10.1.3 LIVING COMMUNITIES[M21]

10.1.3.1 Environment

Adaptation is the **fitness** of an **organism** for its environment. The **environment** consists of the surroundings in which organisms live and is both physical—**non-living**—and **living**. Environments are either **terrestrial**—on the land—or **aquatic**—in the water. Aquatic environments are either fresh water or marine.

Different places in which organisms live in the major environment are called habitats.

10.1.3.2 Relations between Plants and Animals

Living things adapt not only to their physical environment but also to their **living environment**—*i.e.* they must adapt to other plants and animals living around them.

Living things use each other as sources of **raw materials**. **Organisms** thus live in groups or **communities** in order to obtain their necessary food materials.

A **food chain** illustrates how various living things become the food of others and connects an animal with its food source. Food chains always begin with a plant.

Animals that use plant matter as their food and energy source are called **herbivores**, while those that use other animals are called **carnivores** and those that feed on both plants and animals are called **omnivores**.

A living community in any habitat can be represented by a **food pyramid**:

- At the base of the pyramid is the large amount of soil that supports the growth of a smaller weight of grass. As we move up the pyramid we see that this smaller weight of grass supplies food for an even smaller weight of herbivores and finally a still smaller weight of carnivores;
- **Energy** supplied to the various species of any plant and animal community comes originally from the **sun** through **photosynthesis** in the green plant. Some of the energy is passed successively as food from species to species as the food pyramid is ascended.

10.1.3.3 Cycles of Raw Materials

There is no waste of raw materials for living things because of **recirculation of chemicals**.

10.1.3.3.1 The Water Cycle

- Water is continually **recirculated** from the atmosphere to the soil and oceans
- Excess water drains from the soil to rivers, lakes and underground reserves
- Water converted to water vapour by heat energy from the sun returns to the atmosphere from the soil and oceans
- Living matter is mainly water. The density of life in a region depends on the availability of water. Deserts have few forms of life, tropical forests teem with life
- Plants and **micro-organisms** make use of water in the soil. They also **transpire** releasing water vapour to the atmosphere. During **respiration** animals return water vapour to the atmosphere and water—as urine—to the soil

10.1.3.3.2 The Carbon and Oxygen Cycle

Carbon is the **most abundant element** in **living matter**. As carbon dioxide it is present in the atmosphere and oceans. Carbon is continually recirculated as follows:

- Carbon dioxide is essential for the manufacture of carbohydrates by plants.
- Animals obtain carbohydrates by eating plants or other animals.
- Carbon dioxide is released by plants and animals during respiration.
- Plant and animal remains decayed by bacterial action yield carbon dioxide.

In photosynthesis oxygen is produced. The oxygen replaces atmospheric oxygen used in respiration. Oxygen is continually recirculated.

10.1.3.3.3 The Nitrogen Cycle

- Plants obtain nitrogen in the form of nitrates from the soil. Plants require this nitrogen to manufacture protein.
- Animals obtain their protein by eating plants or other animals. Some of this protein matter is retained in the animal body and some is returned to the soil in urine and faeces.
- Fungi and bacteria cause dead plants and animals to decay. They convert animal waste matter to ammonium salts. Bacteria convert these salts to nitrates.
- Denitrifying bacteria convert some ammonium salts and nitrates back to nitrogen.

Nitrogen is continually recirculated.

10.1.3.3.4 The Cycle of Essential Elements

- Other elements are essential for plant and animal life.
- Plants obtain these elements from soil solution.
- Animals obtain these elements by eating plants or other animals.
- When the plants or animals die and decay these salts are returned to the soil.

10.1.3.4 Communities

10.1.3.4.1 The Sea

- **Phytoplankton** convert carbon dioxide, water and mineral salts to food by photosynthesis. They float near the surface where they receive ample sunlight.
- Phytoplankton are food for small shrimp-like creatures called **zooplankton**.
- Zooplankton are food for various types of **carnivorous fish** which in turn are food for larger carnivores.
- Plants and animals die and bacterial decay returns the carbon dioxide and mineral salts to the water. Nitrogen salts are also replaced by bacterial decay of dead matter and waste material.
- In some regions, partly decayed organisms collect on the sea floor and may ultimately be transformed into **petroleum deposits**.

10.1.3.4.2 Rock Pool on a Marine Platform

In a rock pool, there is a feeding and energy interrelationship:

- **Photosynthetic algae** convert carbon dioxide, water and mineral salts to food.
- **Herbivores**—various molluscs—feed on the algae and in turn are food for carnivorous molluscs. **Detrital feeders** sheltering among the algae feed on matter undergoing decay by bacterial action. **Scavengers**, such as the crab, live on dead animal matter.
- **Filter feeders**—tube worms—present depend on waves and the high tide to bring in plankton for their food.

- All members of the community depend on waves washing into the pool to replenish the oxygen supply.

10.1.3.4.3 Stagnant Pool in a Freshwater Creek

The **energy of the community** is obtained from the **potential energy of the detritus**. The detritus consists of plant remains, faeces, the bodies of organisms and bacteria feeding on these.

- The detrital feeders are food for the carnivores.
- Special adaptations for obtaining oxygen are present in stagnant pool forms of life. The midge fly lava is able to store oxygen in times of shortage with the aid of a special pigment haemoglobin.

10.1.3.4.4 An Australian Paddock

Light intensity, daily and seasonal fluctuations of temperatures and variations in moisture content of the soil have developed plants and animals with special adaptations to survive in this environment.

- There is a **stratification of animals** depending on their ability to withstand dry conditions and heat. Some animals live in the moist conditions of the soil or leaf litter during the day and come to the surface at night. Others with effective armour-plating such as grass-hoppers remain in the drier grass layers during the day.
- Plants best adapted to the competition for light and moisture grow with the greatest speed and predominate.
- Animals need light to see and their protective colouring may be influenced by light.
- In the paddock, there is a layer of vegetation, beneath it a layer of litter and beneath this the soil. The species of grasses will depend of whether it is natural pasture or improved pasture containing legumes and imported grass species. There may also be gum trees.
- The paddock will contain a wide variety of animal life. Micro-organisms and earth worms are in the soil, various types of insects and spiders move around in the grass. Birds, permanent residents and visitors, will be present if there is cover for them. Vertebrates, ranging from lizards to cattle and sheep, may be present.
- There is an energy flow in a paddock. Primarily energy comes from the sun through plants to the animals present. The food web is:

plants $\longrightarrow$ **herbivores** $\longrightarrow$ **carnivores**

The carnivores include scavengers.

10.1.3.5 Man's Influence on His Environment

- When man cultivates the soil he removes the protective cover of vegetation and lays the soil open to erosion. This leads to loss of top soil.
- Man has decreased the numbers of native animals in settling new lands.
- New plants and animals have been imported to new lands. Some of these have been beneficial, some have been a serious nuisance. In Australia, noxious weeds, prickly pear and rabbits have been serious pests.
- Man can control pests by biological methods
  - Prickly pear with cactoblastis
  - Rabbits with myxomatosis

10.1.3.6 Problems of the Future

The very rapid growth of world population poses food production problems for the scientist.

References

Biology (7th Ed., Australian Version), Campbell, N. A., Reece, J. B. and Myers, N.. (Pearson Education Australia, 2006) [ISBN 1-74103-386-1]