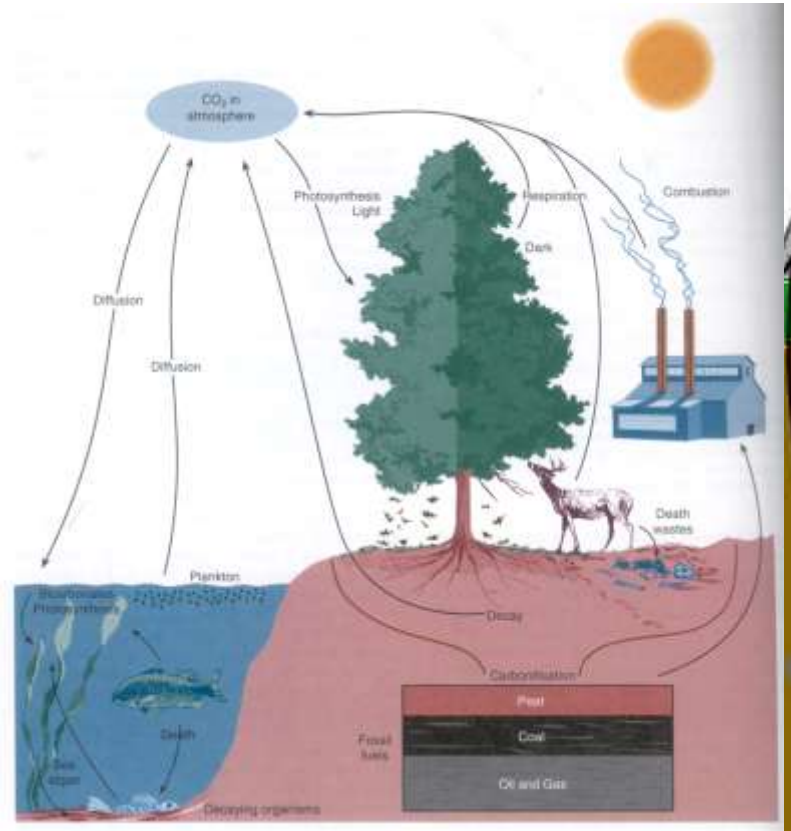
Biogeochemistry

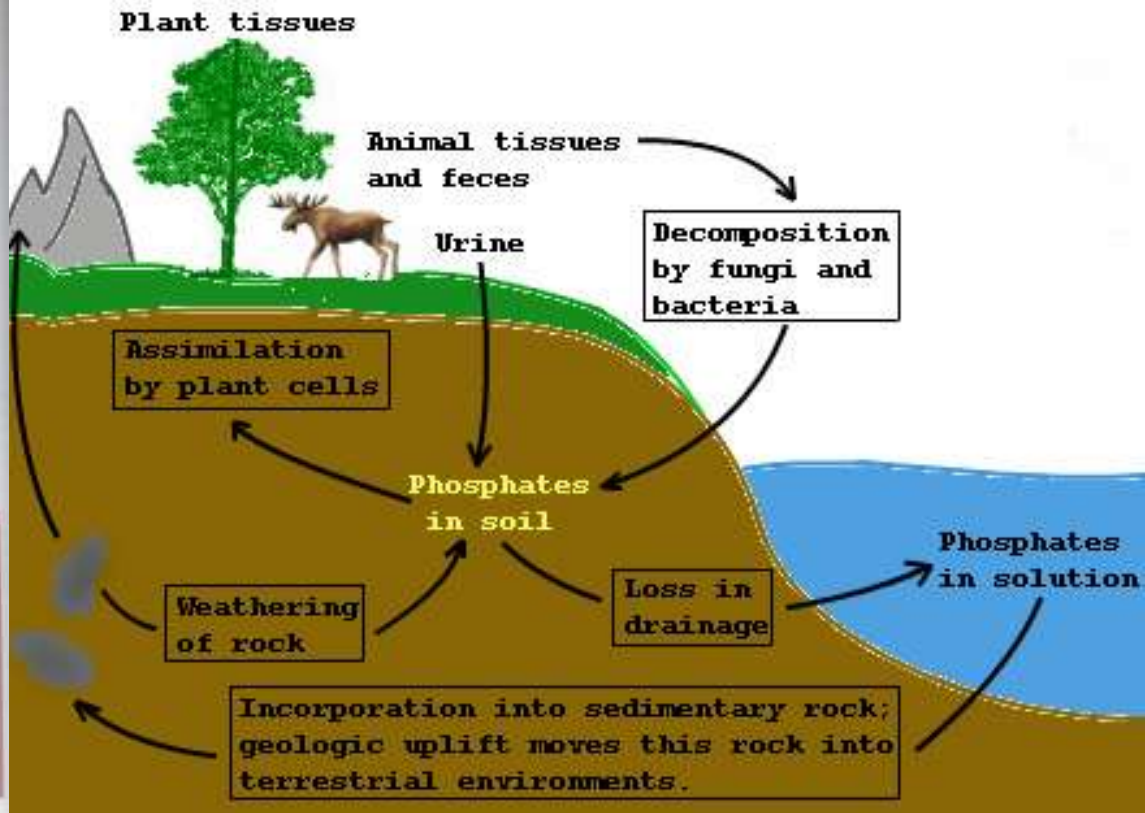
- Distribution and dynamics of chemical elements
- Cycling of chemicals associated with energy flow
- Types of the cycles
  - Geochemical: Exchange of chemicals between ecosystem
  - Biogeochemical: Exchanges of chemicals within an ecosystem
  - Biochemical: redistribution of chemicals within individual organism


R
Sun
Nutrient import
Nutrient export
R
R
Primary production
Organic storage
Carnivores
Herbivores
R
Decomposers
Soil reservoir

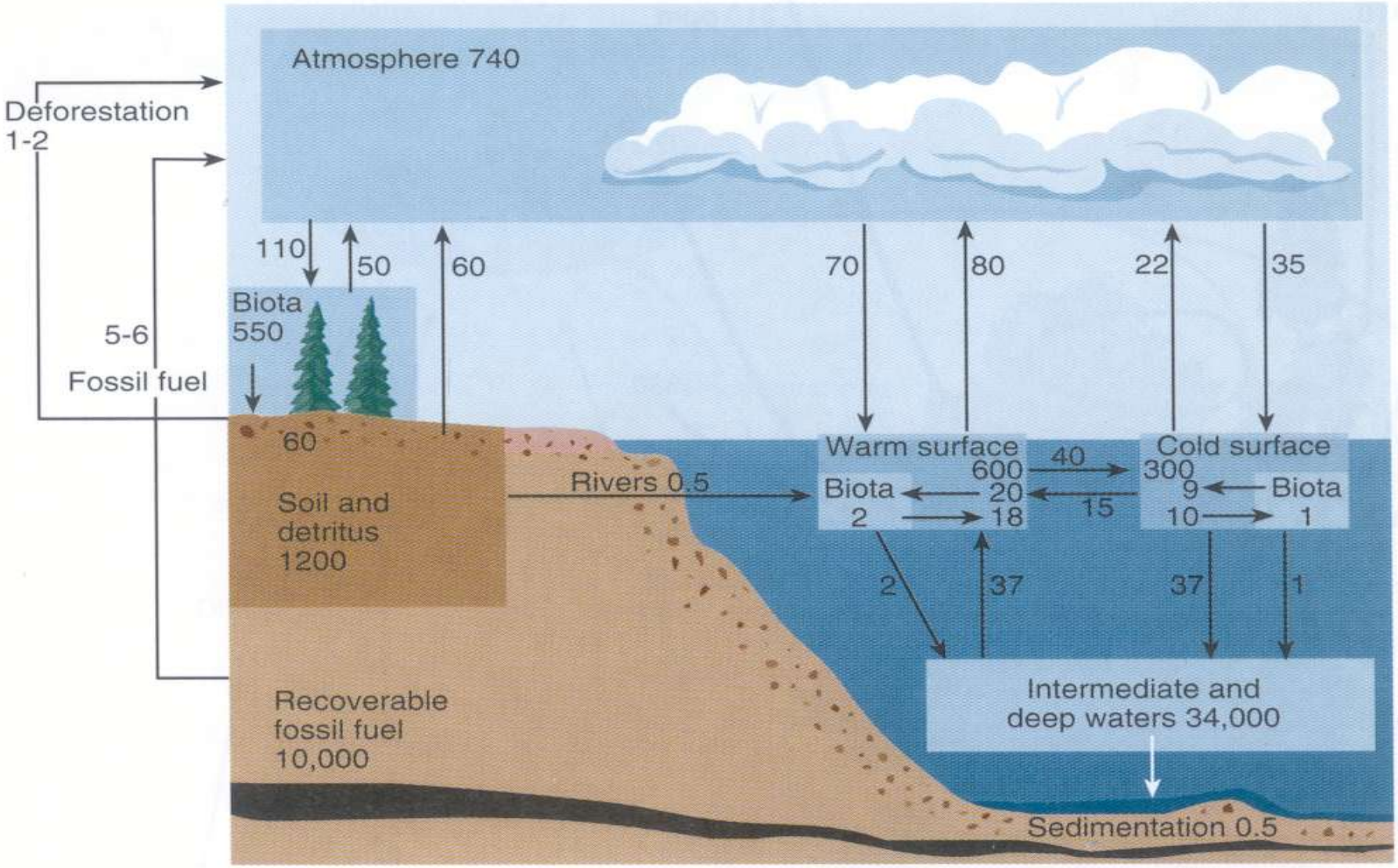
- Plant nutrition
  - Inorganic chemistry of plants
  - Acquisition of nutrients
  - Nutritional deficiencies
    - Nutrient deficiency-adequate nutrition-luxury consumption-toxic accumulation
- Animal nutrition
  - Herbivores
  - Carnivores
  - Nutrient deficiency

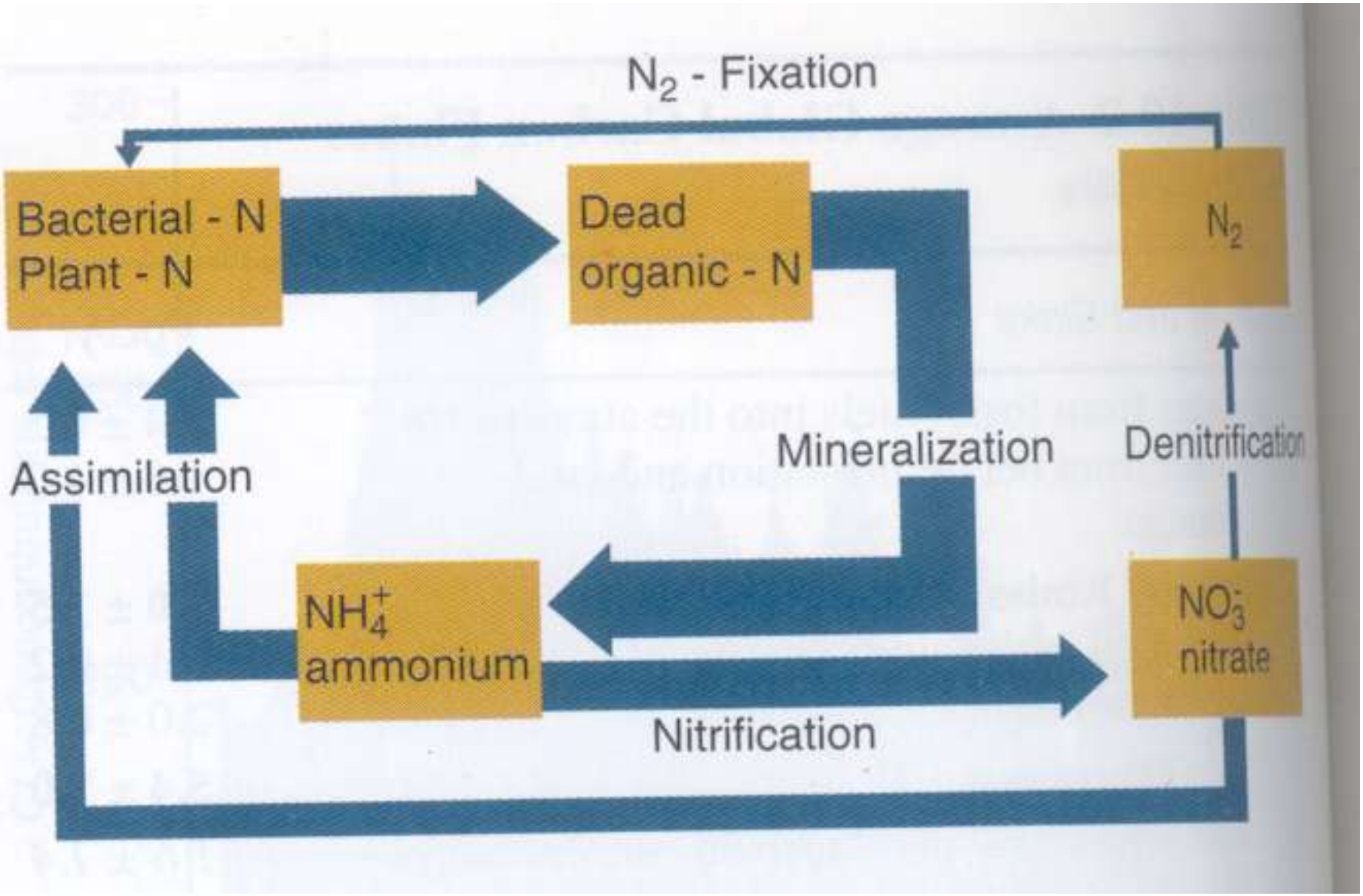
- Biogeochemical Cycles
- Gaseous Cycles
- Oxygen Cycle
- Carbon Cycle



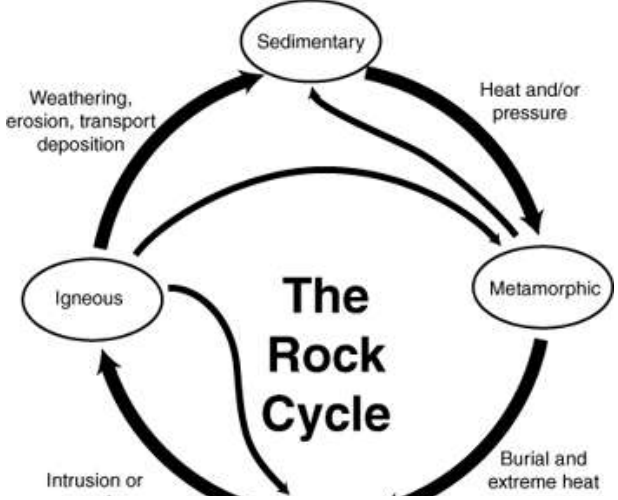


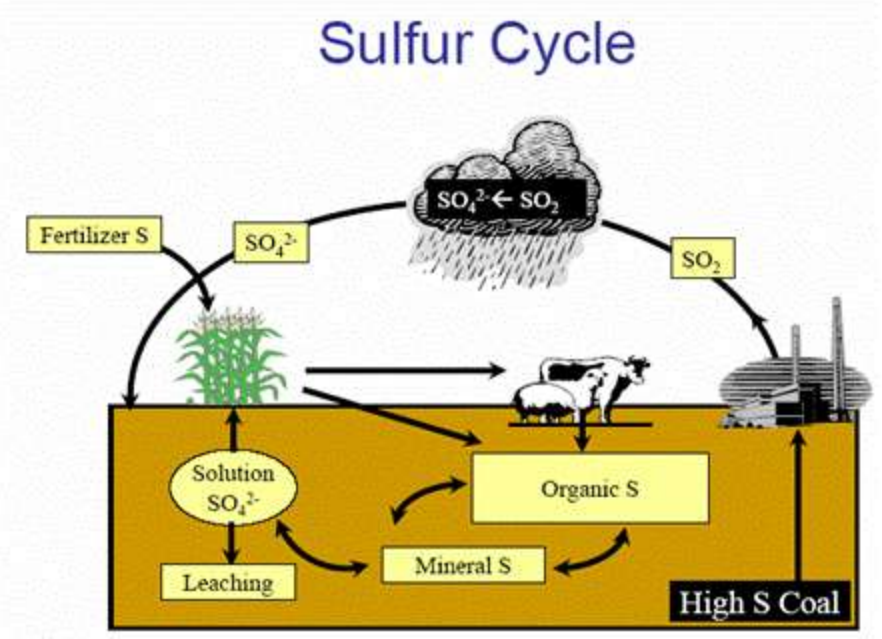
Nitrogen Cycle



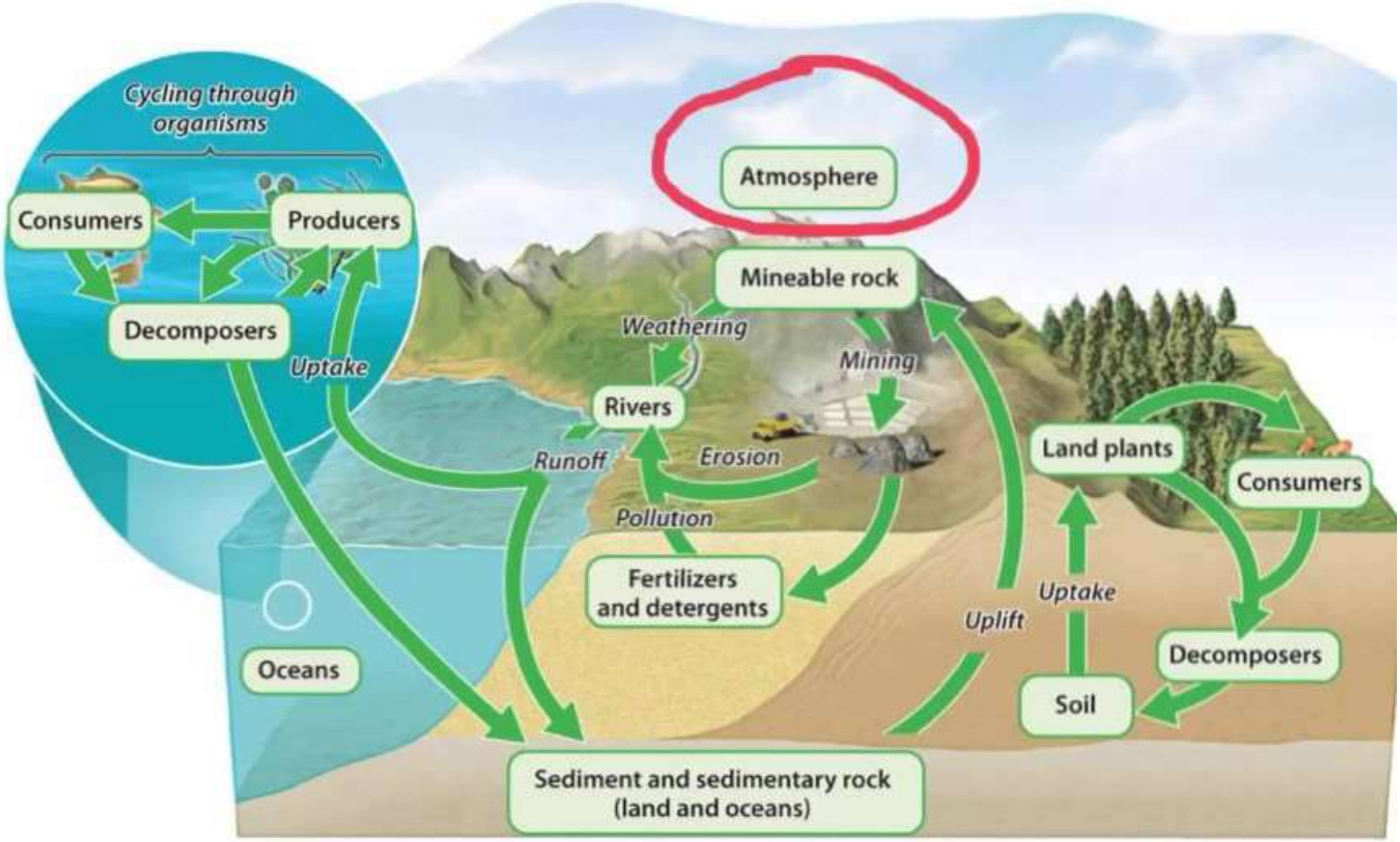

N_2 - Fixation
Bacterial - N
Plant - N
Dead
organic - N
N_2
Assimilation
Mineralization
Denitrification
NH_4^+
ammonium
NO_3^-
nitrate
Nitrification

- Rock Cycle
  - S, P, Ca
  - Salt solutions & rock
- Sulphar Cycle
  - Gas & Sedimentary Cycle
  - Human Impact
    - Health hazards
    - Killing of plants
- Phosphorus Cycle
  - Rocks





Phosphorus Cycle



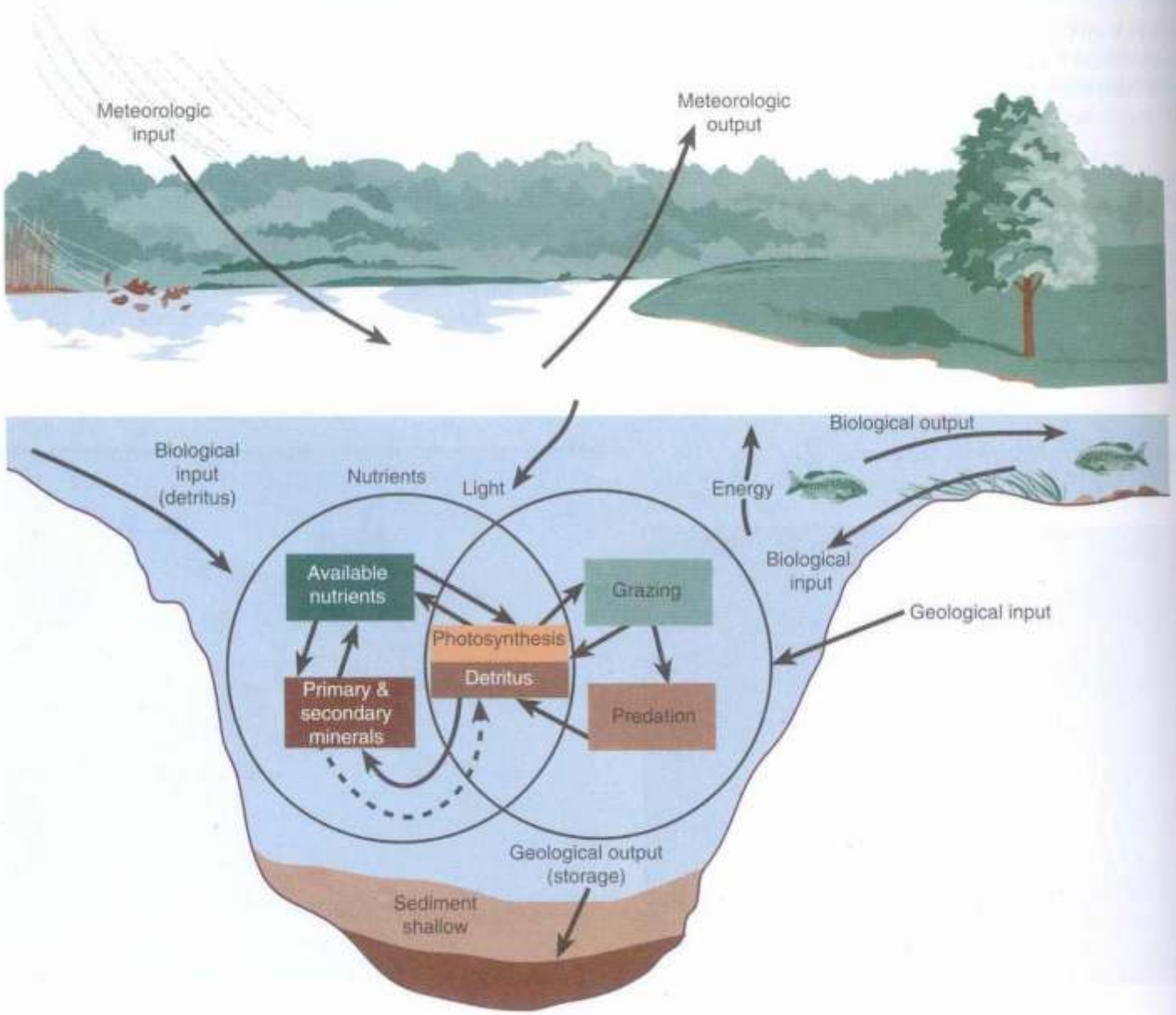
- Importance in forestry
  - Biogeochemical mechanism responsible for production of biomass.
  - Harvesting under coppice system
  - Role of under story
  - Litter
  - Insect attack
  - Mycotrophy
  - Increased availability of nutrients: The Assart Effect
  - Effect of fire, grazing
  - Pollution and phytoremediation

- Aquatic Ecosystem
  - Fresh Water Ecosystems
  - Salt Water Ecosystems

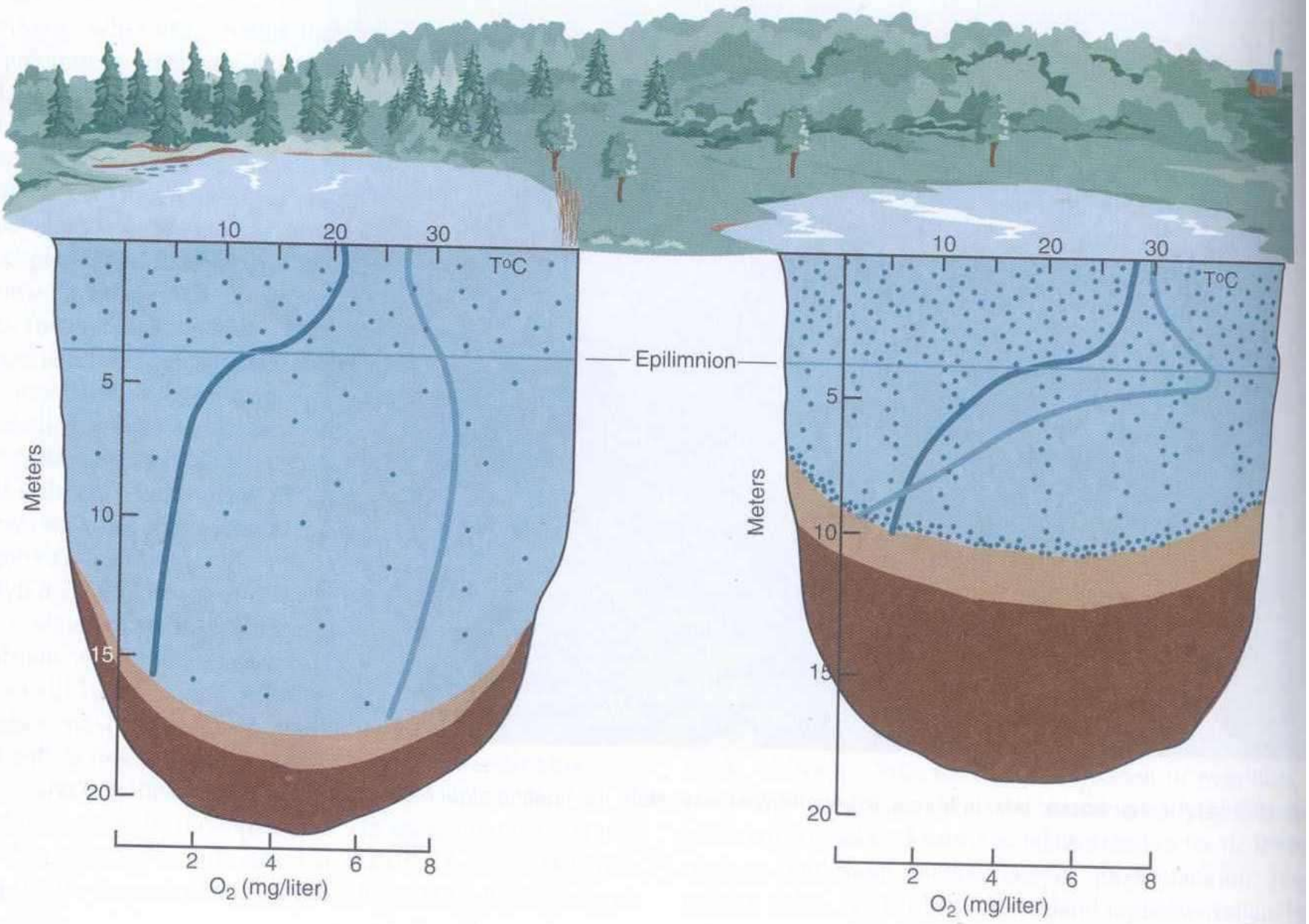
- Fresh Water System
  - Lentic Ecosystem – Standing water habitats.
  - Lotic Ecosystem – Running water habitats.

- Lentic Ecosystem
  - Physical Characteristics
    - Temperature – epilimnion, metalimnion, hypolimnion
    - Oxygen
    - Carbon dioxide
    - Light
      - Trophogenic zones – (epilimnion) – productive zone
      - Tropholytic zones – (hypolimnion) decomposition is most active
      - Compensation zones – production – respiration = 0
    - Structure
      - Littoral zones
      - Limnetic zone
      - Benthic zone
    - Function
    - Nutrient status
      - Oligotrophic systems – low surface to volume ratio
      - Eutrophic systems – high surface to volume ratio
        - Cultural eutrophication
      - Dystrophic systems – humic material
      - Marl system (hard water rich in $CaCO_3$, unproductive, low nutrients

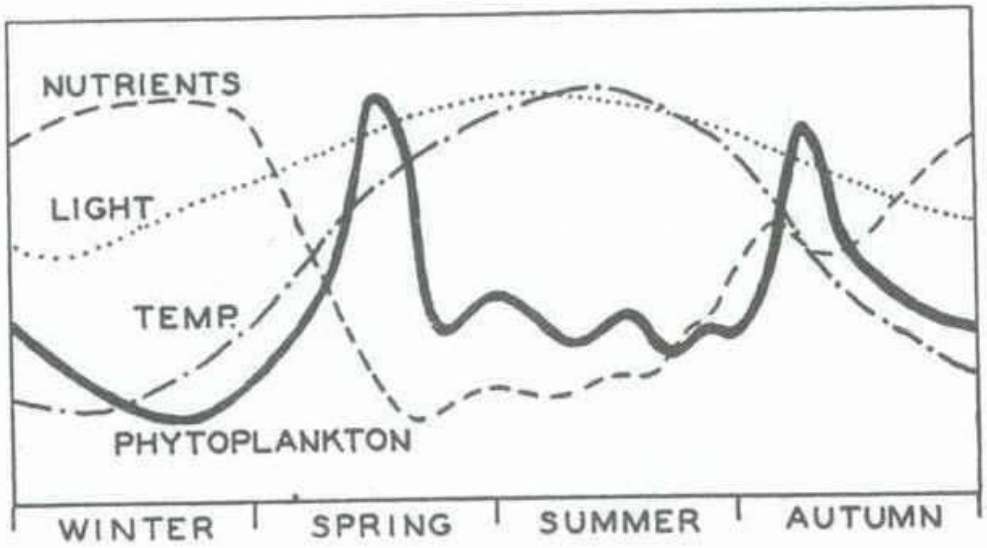
Model for nutrient cycling and energy flow in a lake ecosystem. Meteorological, geological, and biological inputs enter from the watershed. Nutrients and energy move through a number of pathways. Part accumulates in bottom sediments. (Based on Likens and Bormann 1974 and Rich and Wetzel 1978.)



Comparison of oligotrophic and eutrophic lakes.



- Lotic Ecosystem
  - Physical Characteristics
    - Run off
    - Transportation of Material
      - Soil
      - Organic matter
      - Nutrients – Primary productivity is higher
    - Fast water
      - Ephemeral algal growth
      - Width influence productivity
    - Slow water
      - Deposition of silt & organic matter
    - Watershed
    - Function
      - Organic matter
      - CPOM – Bacteria, Fungi, Shredders
      - FPOM – Bacteria, Collector
      - DOM
    - Nutrient cycling
      - Spiraling
    - Regulated Rivers



The probable mechanism for phytoplankton pulses in temperate-zone ponds and lakes. See text for explanation.

- Wetlands
  - Wetlands are area of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including area of marine water the depth of which at low tide does not exceed six meters. (IUCN, 1971)
  - Fen – Slightly acidic, dominated by sedges in which peat accumulates
  - Marsh – Grassy vegetation
  - Peat – (undecomposed, unconsolidated) organic matter
  - Types-basin, riverine, fringe

CLASSIFICATION

I. TIDAL WETLANDS

a Woody vegetation

i Permanently flooded (or waterlogged)

Mangroves

Mangrove scrub

Saltwater mixed forest (Heritiera)

Brackishwater mixed forest (Heritiera)

Palm swamp (Nypa)

ii Seasonally flooded (or Waterlogged)

Saline scrub

b. Herbaceous vegetation (mostly submerged)

i. Permanently flooded (or waterlogged)

Coastal beds of kelps and seagrasses

Lagoons

Estuaries and Backwaters

ii. Seasonally flooded (or waterlogged)

(may include areas flooded by very high tides)

II. INLAND WETLANDS

A. Saline Wetlands

a. Woody vegetation
    i. Permanently flooded (or waterlogged)

       There are none.
    ii. Seasonally flooded (or waterlogged)

       Salt lakes

b. Herbaceous vegetation (submerged or other halophytes)
    i. Permanently flooded (or waterlogged)

       Saline high altitude lakes

       (in most cases Littoral zones only)
    ii. Seasonally flooded (or waterlogged)

       Salt lakes

B. Freshwater Wetlands
   a. Woody vegetation
      i. Permanently flooded (or waterlogged)
         Myristica swamp
         Submontane hill valley swamp
         Creeper swamp (including cane brakes)
      ii. Seasonally flooded (or waterlogged)
         Eastern seasonal swamp
         Barringtonia swamp
         Syzygium cumini swamp low forest
         Seasonal swamp low forest
         Eastern Dillenia swamp
         Riparian fringing forests
         Alder forests
         Riverine blue pine forests
         Wet bamboo brakes

b. Herbaceous vegetation

i. Permanently flooded (or waterlogged)

Submerged and/or floating leaved

Cattails (mainly Typha angustata)

Reeds

Tall emergents (other than reeds and cattails)

Short sedges and grasses

Wet meadows

ii. Seasonally flooded (or waterlogged)

Submerged and/or floating leaved

Cattails (mainly Typha elephantina)

Reeds

Tall emergents (other than reeds and cattails)

Tall sedges

Short sedges and grasses

Wet meadows

Tall grasses

(Gopal and Sah, 1995)

- Structure
  - Hydrology – Precipitation, flow, direction, chemical properties of water
  - Hydroperiod – Duration, frequency, depth, season of flooding.
  - Hydroperiod and vegetation
- Functions
  - Productivity
  - Support plants and animals

- Saltwater Ecosystem
  - Physical feature
    - Stratification – Pelagic and Benthic regions
    - Temperature
    - Salinity
    - Pressure
    - Waves
    - Tides
    - Structure
      - Phytoplankton
      - Zooplankton
      - Nekton
      - Benthos
    - Function
      - Low productivity
      - Nutrient poor

- Coral Reefs
  - Anthozoa+Algae
  - Continental shelves & submerged volcanoes
    - Fringing Reefs – Project directly seaward from the shore
    - Barrier reefs – Parallel shorelines and are separated from land by a lagoon
    - Atolls – Coral island
- Structure – Depth light, grazing competition & disturbance.
- Function – Photosythetic, heterotrophic
  - High productivity & high diversity
- Estuaries
- Mangroves

Grassland

- 42% area under grassland
- Mostly converted to agricultural land
- Characteristics
  - Rainfall 25-75 cm/yr
  - High rates of evaporation
  - Periodic severe droughts
  - A rolling to flat terrain
  - Animal life-grazing and burrowing spp.
  - Dominated by grasses
    - Sodic
    - Bunch

- GRASSLAND
- Ecological status of the grass cover
  - Grasslands
  - Burning, cutting, grazing and cultivation, shifting
  - Habitat loss, Soil and moisture conservation
  - Grassland climax, exceptionally favourable conditions bring in the deciduous forest (post-climax) and exceptionally unfavourable conditions the desert (pre-climax).

- Structure
  - Roots
  - Ground layer
  - Herbaceous layer
- Mulch
  - Reduce evaporation
  - Retard infiltration
  - Reduced CO_2 uptake
  - Insulating soil surface from solar radiation
  - Nesting cover for birds
- Animal life

- Rainfall & temperature
  - Species composition
  - Productivity
- Range of aboveground biomass
  - 0.5t/ha to 8.27t/ha
- Range of belowground biomass
  - 0.45t/ha to 47t/ha

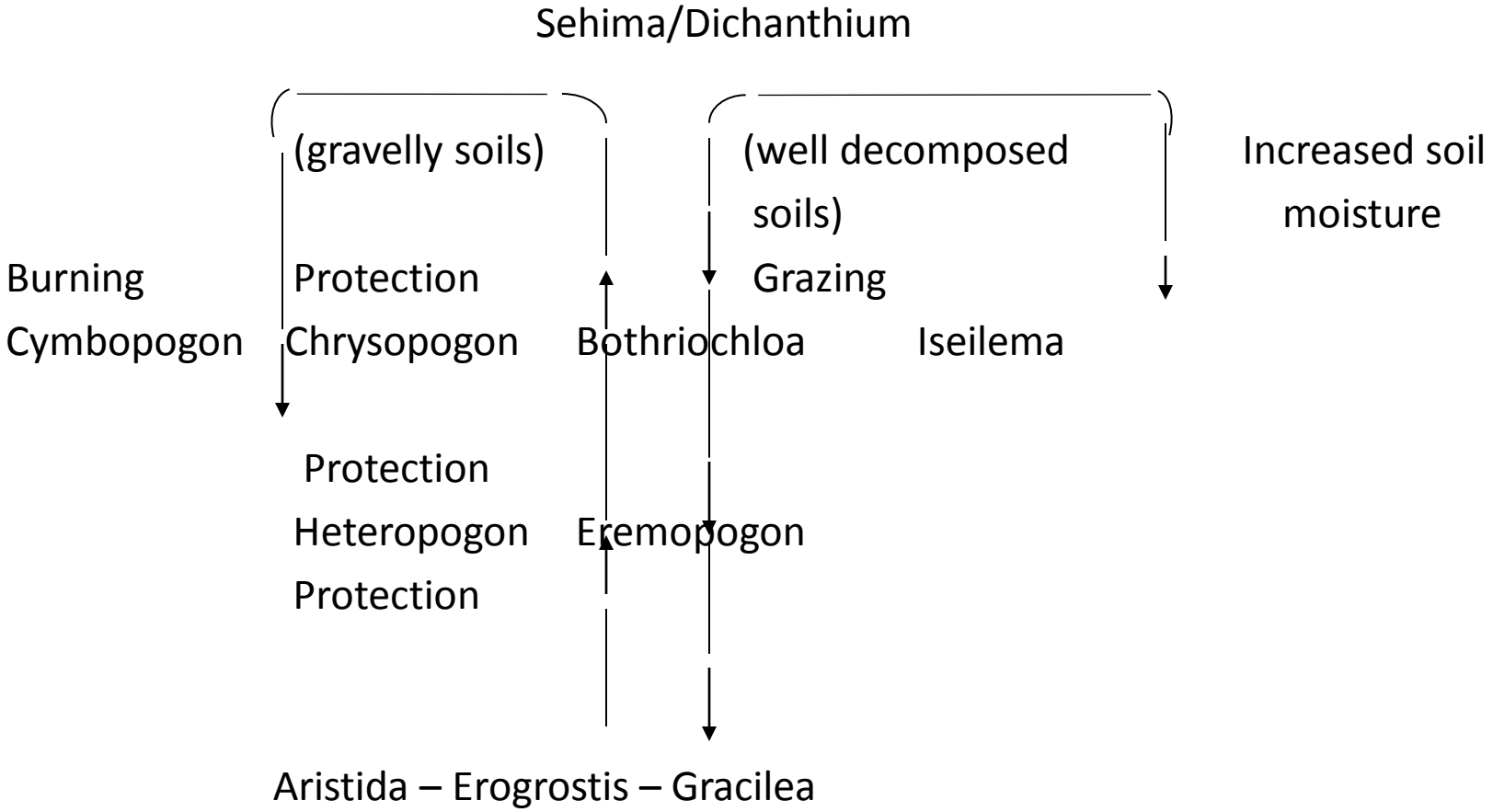
Forage productivity under different canopy cover

Table 1: Forage productivity under different canopy cover.

Site	Compartment No.	Canopy cover	Basal area m^2/ha	Forage productivity kg/ha./yr
Kalitalai	230	18%	3.5	1905
Kalmi	249	36%	7.1	934

Major type	Sub-type
Dichanthium/Cenchrus/Elyonurus	Cenchrus, Elyonurus, Cynodon, Eleusine and Aristida/Eragrostis
Sehima/Dichanthium	Cymbopogon, Chrysopogon, Bothriochloa, Heteropogon, Eremopogon and Aristida/Eragrostis/Gracilea, and the three edaphic sub-covers, Themedo/Pseudanthistiria, Iseilema and Ischaemum
Phragmites/Saccharum	Imperata, Vetiveria and Desmostachya
Themeda/Arundinella	Dimeria, Eulaliopsis, Chrysopogon, bothriochloa, Heteropogon and eragrostis/Eragrostiella
Temperate and alpine (Calamagrostis, Agrostis, Poa, Phleum, Muhlenbergia, Bromus, Holcus, Dactylis, Orgyzopasis)	

Progressive and regressive changes in a type of grass cover



Ecological trend in closed area

Table 2: Increase in forage productivity in different site closed for different period.

Site	1 Year closure	2 Year closure	3 Year closure
Kalmi	229 kg/ha/yr	934 kg/ha/yr	1295 kg/ha/yr
Bukhari	1328 kg/ha/yr	2535 kg/ha/yr	----
Kurkuta	1788 kg/ha/yr	2288 kg/ha/yr	2336 kg/ha/yr
Pathier	280kg/ha/yr	1235kg/ha/yr	1650kg/ha/yr

Tropical Savannas and Shrublands

- Characteristics
- Structure
- Function

Deserts

- Characteristics
- Structure
- Function

Forests

- Types
- Structure
- Functions