

# CHAPTER 7

## Ecological Management

### PERFORMANCE OBJECTIVES

*At the end of this chapter, students should be able to:*

- *identify some of the types of association existing among different species.*
- *identify the beneficial, harmful and neutral forms of association among organisms.*
- *deduce the mode of life of a given organism from observed characteristics.*
- *discuss why living things possess a range of tolerance to environmental factors.*
- *list the biotic factors that impose tolerance on organisms.*
- *depict tolerance range with a graph.*
- *identify adaptations modified in organisms in response to environmental factors.*
- *describe the availability of water as a principal factor for plant and animal nutrition.*
- *list examples of adaptations to environmental factors.*

### INTRODUCTION

Ecology is defined as the study of living organisms and the relationships or interactions between them and their environment.

This study is relevant to a number of other disciplines such as conservation biology, wildlife management, forestry, fisheries and agriculture. In order to manage ecological systems and resources efficiently, an understanding of the associations and adaptations, which enable the organisms to survive, is necessary. However, ecological management focuses on preservation of natural resources, the environment and its species.

An association is an ecological unit in which two or more species exist in close proximity to one another than would be expected on the basis of chance. There is a close association between the living (biotic) and non-living (abiotic) components of the environment. Both affect each other and are equally important for the ecosystem.

### TYPES OF ASSOCIATION

#### SYMBIOSIS

This is an interaction between different species, which are called symbionts. Symbiosis has often been restricted to associations where both species benefit. In symbiotic association, however, at least



▲ **FIGURE 7.1** Symbiotic association – lichen (foliose lichen)

one member benefits. Symbiotic relationships may be grouped as parasitism, mutualism and commensalism. Some symbiotic associations may be obligate, whereas some are facultative.

In obligate relationships, both symbionts depend on each other to survive. Each symbiont cannot live on its own. Examples include the lichen, which is a symbiotic association between a fungus and an alga. Both symbionts benefit from this association.

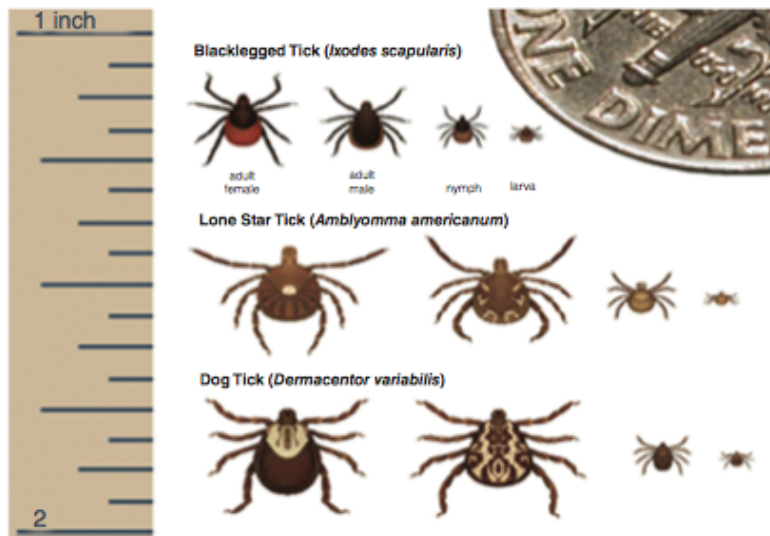
## **PARASITISM**

- Parasitism is an association between parasites and their hosts.
- A parasite is an organism that lives in or on another organism called the host and derives its nourishment from the host and injures or causes harm to the host.
- Parasites that live outside their hosts are known as ectoparasites, whereas those that live inside their host are called endoparasites. Parasites of animals include viruses, bacteria, fungi, nematodes (round worms), tape worms, flukes and insects.
- Parasites have modified structures, which enable them attach to their hosts. The effect of the parasite on the host varies. However, the parasite benefits, whereas the host does not. In some cases, the host dies.

**MUTUALISM:** This is an interaction between two species in which both species benefit. Common examples are found between plants and fungi in



▲ FIGURE 7.2 (A) Dodder (parasitic plant)



▲ FIGURE 7.2 (B) Tick (parasite of animals)

an association called mycorrhiza. In this association, the fungus helps the host plant absorb inorganic nitrogen from the soil. Termites also harbour protozoans in their guts.

The protozoans digest cellulose in wood, which forms the bulk of food for the termite, whereas the termite protects the protozoa and provides a conducive environment for their survival, and both organisms benefit.

**COMMENSALISM:** This is a symbiotic interaction between two species in which one benefits while the other is not significantly affected. The following are some examples of commensalism:

- (i) The association between the remora and the shark. The remora (a small, bony fish) attaches itself to the shark for the purpose of picking up scraps of food left by the shark while feeding.
- (ii) Some bacteria live in our large intestine. They feed on the food in our gut and do not harm us.
- (iii) Epiphytes growing on branches of larger plants do not obtain nourishment from such plants, but simply benefit by being exposed to sunlight.

## **SUGGESTED PRACTICALS**

### **ACTIVITY 1**

- (i) Teacher should take students out on a field work to observe lichens and epiphytes on trees.
- (ii) Specimens of root nodules and parasites such as *Ascaris*, ticks and liver fluke or tapeworm should be provided by teacher for observation by students.

### **FEATURES OF BIOLOGICAL IMPORTANCE POSSESSED BY DIFFERENT ORGANISMS IN AN ASSOCIATION**

Living organisms possess a number of different adaptations, which enable them survive in their environment.

### **ADAPTIVE FEATURES FOUND IN PARASITES**

- (i) Possession of organs for piercing the host and sucking nutrients from the host.
- (ii) Possession of structures for attachment to the host, such as claws or suckers.
- (iii) Ability to secrete enzymes that could dissolve tissues, thus facilitating entry into host's body.
- (iv) Ability to produce a large number of offspring to increase chances of survival.
- (v) Protective body surface (cuticle) to withstand host's digestive enzymes (for intestinal parasites).

### **TOLERANCE**

This could be defined as the ability of an organism to withstand extreme variations in the environmental conditions. Biotic components interact with abiotic components such as temperature, rainfall, high light intensity, salinity and soil factors.

The abiotic factors play a significant role in the distribution of living organisms. The limits within which organisms can withstand changes in abiotic factors depend on what is prevalent in their environment. For example, temperature can prevent a plant from surviving in an environment.

**CONCEPTS OF MINIMUM AND MAXIMUM RANGE TOLERANCE:** The law of minimum tolerance was introduced in 1840 by Justice Liebig, and the law states that "the growth of a plant will be limited by whichever requisite factor is most deficient in a local environment".

This law was expanded in 1913 by V.E. Shelford by applying it to animals and considered the fact that too much of anything could be as bad as too little of it. Hence, Shelford's law of tolerance states that "the distribution of species will be limited by the environmental factors for which the organism has the

narrowest range of adaptability™.

Because organisms can only live within certain minimum and maximum limits for each abiotic factor, the range between the upper and lower limits is known as the tolerance range for that factor. For instance, for most animals, the minimum temperature limit is 0°C and the maximum limit is 42°C. Their tolerance range is 0–42°C.

Based on the law of tolerance, an organism may have a wide range of tolerance for one abiotic factor and a narrow range for another factor. An organism with a wide range of tolerance for all factors is likely to have a wide distribution.

### **GEOGRAPHIC RANGE GRAPH ILLUSTRATING MAXIMUM AND**

**MINIMUM RANGE OF TOLERANCE:** Plants and animals species can only be found in habitats within the minimum and maximum limits of tolerance to the environmental factors. These limits constitute the geographic or distributional range of the species. The branch of biology that deals with the geographical distribution of animals and plants is known as biogeography.

Variations in abiotic factors are responsible for the geographical range of species. This is also responsible for the major biomes such as tropical rainforest, grassland (Savannah), desert, freshwater and marine biomes. These have diverse species of plants and animals, which occur in micro-habitats that support it within the overall range.

### **ADAPTATION**

Adaptation is a process by which an animal or plant becomes fitted to its environment. This results in changes in structure, function and behaviour of the organism in order to increase its chances of survival in the environment. Adaptations occur when an organism encounters a new environment. This could lead to the evolution of new groups. The adaptive features could be anatomical or physiological.

Some insects mimic leaves in order to escape predators, whereas some plants produce toxins, which prevent other plants from growing near them, thus reducing competition.

### **ADAPTATION OF PLANTS**

Plants have been placed into three groups on the basis of the environmental conditions under which they grow, especially on the availability of water in the soil. The groups are hydrophytes, mesophytes and xerophytes.

**ADAPTATION OF HYDROPHYTES:** Hydrophytes are plants that have adapted to living in the aquatic environment. They can also be called aquatic macrophytes. They are either submerged or floating on the water surface. The plants can also grow in soil that is permanently saturated with water.

Their adaptive features include the following:

- (i) Possession of flat broad leaves for floatation

(ii) Presence of air sacs for floating



▲ **FIGURE 7.3** Hydrophyte – Water Lily (*Nymphaea* spp.)

- (iii) Breathing roots that are able to absorb oxygen
- (iv) Small feathery roots
- (v) Less rigid structure because water pressure supports them
- (vi) Numerous stomata, which can be on either side of the leaves
- (vii) Stomata that are open most of the time
- (viii) Thin cuticle, which would not stop water loss
- (ix) They have succulent stem

Examples of hydrophytes include water lily, water lotus and water hyacinth.

**ADAPTATION OF MESOPHYTES:** Mesophytes are plants that grow in areas of moderate water supply. They are terrestrial plants. Mesophytes make up the largest ecological group of terrestrial plants. However, they do not have any specific morphological adaptations. Some adaptations found in mesophytes include the following:

- (i) Presence of well-developed vascular bundle
- (ii) Presence of large thin leaves
- (iii) Presence of large number of stomata on the under surface of the leaves
- (iv) Presence of well-developed roots which often branch
- (v) Presence of erect and branched stem

Examples of mesophytes include mango, orange, neem, maize and sunflower.



▲ **FIGURE 7.4** Xerophyte (cactus)

**ADAPTATION OF XEROPHYTES:** Xerophytes are plants that grow in dry areas with little water or moisture such as deserts. Adaptive features of xerophytes include the following:

1. (i) Reduced leaves that are reduced to spines and tiny scales to reduce water loss
2. (ii) Reduced number of stomata to reduce water loss
3. (iii) Sunken stomata to reduce transpiration
4. (iv) Large hairs on surface to reduce water loss
5. (v) Succulent leaves and stems to store water
6. (vi) Deep root system to absorb water from depths

Examples include cactus, opuntia and pine.

### **ADAPTATIONS OF TERRESTRIAL ORGANISMS**

1. Most terrestrial organisms possess well- developed supporting or skeletal systems.
2. The flight birds and mammals possess light skeleton to enable them swing in the air.

3. The climbing animals possess long curved claws for support or nuptial pads to help them grip surfaces.
4. Some grassland and desert animals exhibit protective colouration to prevent easy detection by predators or prey, e.g., chameleons, snakes.
5. The herbivores graze on a variety of forage.
6. Most weak animals possess keen eyesight and can run fast to escape from their predators.
7. They have well-developed sense organs.
8. Some possess impermeable coverage to prevent water loss, e.g., monitor lizard and ant eater.

## **EFFECTS OF AVAILABILITY OF WATER ON ADAPTIVE MODIFICATION**

All terrestrial organisms face the problem of water loss from their body fluids to the environment. The body fluids of these organisms are maintained by specialised osmoregulation or excretory organs such as malpighian tubules and kidney. A balance must be achieved between the amount of water lost and gained.

Many aquatic organisms especially those in fresh water environment have their body fluids more concentrated than their surroundings and as such gain water by osmosis. In order to minimise this, they have impermeable outer covering. On the other hand, those with body fluids less concentrated than their surrounding would lose water to their environment. The water lost is replaced by drinking much water from the environment.

## **STRUCTURED ADAPTATIONS OF TADPOLE AND FISH**

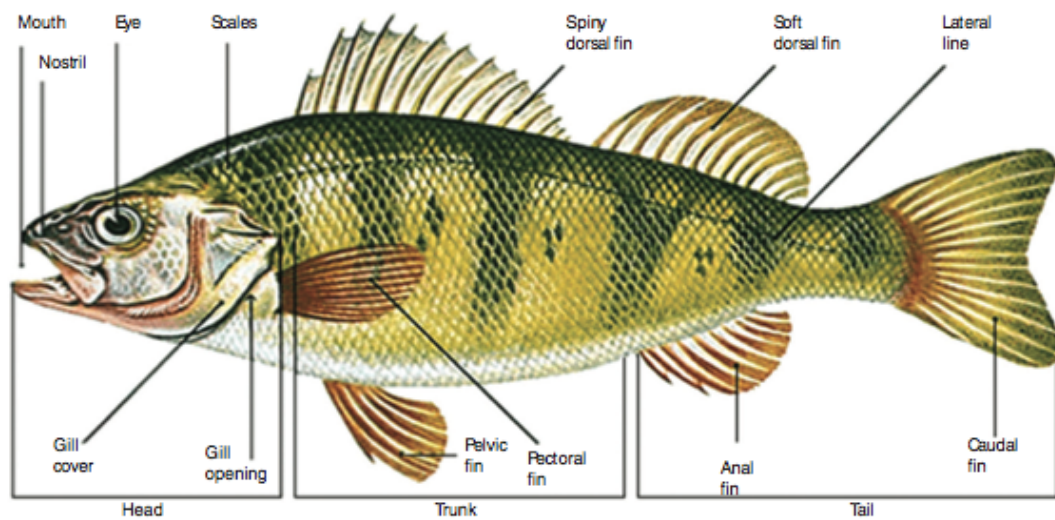
Structured adaptations shown by tadpole and fish are as follows:-

1. (i) Their body is streamline in shape and neck is absent. This makes movement in water easy.
2. (ii) Gills are present and are used for gaseous exchange.
3. (iii) Fins are present and used for swimming.

## **STRUCTURED ADAPTATIONS IN BIRDS**

Carnivorous birds like the eagle and hawk have strong hooked beaks for killing prey and tearing their flesh. Their feet are strong and have long sharp claws for catching the prey and holding it tightly while in flight. They also have keen eyesight.

Birds such as ducks have webs between their toes. These serve as paddle while they are swimming. Their beaks are flat, grooved and ridged on the inside to enable them grip fish and sieve muddy water for fishing. The domestic fowl has short, strong beak. The feet are strong but have blunt nails, which they used for scratching the earth in search of worms and grains. Parrots have strong curved beaks used for climbing and cracking hard seeds, while two toes of the feet point backward, for gripping and support.



▲ **FIGURE 7.5** Adaptations of fish (streamlined Shape)



## BIRD BEAKS



duck



gul



eagle



cross bill



night hawk



avocet



wood pecker



parrot



flamingo



kiwi



spoon bill



pelican

▲ FIGURE 7.6 Adaptation of beaks and feet of birds

## SUGGESTED PRACTICALS

- (i) Teacher should place the students in groups of five and take them out to the school compound. Students should be asked to identify organisms involved in various associations.
- (ii) Students should be guided by the teacher to collect specimens of aquatic plants and herbaceous plants from the terrestrial environment and list features they possess and also their differences. Students should relate the features to the habitats in which the plants live.

## CHAPTER SUMMARY

â- In the ecosystem, there are a wide variety of living organisms, which exist mainly through their food relationships. The types of interactions or associations can be grouped broadly into predator-prey relationships and symbiotic

relationships. Virtually, all organisms are fed upon by a predator.

â- The size of the predator population is affected by how much prey is available and the prey population is to some extent regulated by its predator. Other forms of symbiotic associations are parasitism, mutualism and commensalism. Some associations may be facultative, whereas others may be obligate. The biotic component also interacts with the abiotic components of the ecosystem, thus making the ecosystem a functional unit. The abiotic component plays a vital role in influencing the distribution of living things.

â- Adaptations are features, which may be structural, physiological or behavioural, exhibited by living organism, enabling them to live and reproduce in a particular environment.

â- Organisms develop modifications known as adaptations, which enable them survive in their environment. The adaptations vary from one organism to another and from one environment to another. The ability of organisms to withstand extreme variations in environmental conditions is known as tolerance. Organisms have a range of tolerance in any environment.

## REVISION QUESTIONS

Choose the correct options to the following questions.

1. An ecological unit in which two or more species of organisms occur in close proximity is known as

a. adaptation. b. assimilation. c. association. d. commensalism.

2. Parasites that possess boring organs for penetrating the host body are called

a. Indoparasites b. Endoparasites c. Exoparasites d. Underparasites

3. The ability of an organism to withstand extreme variations in environmental **conditions is known as**

a. tolerance. b. toughness. c. resistance. d. adaptation.

4. The features that helps an organism to survive and exploit its environment is known as

a. modified features. b. structure features.

c. adaptive features. d. enhanced features.

5. The characteristics that increase as an organism's potential to survive in its **environment is called**

a. association. b. adaptation. c. modification. d. tolerance.

## ESSAY QUESTIONS

1. Define the term association with respect to ecological management.

2. Explain the term commensalism, giving one example.

3. State the law of tolerance and explain the term tolerance range.
4. What do you understand by the term adaptation?
5. State five adaptive features of terrestrial organisms.