Chapter 18 – 21 : Ecology Notes

1. **Ecology:** Scientific Study of Interaction between organisms and their environment (a branch of biological sciences); inter-relationship between living and nonliving parts of the world.
   Example: How does the length of day influence migrating bird's behavior? How does the pesticides in ground water affect us? How does acid rain affect living organisms?

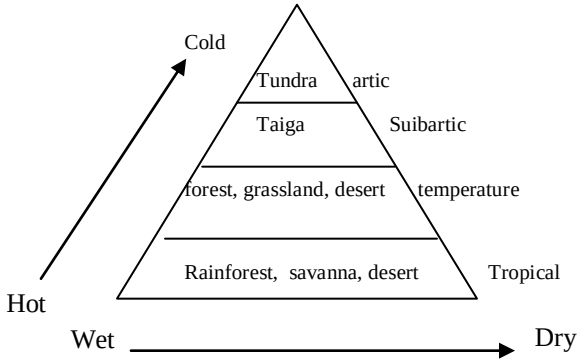
2. **Areas covered –** Biosphere (portion of the earth that supports life)
   Atmosphere
   ⇕ Where life is
   Ocean
   → Biotic factors: all the living organisms
   Example:
   → Abiotic factors: all the non livingorganism.
   Example: light, air currents, temp, soil, moisture.

3. **Level of Organization**
   (Analogous to student's home → city → state → country → earth)
   Organism: any unicellular or multicellular form exhibiting all the characteristics of life.
   ↓
   Population : a group of organisms or one species living in the same place at the same time that interbreed.
   ↓
   Communities: A collection of interacting population
   ↓
   Ecosystem: all the biotic and abiotic factors in a community.
   ↓

   Aquatic Biomes
   Marine Biome – high salt content, characteristics differ with distance from land and depth. Aphotic zone is dark while photic zone allows for photosynthesis.
   Freshwater Biome – very low salt content, flowing in rivers and streams, or standing in ponds and lakes. Plankton, microscopic algae act as producers.
   Estuary - moderate salt content due to mixing of fresh and salt water where rivers flow into the ocean.

   Terrestrial Biomes
   Tropical Rain Forest – heavy precipitation, much biodiversity, levels of niches including the canopy, understory, forest floor.
   Desert – Poor sandy soil, very little precipitation, extreme temperature, specially adapted organisms
   Grassland – rich soil, moderate precipitation and temperature, grasses and grazing animal species.
   Temperate (Deciduous) Forest – Rich soil, moderate precipitation and temperature, trees that lose their leaves, abundant wildlife.
   Taiga/Coniferous forests – acidic soil, moderate precipitation and cold temperatures, conifers or cone-bearing trees and abundant wildlife.
   Tundra - Poor soil, permafrost, very little precipitation and cold temperatures, small plant species, migratory animal species.

   Biome: a large group of ecosystem that share same temperature and precipitation – chapter 21
   ↓



   Biosphere: lithosphere (land), hydrosphere (water), and atmosphere (air).

4. **Organism Ecology**

Niche vs Habitat

Niche: the role species play in a community

Example: regarding food, space, reproduction, and how it interacts with environmental condition.

Habitat: place where an organism lives out its life

How is niche and habit different?

Example: squirrel's habitat**: forest &** squirrel's niche**: to distribute and store seed**

mushroom's habitat: moist forest soil & **mushroom's niche**: to break down and recycle organic matter.

Side note: This 17th-century borrowing from French has traditionally been pronounced (n$\bar{\imath}$ch), rhyming with *itch*. The pronunciation (n$\bar{e}$sh), rhyming with *quiche*, is a 20th-century revival of the French pronunciation, which some people dislike because they think it seems affected. However, this pronunciation is now given by most dictionaries as a standard variant.

Roles of living things

Producers: organisms that make their own food from inorganic molecules and energy (sunlight). Example: plants, bacteria

Consumers: organisms that cannot make their own food instead obtain energy by eating other organisms.

Four types of consumers

1. herbivores: organisms that eat only plants.
2. carnivores: organisms that eat herbivores or other carnivores.
3. ominovores: organisms that each both producers and consumers.

Example: Bear → ? (eats berries & fish) People →? (hamberger)

4. detrivores (scavengers):feed on bodies of dead organisms

Examples: vultures, hyenas

Decomposers: Bacteria and fungi that consume the bodies of dead organisms and other organic wastes.

5. Population Ecology

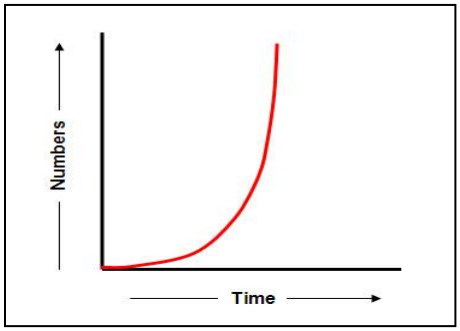
Three important characteristics of populations are geographic distribution, density, and growth rate.

Geographic distribution – the range or area inhabited **by the organism**

Density – the number of individuals per unit area

Population growth – can be calculated with the following formula:

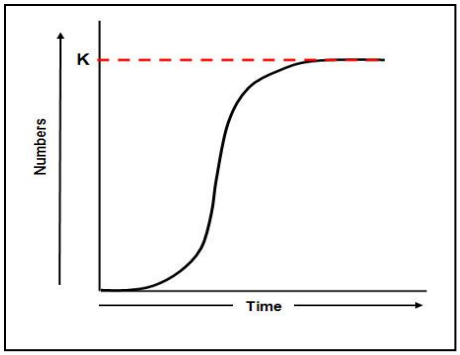
$$\text{Growth} = \frac{\text{(number births + immigration) – (number deaths + emigration)}}{\text{Time}}$$



Two types of growth:

1) exponential growth – rapid growth which forms a J-shaped growth curve

- **Starts slowly due to the lag time required for sexual maturity**
- **Occurs under ideal conditions with unlimited resources**



2) Logistic growth – initial rapid growth that slows and reaches a level of stability

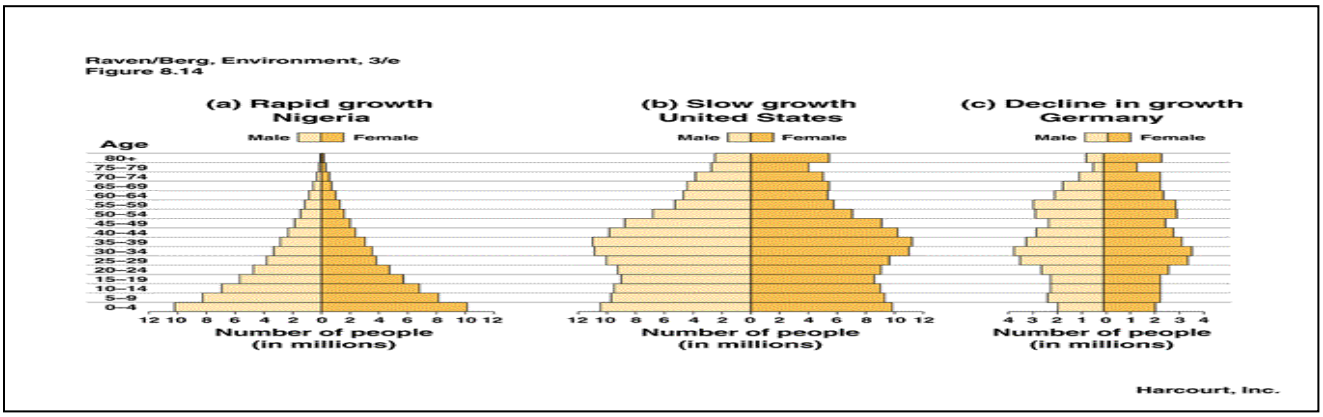
- **Starts like exponential growth but then resources become limited**
- **Reaches a carrying capacity (K) – the maximum level supported by the environment**

Limiting Factors – factors that limit the survival, distribution, or reproduction of organisms thus affecting the population size (p124-127)

- **Density-dependant factors** **– competition, predation, parasitism, and disease (numbers matter!)**
- **Density-independent factors** **– weather, natural disasters, human activities (numbers do not matter!)**

Human Population Growth (p129-132)

Human population growth is in exponential growth phase for world population. Countries have different growth rates which can be determined by examining age structure diagrams.



Growth of plants in ecosystems is often limited by the availability of nitrate and ammonia in the soil.

5. Community Ecology (Relationship for survival)

Competition: the "fight" for resources in the environment

Predation: the act of one organism feedign on another
Predator – the animal that hunts
Prey – animal being hunted

Symbiosis: the relationshiop in which there is a close and permanent association between organisms of different species.

- Commensalism: a symbiotic relationship in which one speices benefits and the other speices is neither harmed or benefited.
  Example: orchids, ferns, mosses growing on the branches of larger plants.
- Mutualism: a symbiotic relationship in which both speices benefits.
  Example: bees and flowers
- Parasitism: a symbiotic relationship in which one organism benefits at the expense of the other.
  - Example: tapeworm/round worm

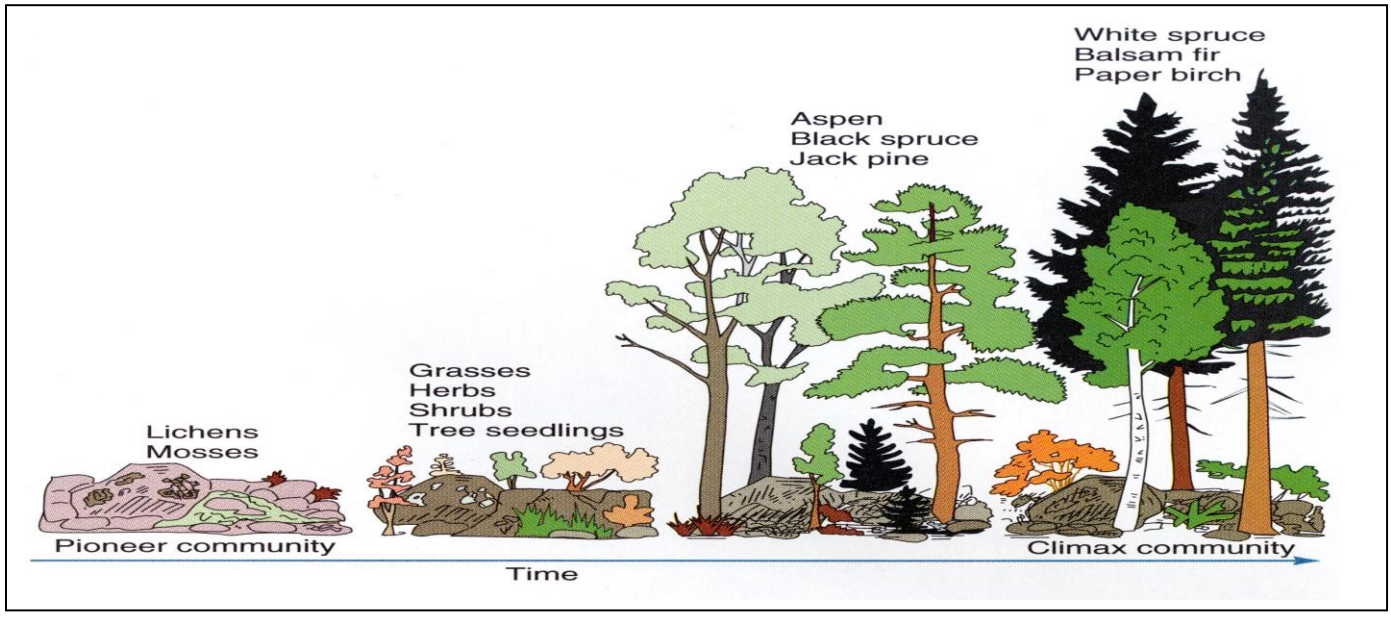
Ecological Succession

Succession involves gradual changes in an ecosystem over time. In succession, one species replaces or succeeds another.

Primary Succession – occurs when living things move onto new land. Requires a pioneer species such as a lichen.

Secondary Succession – occurs when living things recolonize an area that has undergone disturbance

Climax Community - the stable, mature community that undergoes little change.



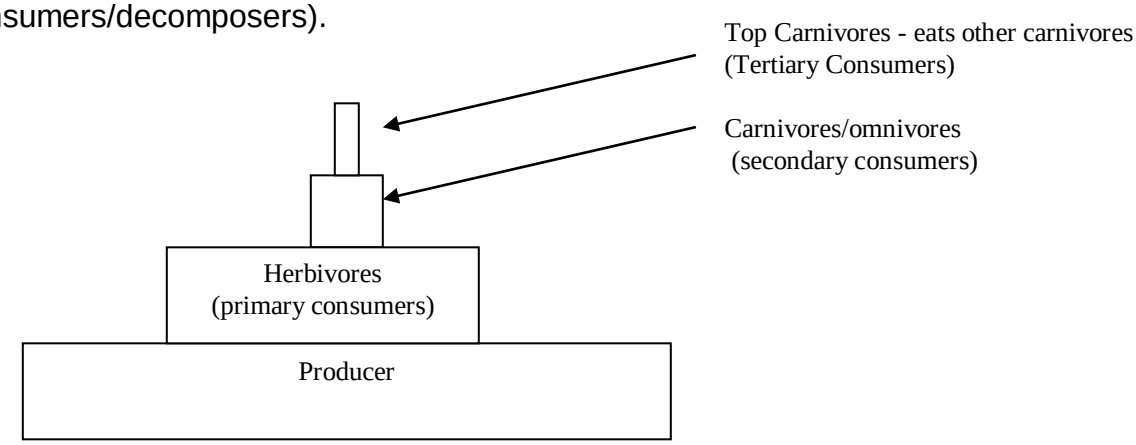
6. Ecosystem Ecology

At ecosystem level, energy and matter flow are examined.

Trophic Levels (see diagram)

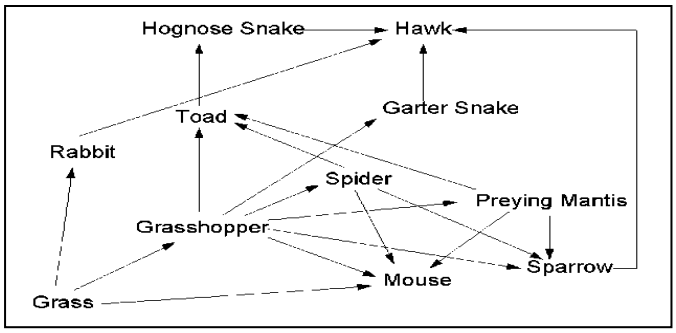
A layer in the structure of feeding relationship in an ecosystem.

Autotroph : organisms that use energy from the sun. (producers) → largest number.
Heterotroph: organisms that depend on autotrops as their source of nutrients and energy (consumers/decomposers).



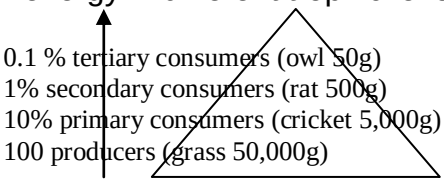
Food Chains & Food Web (handout)

Food chain: a series of different organism that tranfer food between the trophic levels of an ecosystem.
Food web: a network of food chains representing the feeding relationships among the organisms in an ecosystem.



Ecological Pyramids

Ecological pyramid is a diagram that shows the relative amount of energy in different trophic level in an ecosystem. At the top only 0.1 % of energy of producer appears



Cycles of matter in ecosystem (handout)

- **Water cycle – evaporation, condensation, precipitation**
- **Carbon cycle – photosynthesis and respiration involve CO2 exchange**
- **Nitrogen cycle – bacteria act to fix nitrogen into usable forms**
- **Phosphorous cycle – the weathering of rocks allows phosphorous to enter soil and water**

Water cycle See figure 17-12 (evaporation/transpiration →water vapor/cloud → precipitation → run off (lake) & percolation to soil → evaporation/tranpiration.

Carbon Cycle See Figure 17-13

- cellular respiration (production of CO2) → carbon into atmosphere
- death and decomposition produces fossil fuel → combustion of fossil fuel or deposited to water → carbon into atmosphere
- marine organism use dissolved CO2 in water to make calcium carbonate
- trees use CO 2 in atmosphere to make O2.

Nitrogen Cycle See Figure 17-14 organisms need nitrogen and phosphorus to build proteins and nucleic acids. Phosphorus is an essential part of both ATP and DNA.

1. **assimilation** is the absorption and incoprtaion of nitrogen into plant and animal compounds.
2. **ammonification** is the production of ammonia by bacteria duringthe decay of nitrogen contating urea (found in urine) → nitrogen fixation.
3. **nitrification** is the production of nitrate from ammonia.
4. **denitrification** is the conversion of nitrate to nitrogen gas.

7. Biome (see above)

8. Biosphere

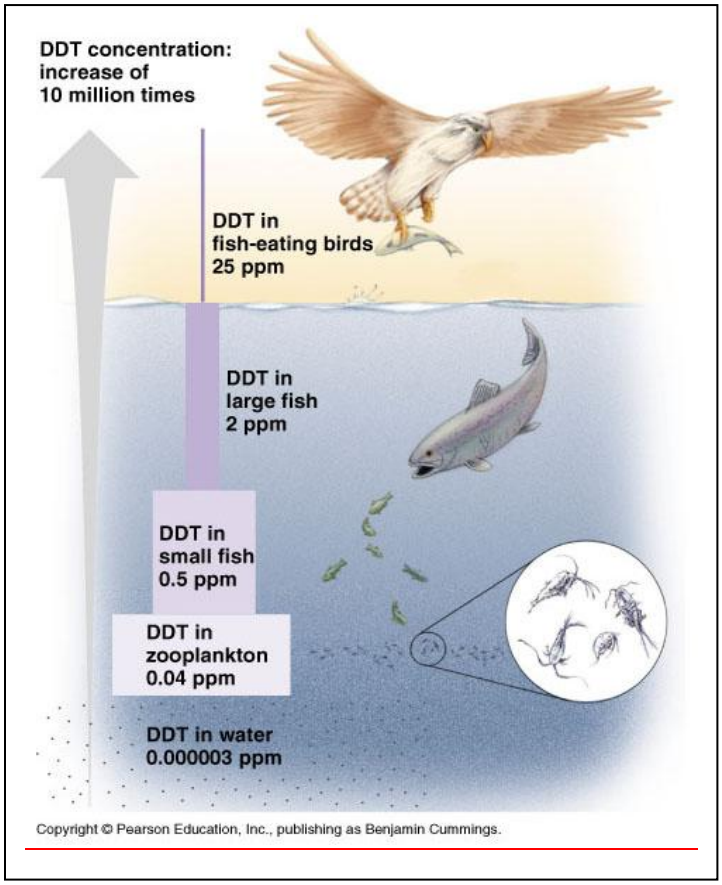
Humans impact the biosphere in many ways through the use of natural resources. This impact is often negative.

Habitat destruction

- **Deforestation and clear-cutting**
- **Solid wastes**
- **Fragmentation due to roads and power lines, etc**

Pollution

- **Greenhouse effect - due to increased carbon dioxide emissions**
- **Global warming**
- **Acid precipitation**
- **Ozone depletion – due to CFC's that break down ozone which protects the Earth from ultraviolet radiation**
- **Biological magnification Rachel Carson highlighted the dangers of pesticides and the way they build up in the body tissues (magnify) as you move up the food chain**



Threats to Biodiversity

- **Extinction – no more individuals exist in nature**
- **Endangered species – population is rapidly declining .**
- **Threatened species – population growth very low or in decline.**