CHAPTER 22
ECOLOGY

INTRODUCTION

Definitions

Ecology is the study of organisms in their environments.

Biosphere includes all areas where organisms can be found, for an example the earth.

Ecosystem includes the study of the biotic and abiotic factors in an environment. This includes the interrelationship between the organisms in an envionment (biotic) and the interrelationship between the organisms and the environment (abiotic).

Population is a collection of organisms of the same species in a given area, for example, a population of ants, or human beings.

A community describes all the population of organisms in an area, for example in an area, all the human beings, trees, animals, and insects in that area.

Habitat is the dwelling place of an organism.

Niche is the functional role of an organism in an ecosystem.

Ecological Equivalents: Plants with similar structures and similar functional roles in different geographical areas are described as ecological equivalents. For example, Cactus (New World Desert plants) and Euphorbes (African desert plant) are ecological equivalent plants.

Competitive Exclusion Principle: This principle states that no two species may occupy the same niche, if they do, one eventually displaces the other, because of competition for nutrients, habitat and other resources. A displaced species has to be able to adapt to the environment, find another niche, in order to survive, otherwise it becomes extinct.

Generalized Niche: Species that have broad tolerance for various environmental conditions are described as having a generalized niche.

Specialized Niches: Plants or species that have very narrow tolerance to environmental conditions are said to occupy specialized niches. Such plants easily get extinct.

Food Chain: A simple linear pathway in which food is transferred from one level to the next in an ecosystem. Each food chain always begins with producers / autotrophs, followed by herbivores (primary consumers), followed by carnivores (secondary consumers and tertiary consumers), and finally omnivores.

Biological Magnification: This describes the concentration of chemical substances as they flow from one trophic level to the next. For example some insecticides (DDT) can be stored in lipids and can be transferred from one trophic level to the next as a highly concentrated toxic substance. Toward the pick of the pyramid, the chemical can become very highly concentrated that they become dangerous to humans.

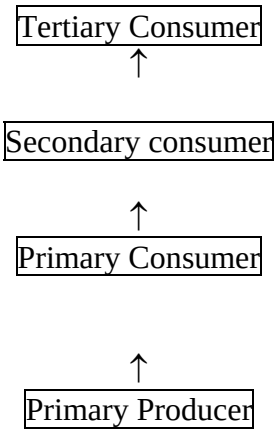

Figure 21.1. An Illustration of a simple and linear food chain starting from the primary producers up to the tertiary consumers.

Food Web: A food web consists of several food chains within an ecosystem. It is a complex interconnecting food chains in an ecosystem.
Trophic Level: Every level in the food production or consumption in the food chain or food web is called a trophic level.

Energy Flow
In an ecosystem, energy flows from one consuming level to the next. The higher up the trophic level the less energy is present. It begins with the sun (the ultimate source of energy), trapped by chlorophyll in the primary producers and converted into chemical energy. Primary consumers (herbivores) convert this chemical energy trapped in the primary producers into another form of chemical energy within their system. Energy is continuously converted from one form to another form as it passes through each trophic level. At every step of conversion a high % of the energy is lost. At the peak of the energy pyramid, the % of energy is relatively lower than at the base.

Ecological Pyramids: The percentage of energy in each trophic level if represented can be shown to form a pyramid, known as ecological pyramid. Ecological pyramids could be in numbers, biomass, or energy flow.

Pyramid of numbers: Number of organism at each trophic level.

Biomass: This is the dry mass or the actual organic materials in the living organism.

Energy: The energy content decreases up the pyramid. Only 5-20% of energy is passed from one trophic level to the next.

Biological Cycles:
Carbon Cycle: About 40-60% of the biomass (dry weight) is made up of carbon. Carbon is obtained from carbon dioxide in the atmosphere and is used in
photosynthesis. Carbon dioxide level has increased, and this is used as heat trap. The gas captures sunlight and converts it into heat, this leads to the global warming.
This is known as the greenhouse effect.

Nitrogen Cycle:
Nitrogen is an important element in the ecosystem. It is in all amino acids and nucleic acids. Plants use nitrogen in the form of ammonia or nitrates. Nitrogen from the atmosphere dissolves in the rain to form ammonia or fixed by nitrogen fixing bacteria in the nodules of legumes. Animals obtain nitrates by eating plants. When both animals and plants die, saprophytic organisms (decomposers) break down the dead organisms to release nitrogen into the atmosphere.

Ecological Succession
This represents the gradual changes that occur in an ecosystem over a long period of time, due to the modification of the physical environment of the ecosystem. This modification of the abiotic component of the ecosystem is followed by the modification of the biotic component of the ecosystem. Succession can be primary or secondary.

Primary succession is the beginning of vegetation in a bare area; for example appearance of lichens on a rock. Lichens are referred to as first plant community or pioneer species. Other plants later follow the lichens; examples are the mosses, then grasses and herbs and finally other plants.

Secondary succession: A vegetation that was destroyed by either natural forces or humans comes back to live. For example, a land that might have been destroyed by fire or man, after a period of time, begins to support vegetation.

Climax Community
In a community, where everything is stable, no new plants are growing, the community is referred to as stable.

Biomes
These are the terrestrial divisions in the biosphere. These are large climax communities in the biosphere. Biomes are determined by the climatic conditions of the area.
The amount of yearly precipitation determines whether the biome is a desert, grassland or a forest. The altitude determines the temperature, this is also very important in the development of biomes. The major biomes are:
Desert
Annual rainfall is below 10 inches, plants (Xerophytes) and animals here must exhibit adaptation to survive dry conditions.

Chaparral

The climate in this biome is hot, dry summers and cool rainy winters. This is in the California areas that have Mediterranean climate. Plants here have thick leathery leaves that reduce transpiration.

Grasslands

The average rainfall here is about 10 to 30 inches. The summers are warm followed by cool winters. Grasses are the dominant vegetation here. Examples are the Prairies (North America), Savanna (tropical areas), Tundra (polar grassland).

Forests

Examples are Boreal forest in North America, with annual rainfall is 15-40 inches; temperate rain forest, annual rainfall is 80-152 inches, trees here are also conifers. These two are called coniferous forests. There is the deciduous forest found in the eastern United States, the annual rainfall here is 30-60 inches, the trees here are oak, hickory and other hardwood. These trees shed their leaves annually. There is also the tropical rain forest in South America. In this vegetation there is diverse population of trees, up to 208 tree species can be found here as compared to 25 species of trees in the deciduous forest. This forest has seasonal changes in temperature with an annual rainfall of 80 - 180 inches of rain. The soil is poor.

Study Questions

1.Define or explain each of the following ecological terms:

- ecology
- biosphere
- community
- habitat
- niche
- ecological equivalent
- competitive exclusion principle
- a generalized niche
- a specialized niche
- food chain
- food web
- biological magnification
- trophic level

2. What do you understand by ecological pyramids?

3. Define the following: pyramid of numbers, and biomass.

4. Explain the efficiency of the energy flow from one trophic level to the next.

5. Illustrate the carbon cycle, and nitrogen cycle.

6. Briefly describe ecological succession.

7. What are biomes?

8. Describe the characteristics each of these biomes: deserts, grasslands, and forests.

9. In an ecological pyramid, supposing the energy transfer is 10 % efficient, the primary producer trapped 100,000 kilocalories, what will be the amount of energy at the tertiary consumer trophic level?

10. Explain the following: biomass, pyramid of numbers, trophic level, food chain, food web, ecosystem, population, community, biosphere, niche, habitat, biological magnification.