Chapter 47 and 48
Ecology
Ecology is....

• The study of the interactions of organisms with one another and their physical surroundings
Biosphere

- Part of earth where life exists
- Includes land, air, water and the life that lives in these areas
- 8 km up and 8 km (5 MILES) down
Ecosystem

• A given area's physical features and living organisms
Abiotic factors

- Non-living parts
- Ex. Rocks, wind, water
Biotic Factors

- Living parts
- Ex. Plants, animals
Community

• All the organisms living together in an ecosystem
• Ecosystems are all interconnected
• They function together
• Ex. Forest raccoons might eat pond crayfish
Succession

- Occurs in all ecosystems because the living things cause the ecosystem to change
Ecological Succession

• The process by which an existing community of organisms is replaced by a different community over periods of time ranging from a few decades to thousands of years.
Primary Succession
Succession where no living community existed

- Ex. Volcano
- Pioneer species – organisms that first colonize the area
- Make it possible for new organisms to move in
• Ex. Lichens – produce acids and break down rocks → soil

• As new species move in old ones may disappear
Ex. Ponds and lakes can fill in and turn to a forest.
• Natural disasters or farming can cause succession to begin again → secondary succession
Secondary Succession
Climax Community

- End result of succession
- A stable group of organisms
- Ex. Old growth forest, coral reef
Climax Communities
Biome

- An environment that has a characteristic climax community
- Plants define the community
Land

- Tundra
- Taiga
- Temperate Deciduous Forest
- Grassland
- Tropical Rainforest
- Desert
Tundra
Taiga
Temperature Deciduous Forest
NORTHEAST DECIDUOUS FOREST

SEVENTH IN A SERIES

NATURE OF AMERICA
Grassland

A patch of grassland in Urhoboland fringed by rubber plantation in the foreground.
Picture taken by Albert Aweto
Copyright: Urhobo Historical Society
Tropical Rainforest
Desert
Aquatic

- Freshwater
- Marine
- Estuaries

* Have more organisms than land biomes
Freshwater
Marine
Estuaries
Flow of Energy

- One of the most important factors
- 0.1% of sun’s energy reaches earth and is used by plants
• ½ of the sun’s energy that is absorbed is used right away, the other half is stored as carbohydrates.
• The stored half is obtained by animals when they eat plants
• They use most of it for life processes and only store a little
• Energy flows through an ecosystem.
• It does not cycle!
Energy Flow Through The Ecosystem

- Sun
- Heat
- Producers
- Consumers
- Energy
- Nutrients
- Inorganic Nutrient Pool
- Decomposers
- Heat
Producers

- Organisms that are able to make their own food from inorganic substances
- Ex. Plants and some bacteria
- autotrophs
Consumers

- Get energy directly or indirectly from producers
- Ex. Animals
- heterotrophs
Types of Consumers

- Primary – feed directly on producers (herbivores – eat plants) – ex. Rabbit and mouse
• Secondary – feed on primary consumers (carnivores – meat) ex. Cat
• Tertiary – 3rd level – eat 2nd
• Quaternary – 4th level – eat third
Omnivores

- Organisms that eat plants and animals
- Ex. humans
• Energy flows through an ecosystem from the sun to producers and then to consumers.
Decomposers

- Organisms that obtain their energy from non-living organic matter
- Eat (decompose) dead things
- Ex. Bacteria and fungi
Each step in this series of organisms eating organisms is called a trophic or feeding level.
Biomass

- The total mass of all the organisms in a trophic level
- A small amount of energy taken in by an organism is used to make biomass.
10% Rule

- 10% of the energy at one trophic level can be used by animals at the next trophic level
Open ocean
10% efficiency
(c) Fifth-level harvesting
Energy lost as heat

Decay

Scavengers

High-level carnivores
Omnivores, such as man

Low-level carnivores, including
fish, birds, reptiles

Herbivores, including fish, insects, reptiles
Omnivores, such as man

Plants produce and store energy, using solar energy

Solar Energy

Sun
Pyramid of Energy

- **Energy** transferred at each trophic level
Pyramid of Biomass

- Mass present at each trophic level.
- All of the bottom is needed to feed the next level.
Pyramid of Numbers

- Number of organisms in a particular ecosystem
Feeding Relationships

• Animals and plants are tied together in complicated networks of feeding relationships
Food Chain

• **Simplest feeding relationship**
Food Web

- Complex feeding relationships between many organisms
Figure 6.3 Food webs: (a) a typical terrestrial food web. Roman numerals identify trophic levels.
Biogeochemical Cycles

- Nutrients are recycled
- All organisms need water, carbon dioxide, phosphorus, potassium, nitrogen, oxygen and others to live
As the trophic levels eat each other they obtain the organic molecules and elements
Biogeochemical (Nutrient) Cycles

• The series of biological and physical processes that move nutrients through the environment
Cycle

• used over and over again
Water Cycle

- Evaporation and condensation
Nitrogen Cycle

- N is needed for proteins
- Atmosphere is 78% nitrogen gas - unusable
Nitrogen in the atmosphere

excess nitrogen

Nitrogen-fixing bacteria

Nitrogen-fixing soil bacteria

Nitrogen compounds

Assimilated by plants

Released to the atmosphere

Urine from animals

Dead plant matter

Decomposing organisms

Decomposers

Converted to other nitrogen
The Nitrogen Cycle

1. **Reservoir of nitrogen in atmosphere (\(N_2\))**
2. **Atmospheric fixation (\(NO_2^-\))**
3. **Fertilizers (\(NH_4^+\)(NO₃⁻))**

**Cycle Steps:**

- **Denitrifying Bacteria**
- **Animal waste**
- **Plant matter**
- **Decomposers Bacteria/Fungi**
- **Ammonia (\(NH_3\)) Ammonium (\(NH_4^+\))**
- **Nitrites (\(NO_2^-\))**
- **Nitrates (\(NO_3^-\))**
- **Fixation by nitrogen-fixing bacteria (legume root nodules)**
Nitrogen Fixation

• Process by which certain plants (legumes – beans, peas and nuts) convert nitrogen gas to a usable form of nitrogen

• Carried out by nitrogen fixing bacteria in the roots
Denitrification

- Process by which **bacteria** break down dead organisms and release the nitrogen as **free nitrogen**
- **Denitrifying bacteria**
Carbon and Oxygen Cycles

• Photosynthesis and respiration
The Phosphorous Cycle

Rain washes phosphates from the land.

Phosphate weathers from rock.

Uplifting over millions of years.

Plant wastes released into soil

Led into streams

Settle in streams & oceans

Phosphate becomes locked in rocks.

Animal wastes

Soil decomposers act on plant and animal wastes

Available for plants again

Short-term Cycle

Long-term Cycle
Nutrient Limitation

- Limiting factor: if a nutrient is in short supply and limits an organism's growth
- Ex. Nitrogen in a pond
Eutrophication

• When excess nutrients are in a body of water and cause excessive algae growth
• Caused by fertilizers and manure
Sources of Cultural Eutrophication

- Discharge of untreated municipal sewage (nitrates and phosphates)
- Nitrogen compounds produced by cars and factories
- Discharge of detergents (phosphates)
- Natural runoff (nitrates and phosphates)
- Inorganic fertilizer runoff (nitrates and phosphates)
- Manure runoff from feedlots (nitrates, phosphates, ammonia)
- Runoff from streets, lawns, and construction lots (nitrates and phosphates)
- Runoff and erosion (from cultivation, mining, construction, and poor land use)
- Dissolving of nitrogen oxides (from internal combustion engines and furnaces)
- Lake ecosystem nutrient overload and breakdown of chemical cycling
Chapter 48
Populations and Communities
Population

- Group of organisms that belong to the same species and live in a given area
Growth

- Almost any organism provided with ideal conditions for growth and reproduction will experience a rapid increase in its population.
Exponential Growth Curve

- Does not happen for long with natural populations
Logistic Growth
Once a population reaches carrying capacity it does not grow because:

1. Lack of food
2. Overcrowding
3. Competition among individuals
Factors that control population growth

- Growth is controlled by limiting factors
Density Dependent Limiting Factors

- Factors that operate more strongly on larger populations
- Large and crowded
1. Competition

- Compete for food, water, space, sunlight
- More individuals, more competition
- Niche – evolve not to compete
2. Predation

- When one species eats another
- Predators and prey exist together for long periods of time
- Defenses and counter defenses
• Prey population increases, predator population increases then the prey decrease and then the predator decrease
• Fig 48-6
3. Parasitism

- Parasites live off their hosts, weakening them and causing disease.
- Crowding is good for spreading.
- Do not kill their host too quickly.
4. Crowding and Stress

- Most animals have a built-in behavioral need for a certain amount of space.
- Ex. Territories
- Stress \(\rightarrow\) low birth rate
Density-Independent Limiting Factors

• Some organisms have boom and bust growth curves
• DILF – when population size does not effect the factor
• Ex. Natural disasters and insects on plants
The growth of a population is controlled by both density dependent and independent factors.
Human Population Growth

- Has been growing exponentially for 500 years
48-3 Interactions within and between communities
Community

• All of the populations of organisms living in a given area

• Populations in communities interact with one another in many ways.
Symbiosis

• Important relationships in nature between organisms
Parasitism

- One organism benefits at the expense of another
Commensalism

- One organism benefits and the other is not harmed
- Ex. Birds in trees
Mutualism

- Two species live in such a way that both organisms benefit
- Ex. Clownfish and anemones
Biomagnification
Nearly every ecosystem is connected, either directly or indirectly with other ecosystems.
Nature bats last.
The End