CHAPTER 7

Ecological Management and Conservation

Associations

Interactions or relationships of various kinds exist between two or more individuals in a community. These interactions are called associations and they may be harmful, beneficial or provide no benefit to at least one of the partners. Associations among organisms in an ecosystem or community include, parasitism, saprophytism, symbiosis and commensalism.

Parasitism

This is an association between two living things in which one organism called a parasite depends on another organism called the host for its food.

The host is often harmed by the parasite. Hence, a parasite is a living plant or animal which derives its food from another organism which is often harmed in the process.

An example of plant parasite is *Dodder cuscuta* which is a parasite on many cultivated plants such as cashew.

Another plant parasite is mistletoe (Fig. 7.1), which is a partial parasite on plants like cocoa and kolanut trees. Both parasites have special absorbing organs called haustoria with which they absorb food from their hosts. Mistletoe absorbs part of its food, but can also photopsynthesize using the green leaves it possess, the water and mineral salts it absorbs from its host.

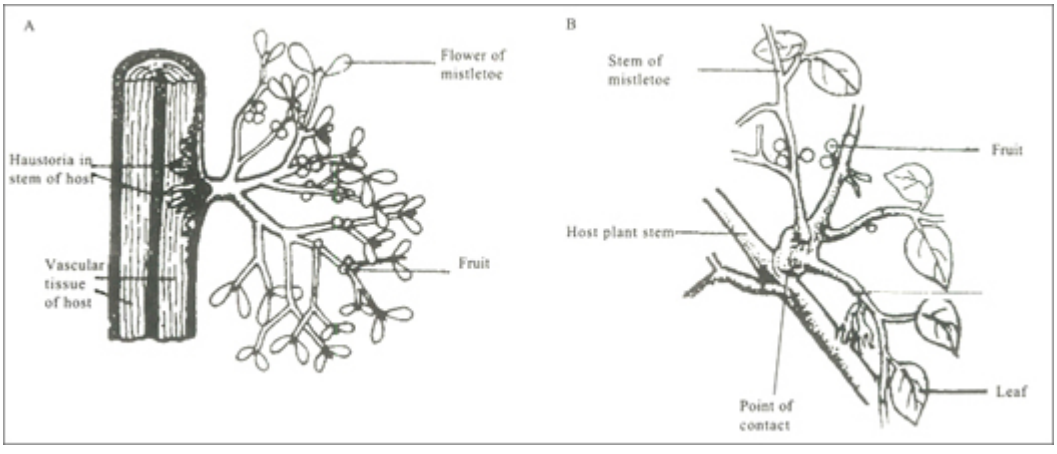

Fig 7.1 A longitudinal section of a branch of the host of mistletoe (childrenâ€™s

matchsticks) showing the parasiteâ€™s absorbing organs. B.A typical African mistletoe. (Loranthus) on its host.

Parasitic fungi cause diseases in plants. Examples are blast a disease of rice, smut and rust which affect cereals.

Many bacteria are parasitic on animals in which they cause diseases. Examples include gonorrhoea, leprosy, syphilis, tuberculosis, typhoid and whooping cough (see Chapter 4).

Animal parasites are found either inside or outside their hosts. Those that live inside their hosts are called endoparasites. They include roundworms, hookworms and tapeworms, which are found in the human intestines. Others are threadworms found in the rectum of humans and the blood fluke which causes bilharzia or schistosomiasis in human beings. A patient of bilharzia usually passes blood with his urine. Animal ectoparasites are those that live outside their hosts. Examples are lice *(Fig. 7.2)* and fleas on human hair, ticks on cattle and dogsâ€™skins.

N.B.
For the life cycles of the pig roundworms and tick, See Chapter 10.

Adaptation of animal parasites
Ectoparasites and endoparasites of animals show many adaptations including the followings:

1. Absence of unwanted organs like lack of digestive organs resulting in improved ability to absorb digested food all over the body e.g. tapeworms.

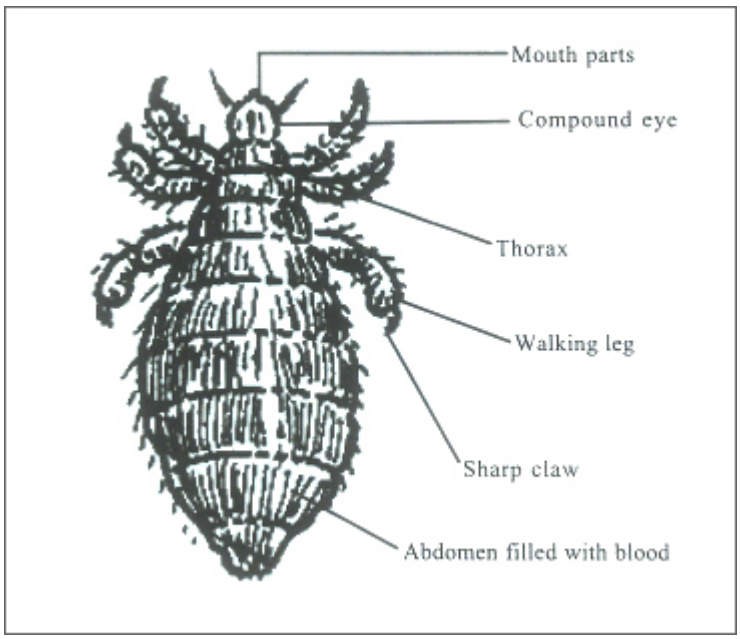

Fig 7.2 The head louse has sharp claws for attaching itself firmly to the hostâ€™s skin while it sucks blood

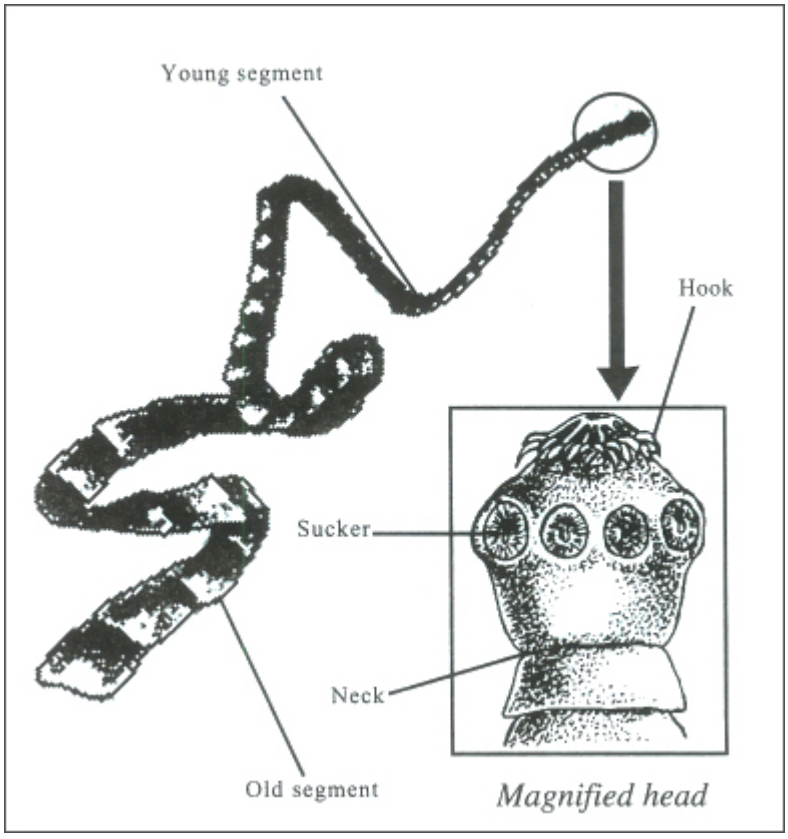

Fig 7.3 A mature pork tapeworm from the human intestine. The beef tapeworm is similar except that it has no hooks on its head or scolex

2. Possession of organs for piercing and sucking nutrients from the host e.g. proboscis in houseflies and mosquitoes.
3. Presence of organs for attaching themselves firmly to their hosts, e.g. claws in bed bugs and lice, hooks in tapeworms *(Taenia solium*, i.e. pork tapeworm).
4. Advanced/well developed mode of reproduction whereby most are hermaphroditic ensuring ease of fertilization. In addition, large numbers of eggs are laid, ensuring survival of many. These eggs are encysted to enable them pass through unfavourable conditions and still survive. Those not hermaphroditic exhibit forms of asexuality by budding off.
5. Loss of certain parts of the body such as the sense organs like eyes and ears in tapeworms and roundworms. Poorly developed muscular and nervous systems.

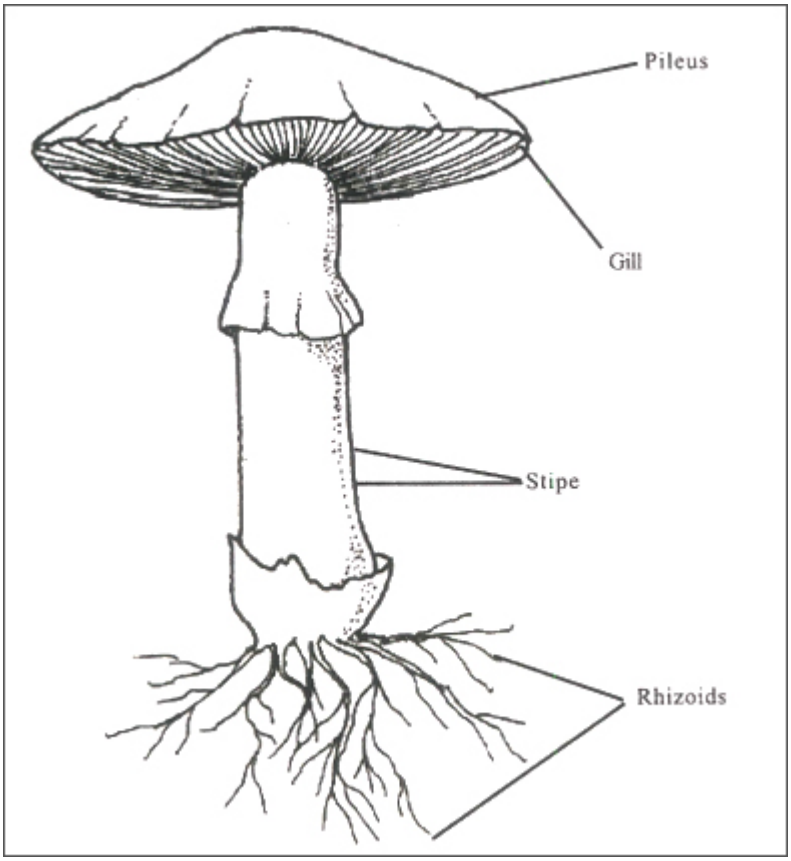

Fig 7.4 A mushroom (Agaricus)

Saprophytism

Saprophytism is an association between a living thing and non-living thing. Thus, a saprophyte is an organism that derives its food from dead organic matter.

Examples of saprophytes are, a number of bacteria, and fungi (e.g. *Mucor*, mushrooms *(Fig. 7.4), Rhizopus* and toadstools) and some nematodes in the soil.

Saprophytic fungi, like mushrooms and toad stools, which feed on decaying humus, help in the decomposition of organic matter. Moulds like *Mucor, Rhizopus* and *Pencillium*, which grow on stored foods (e.g. moist bread and cooked yams), cause these foods to decay. As a result, they cause great economic losses especially in the case of stored cereals.

Symbiosis or Mutualism

This is a relationship between two living things in which the two benefit from one another. Each member is called a symbiont.

Examples of symbiotic associations include the following:

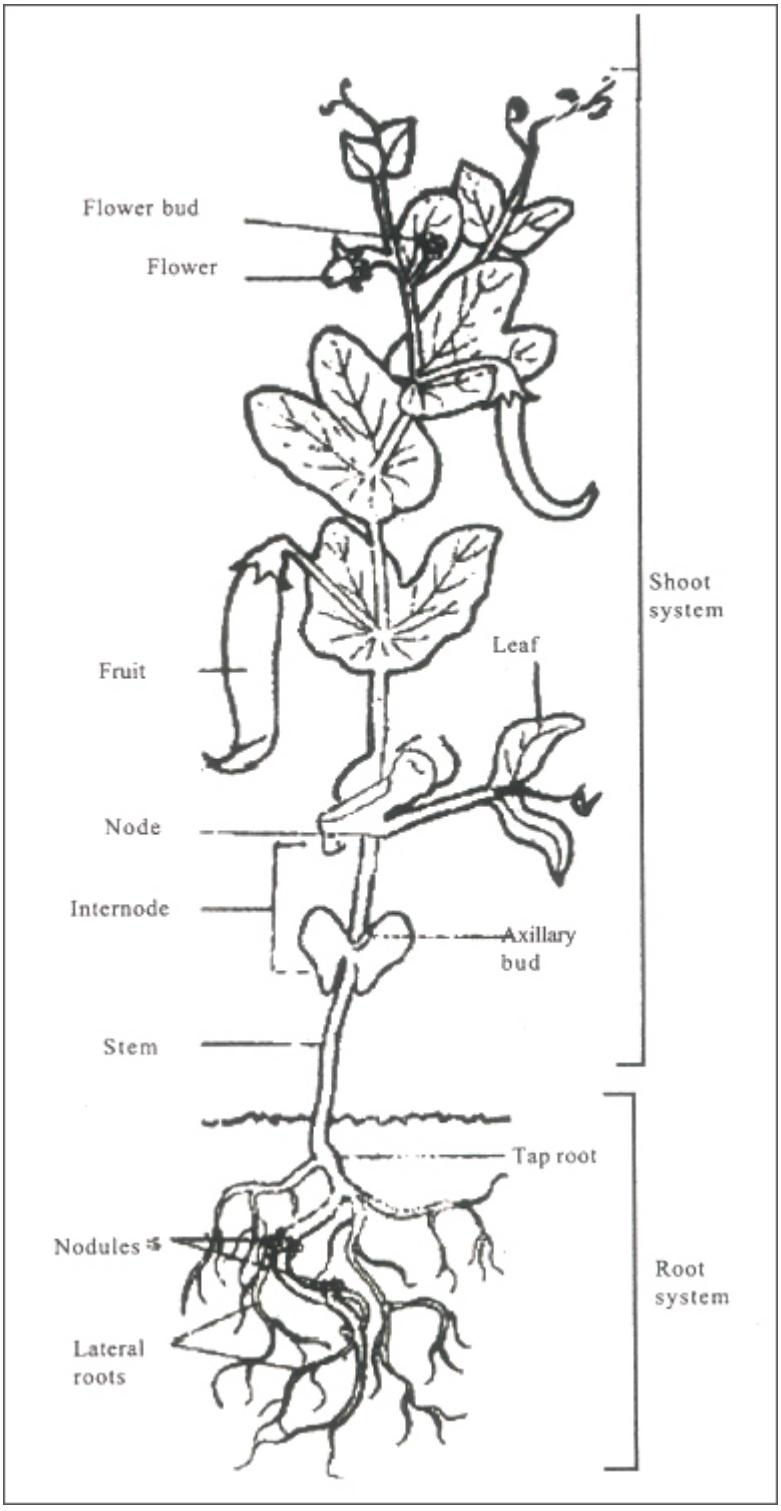

Fig 7.5 Parts of the garden pea showing nodules on the roots.

1. The association between algae and fungi to form lichens (Chapter 4).
2. Protozoa in the intestine of termites. The protozoa helps the termite to digest the cellulose in their food, while the protozoans are protected and given food by the termites. Bacteria and protists which live in the rumen of ruminants (e.g. sheep, cattle and goats). These micro-organisms obtain food and shelter from their hosts. In return, the micro-organisms help the mammals to convert the

cellulose in the food they eat to sugars. They also synthesize amino acid and vitamins from other substances present in the food consumed by their hosts (mammals).

3. Nitrogen-fixing bacteria in the root nodules of leguminous plants. *Rhizobium*, a bacterium living in the root nodules of legumes (See *Fig. 7.5*) obtains nutrients from the cells of the host plant at the same time grows and multiplies there. In return, *Rhizobium* fixes nitrogen into the soil, thereby increasing the nitrogen compounds required by the legumes.

Commensalism

The association between two living things, in which only one benefits while the other is neither harmed nor given any benefits is called commensalism. Each member is called a commensal. Examples include the following:

1. Egret and cattle. The egret picks off some of the ticks on the skin of the cattle thereby helping the cattle get rid of the parasitic ticks thus, enabling the cattle thrive and become more productive. The egret neither loses nor gains from this association.
2. A tiny fish called *Remora* attaches itself to the body of a shark and is carried along by the shark. The fish feeds on the food particles left over by the shark. The shark is not harmed by the fishâ€™s presence. Neither does it gain from it.

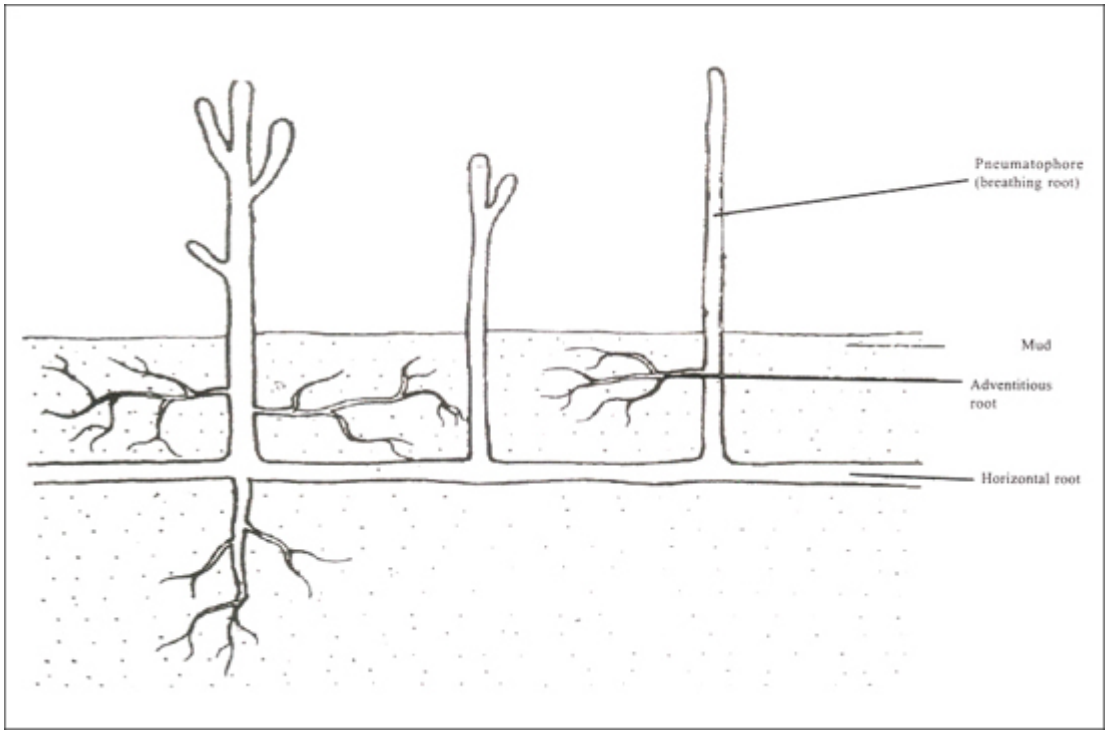

Fig 7.6 Pneumatophores of Raphia palm. The breathing roots protrude above the mud in which the roots grow horizontally.

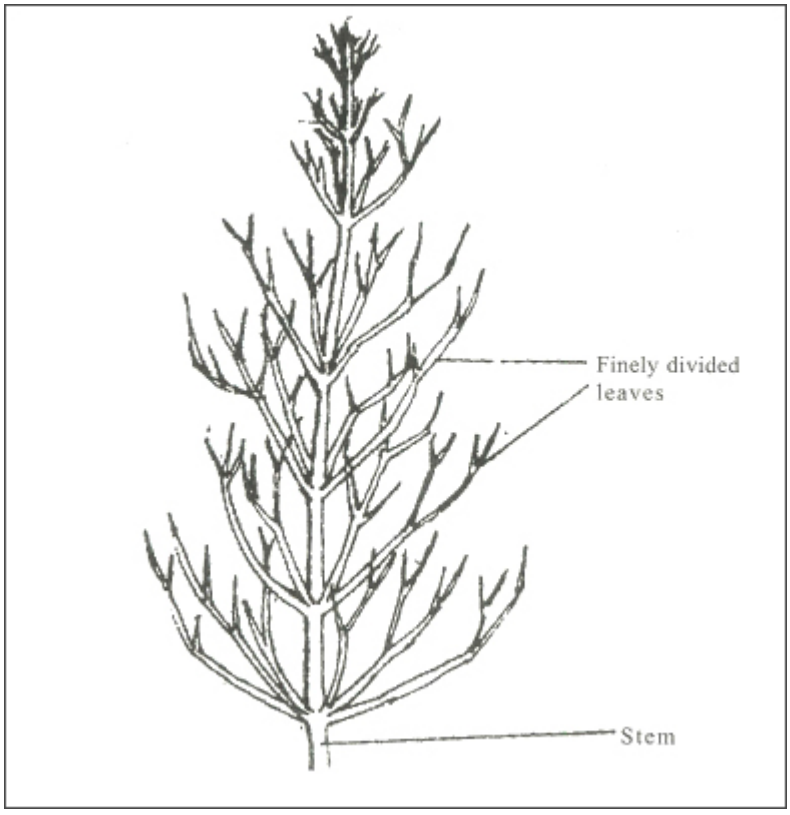

Fig 7.7 Ceratophyllum with many tiny, finely-divided leaves which give a large surface area to absorb enough carbon(IV) oxide for photosynthesis

Adaptation to environmental factors

Adaptation is the ability of an organism to live successfully in a particular habitat as a result of its structure, appearance, and behaviour. Every organism must be adapted if it is to survive in its environment.

The various adaptations shown by animals and plants to aquatic and terrestrial habitats are discussed extensively in Chapters 8 and 9 of Book 2, while adaptation for survival is discussed in detail in Chapter 9 of Book 3.

Adaptation of plants to aquatic habitats

1. Some plants have breathing roots or pneumatophores for gas exchange, e.g. *Avicennia* (white mangrove), *Raphia* palm *(See Fig. 7.6)* and red mangrove *(Rhizophora).*
2. Possession of air spaces in the tissues for buoyancy, e.g. *Ceratophyllum (See Fig. 7.7)*, water lily *Nymphaea (Fig. 7.8*, and water lettuce, i.e. *Pistia (Fig. 7.9).*

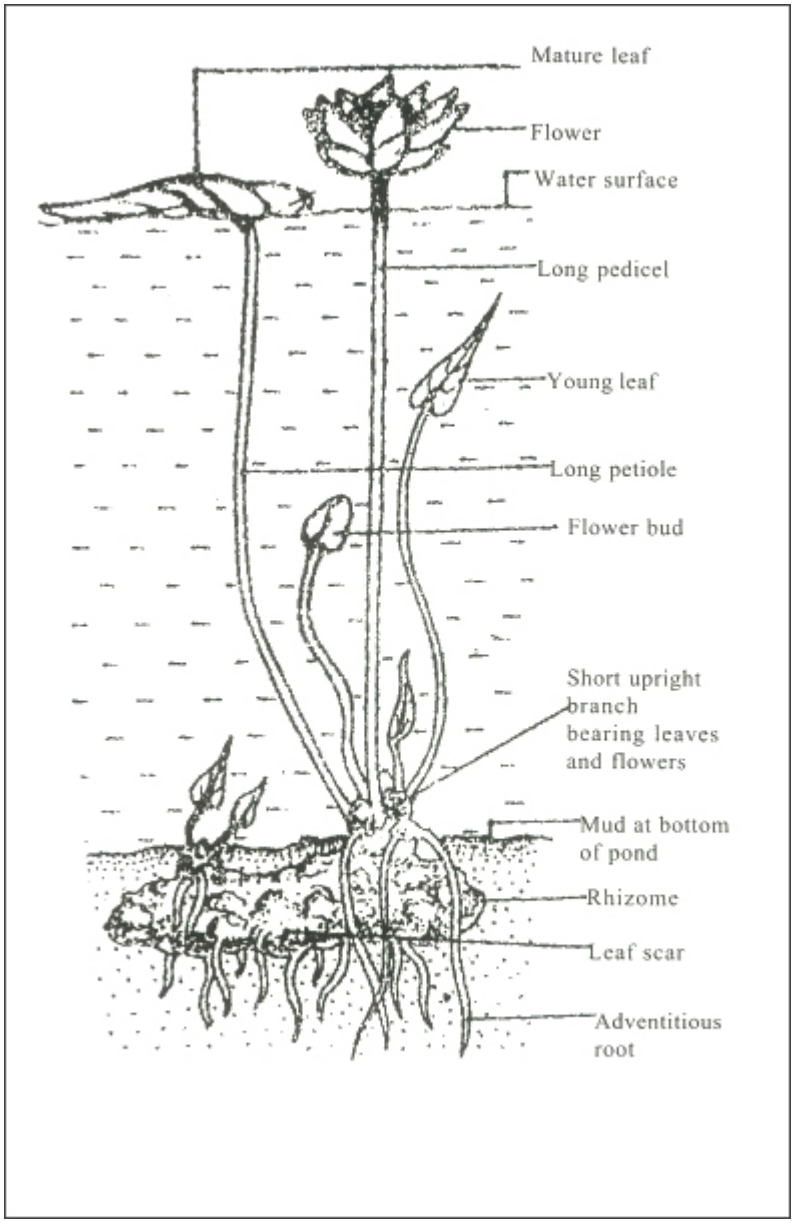

Fig 7.8 Water lily (Nymphaea) with mature leaf and flower floating on water suface.

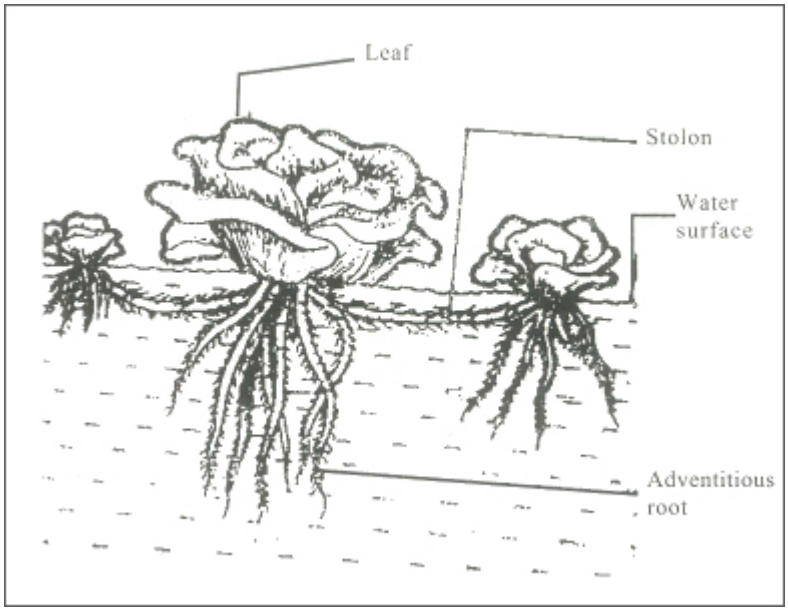

Fig 7.9 Water lettuce (Pistia) with waxy leaf cuticle which is water repellent.

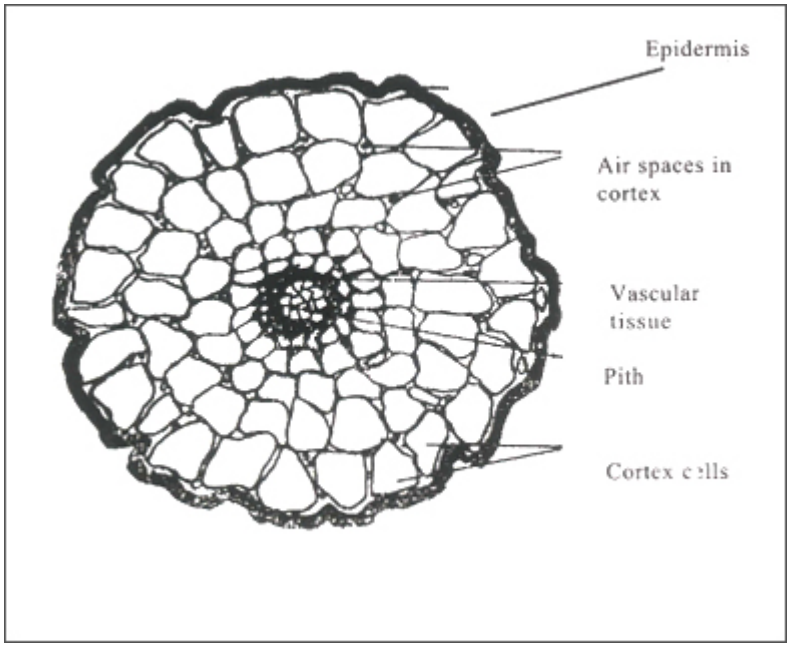

Fig 7.10 Transverse section through the stem of a water plant. Note the large air spaces in the cortex which keep it bouyant.

3. Possession of waxy cuticles on leaves to prevent wetting, e.g. water lettuce *(See Fig. 7.9).*
4. Possession of long stems and flower stalks to expose the flowers and leaves, e.g. water lily *(See Fig.7.8).*
5. Typical roots are absent but adventitious roots or rhizoids may be present, e.g. water lettuce *(See Fig. 7.9).*
6. Some plants have air floats on their leaves, stems and petioles (e.g. water hyacinth) which keep them buoyant.

Adaptation of plants to terrestrial habitat

1. Many plants have thick, waxy cuticles or hairs on leaves to prevent water loss due to transpiration.

2. They also have thick barks on the stems to protect the tissues. In tropical savannas, such barks protect the plants from the annual fire attacks.
3. Some leaves are modified into thorns (e.g. *Euphorbia*) or reduced in size to prevent excessive water loss, e.g. *Casuarina* or whistling pine *(Fig. 7.11)*.

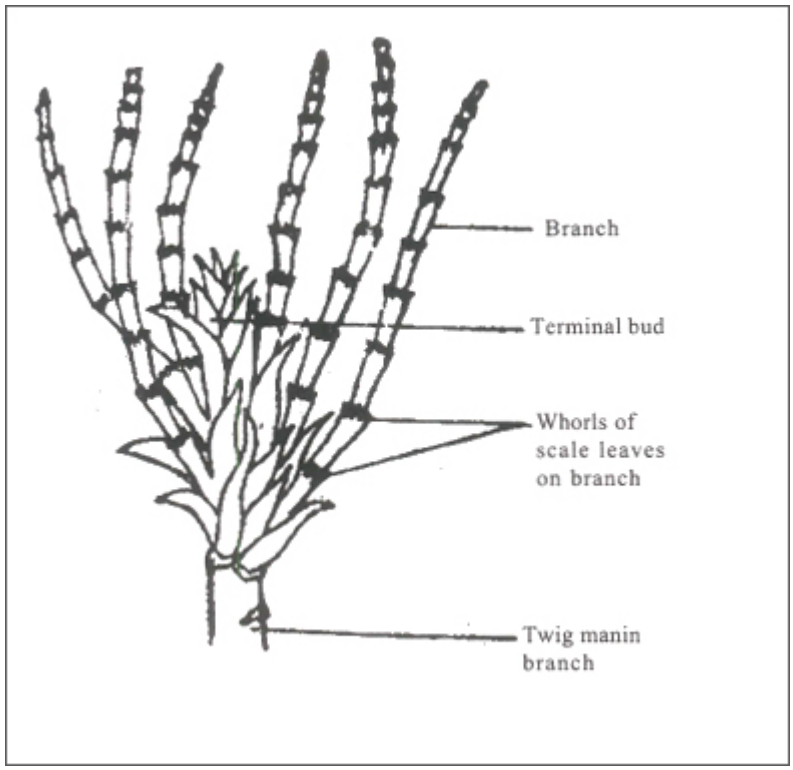

Fig 7.11 A twig of Casuarina tree with leaves reduced to scaly-leaves

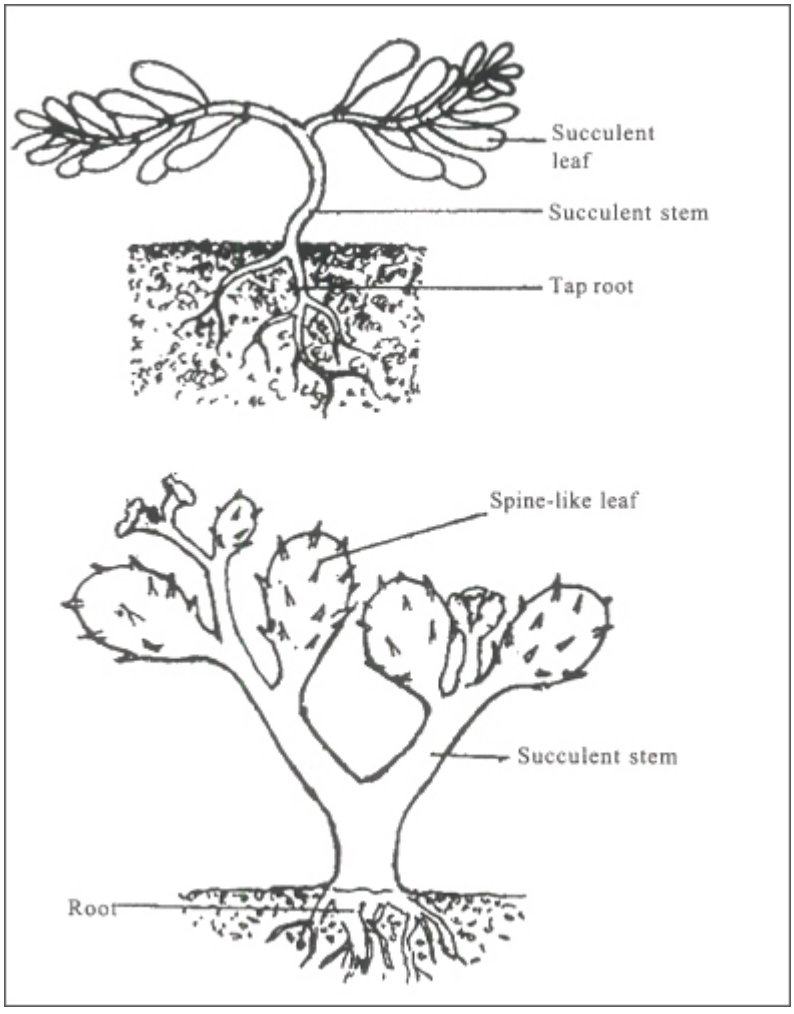

Fig 7.12 A. Portulaca with succulent leaves.
B. Cactus stores water in its succulent stem and has tiny spine-like leaves

4. Some leaves have sunken stomata (e.g. Sahara grass) or reduced number of stomata to reduce water loss.
5. Some leaves are reduced into spines (e.g. *Cactus, Fig. 7.12B*), while many desert plants are leafless.
6. Possession of thickened and succulent stems for water storage, e.g. *Opuntia*, many cacti, sisal, hemp, *Bryophyllum* and *Portulaca (See Fig. 7.12A*).
7. Possession of extensive root system. Many plants that live in arid regions (e.g. hot deserts) have many roots which grow deep into the soil and spread out to increase their chance of tapping deep water supplies.

Adaptation of animals to aquatic habitat

1. Possession of gills (e.g. fish) and breathing tubes or trumpets (e.g. mosquitoe larvae) for breathing.
2. Possession of swim bladder for bouyancy in water, e.g. fish *(See Fig. 7.15).*
3. Possession of lateral lines for detecting vibrations, e.g. fish *(See Fig. 7.14).*
4. Possession of streamlined body to facilitate easy movement in

water, e.g. fish and frog.

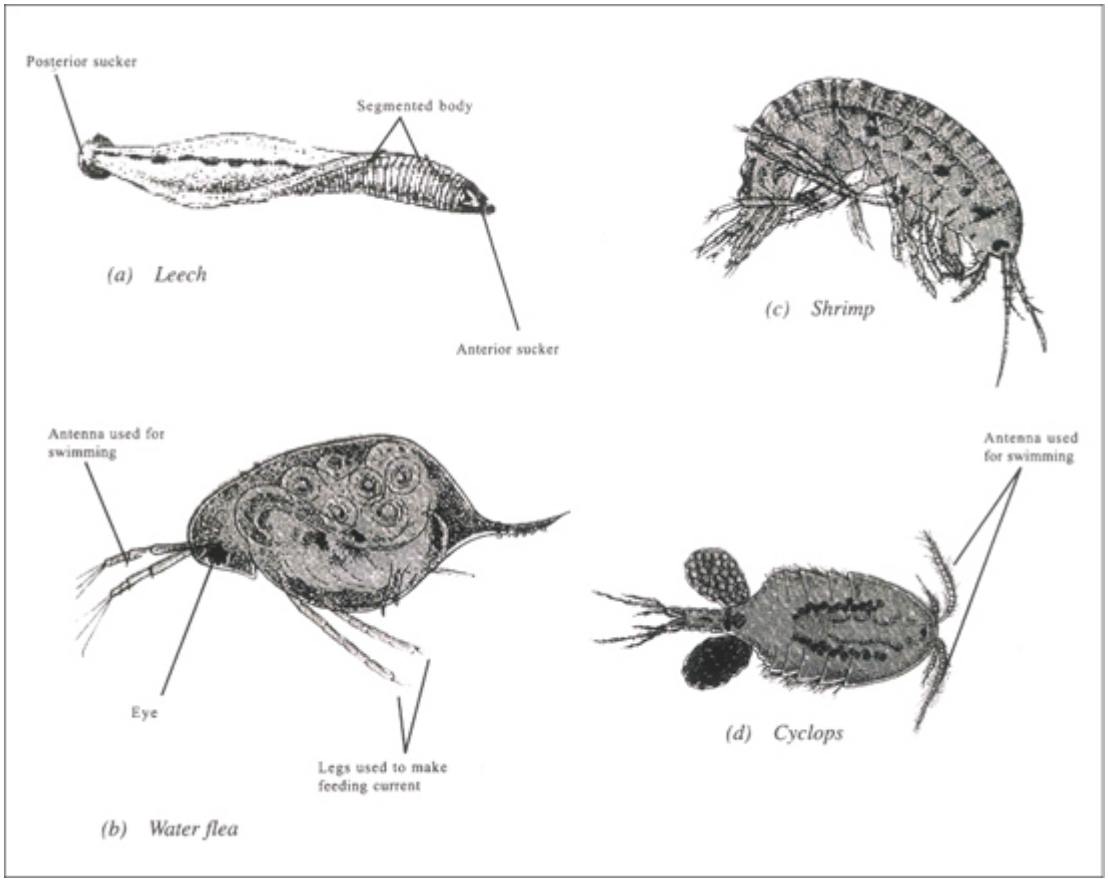

Fig 7.13 Some freshwater invertebrates. A. Leech. B. Water flea. C. Shrimp. D. Cyclops

5. Possession of fins (in the case of fish, and webbed feet (in the case of toad) for movement.
6. Possession of sticky undersurfaces for attachment to surfaces of objects, e.g. snails.
7. Ability of some animals to burrow and remain in moist habitats, e.g. annelids, clams and snails.
8. Possession of suckers or hairs for attachment to vegetation to avoid being swept away by water current, e.g. leech *(See Fig. 7.13A).*
9. Possession of nictitating membrane over eyes in fishes and presence of eyelids in toads and frogs.

Adaptation of animals to terrestrial habitat

1. Mammals possess hairs, birds possess feathers and reptiles possess bony scales for body temperature regulation.
2. Mammals possess thick skin, while insects possess thick cuticle (exoskeleton) to prevent desiccation and injury.
3. Mammals, birds, reptiles and amphibians possess lungs for breathing.
4. Mammals possess sweat glands for excretion and cooling of the body.

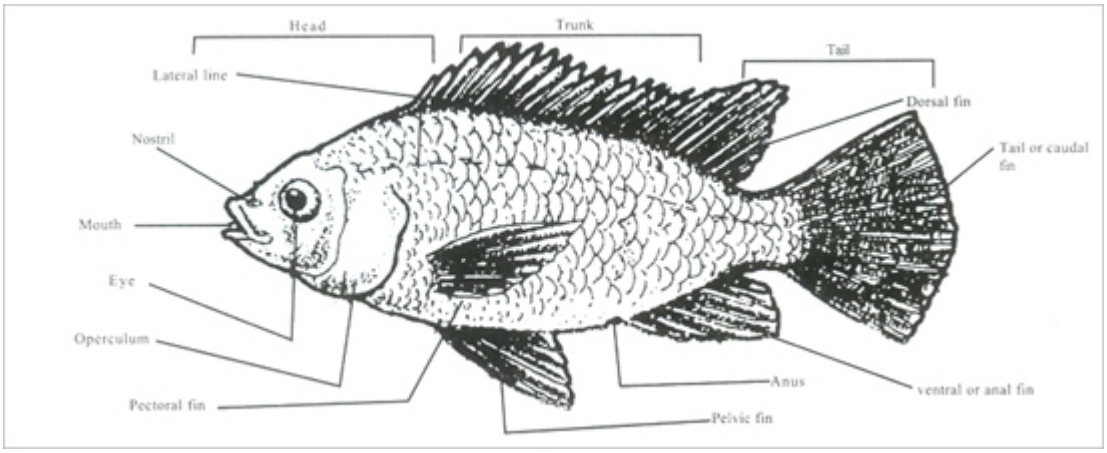

*Fig 7.14 External features of **Tilapia**, a bony fish.*

Morphological adaptations of fish to aquatic habitat

All the external and internal structures of a bony fish *(e.g. Tilapia)* help it to adapt itself to life in water. Let us briefly examine the adaptations shown by a bony fish for movement and feeding. The adaptation shown by fishes for breathing is discussed in Chapter 6 of Book 2.

Adaptations of a bony fish for movement

1. A bony fish, e.g. *Tilapia (See Fig. 7.14)* has paired fins (pectoral and pelvic fins) used for steering, braking or reducing the speed of movement.
2. The unpaired fins (dorsal, ventral and anal fins) are used for balancing or preventing the fish from wobbling.
3. The tail muscles and tail/caudal fin, are used for propelling the fish forward.
4. Its streamlined shape facilitates easy movement.
5. The swim bladder is used for altering the level or depth at which the fish is swimming (i.e. bouyancy).
6. The scales, which overlap with the free ends pointing backwards, enable water to pass smoothly over its body.
7. The lateral lines are used for detecting vibrations in water.
8. The eyes are large and enable the fish to see both its preys and predators.

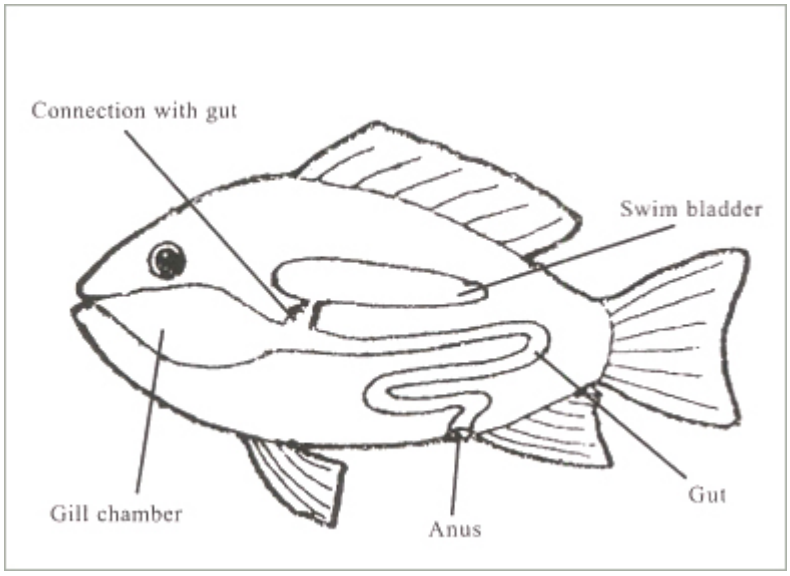

Fig 7.15 Internal structure of a fish showing the swim bladder and gut.

Adaptations of a bony fish for feeding

1. A bony fish, e.g. *Tilapia*, feeds on water weeds, organic particles and other microscopic organisms, e.g. insect larvae in water.

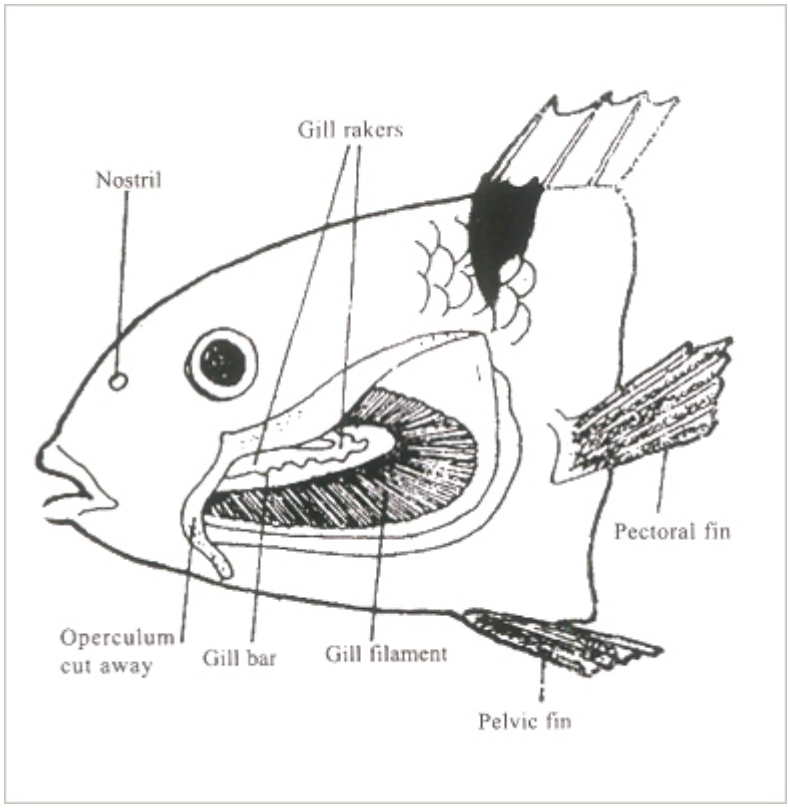

Fig 7.16 The head region of a fish with an operculum removed to show the gills

2. It uses its mouth to capture the food along with water which is filtered out through the gill rakers *(See Fig. 7.16).*
3. The teeth are used for grasping off food particles.
4. The food is swallowed whole.
5. The teeth prevent the prey from escaping.

Morphological adaptation of tadpole to aquatic life

A tadpole resembles a bony fish in several ways including the following:

1. Both have a tail and tail fin each and streamlined bodies which facilitate easy movement in water.
2. Both have gills (external and internal gill stages in the case of tadpole) used for gaseous exchange.
3. Both have opercula which protect the gills.

The tadpole has a very long, coiled intestine which adapts it to its herbivorous mode of feeding. Its mouth has a pair of horny jaws with which it nibbles water weeds. Its two large, prominent eyes enable it to see its prey and predators clearly.

The major morphological differences between a tapdole and a bony fish are shown in Table 7.1. below.

Table 7.1 *Structural differences between a bony fish and a tadpole*

Bony fish	Tadpole
1. Scales are present	Scales are absent
2. Fins are bony	Fins lack bones
3. Lateral lines present	Lateral lines absent
4. Swim bladder present	Swim bladder absent
5. Paired fins present	No paired fins
6. Teeth present	Teeth absent

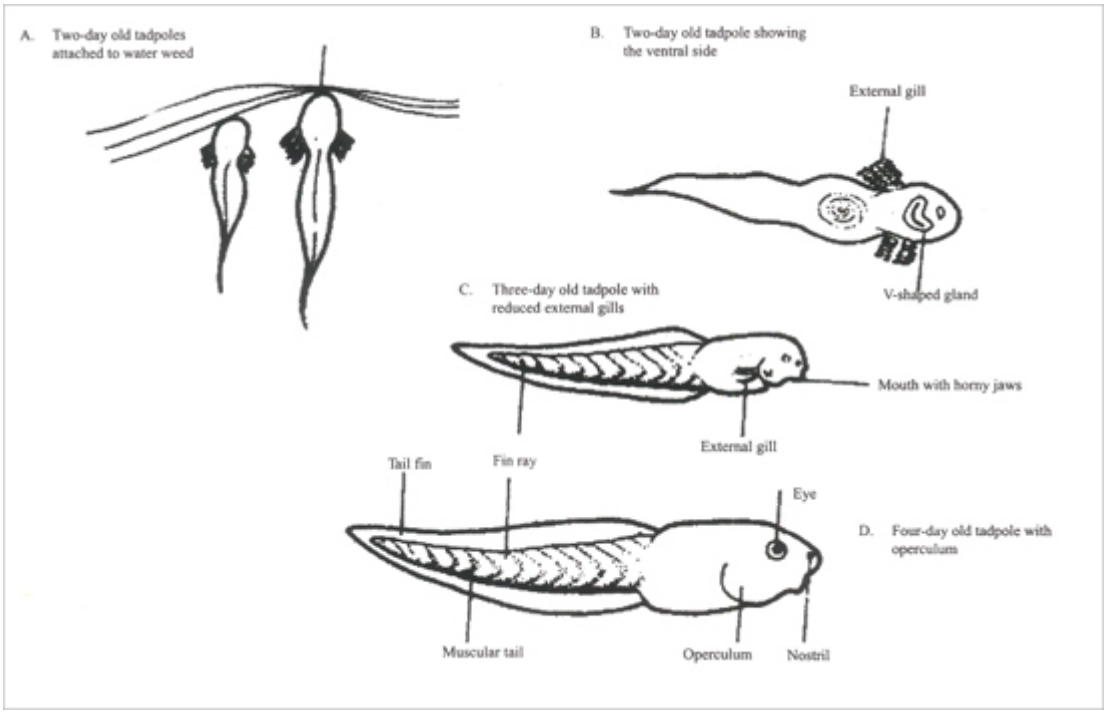

Fig 7.17 Various stages of the tadpole.

Adaptations of the chameleon

The chameleon (see *Fig. 7.18*) is well-adapted to its environment. It

has a long, sticky tongue with which it catches its prey, mostly insects. It uses the claws on its feet and long tail to grasp the objects on which it walks.

To protect itself from predators and hide from its preys, the chameleon has the ability to change its skin colour quickly to blend with that of its environment. This action is physiological and is known to be fastest only in the chameleon. Its large prominent eyes enable it to see its preys and predators afar off.

Fig 7.18 A Chameleon.

Tolerance

For any organism to live well in a particular habitat, the biotic and abiotic conditions there must be favourable. Due to changes in environmental factors, however, some of these conditions are sometimes unfavourable. Really, too little or too much of certain environmental factors (e.g. light, heat, cold, and pH) might produce unfavourable situations.

Nevertheless, many organisms are naturally adapted to withstand or tolerate little unfavourable changes in their environment which affect their survival. Such an ability is called *tolerance*. There is a minimum and maximum limit to which organisms can tolerate certain changes in their environment so as to survive. This range is known as the *limits of tolerance.*

As soon as the limit of tolerance is exceeded, an organism has to leave the habitat (if this is possible) or become adjusted to the new

situation or die. For example, while some plants can withstand long periods of drought, many cannot. While some animals (e.g. camel) can do without water for a long period, others cannot do without water (.e.g fish, frog, and earthworm).

Geographic range

The characteristics which determine the particular habitat organisms can naturally live in successfully is called *geographic range.*

The distribution of a population is determined by their degree of tolerance to variations in environmental factors. Among these are climatic factors like temperature, rainfall, light intensity, day length, relative humidity and food availability.

Many types of plants are widely distributed on the earthâ€™s surface, while other species tend to be restricted in their distribution. The fact that different species of plants are often found growing under similar climatic conditions in widely seperated parts of the world, shows that climatic differences alone cannot explain such distribution.

The desert regions of South-western United States of America and those of West Africa are similar climatically, but the species of plants growing in these regions are very different. For example, numerous species of cacti are common in American deserts but are lacking in the African deserts, while spurges *Euphorbia* are abundant in the African deserts but are very rare in the United Statesâ€™deserts.

Ordinarily, similar plant species occupy the various areas of a particular region. If these areas are separated by barriers e.g. high mountains or large bodies of water, over which plants cannot pass, the plants in these isolated areas tend to develop along divergent lines to become quite distinct. Hence, regions that have been separated for a very long period usually have plants that are peculiar to them. These are mainly plants found in no other parts of the world. Examples of long-isolated lands with very typical and limited plants are the Hawai, the Fiji and other oceanic islands. The animals found in such areas will be peculiar to the areas.

In general, as one moves from the equator to the poles, thick evergreen forests of the tropical rain forest give way to the tropical savannas, temperate savannas, temperate deciduous forests and the coniferous forests of the cold regions and cold deserts such as the tundra which is said to be treeless. Here, the soil is frozen all year round so that very little water is available for plants and animals most part of the year. Plant life in the tundra is characterized by lichens, grasses and sedges. Very few animals are permanent residents e.g. the polar beer, caribou (or reindeer in the old world) and lemmings.

The nature of the soil, the quantity and distribution of rainfall determine the types of vegetation and hence, animals found in various biomes, worldwide. The tropical rain forest, with the highest annual rainfall (250–2,500mm), has the largest number of plant species and the highest primary productivity. This is about 24 per cent of the total world productivity. The temperate forestâ€™s primary productivity is

about 14 per cent of the total world productivity.

Many animals that are highly adapted to high temperature and high relative humidity are numerous in the tropical rainforest. Among the numerous wild animals are large mammals like the elephant (the largest land mammal), hippopotamus, panther, hog, leopard, chimpanzee, baboon, gorilla, monkey and the tiger. An elephant feeds on about 200kg of leaves daily, drinks a lot of water and cannot do without salt which it obtains from termitesâ€™ nests. There are other varieties of animals including birds, reptiles and flying mammals e.g. bats.

In the tropical savannas are many rodents that are nocturnal. Other animals include the jackals, hyenas, vultures, lions, giraffe, rhinoceros and insects. The giraffe -the tallest living animal – is about $5\frac{1}{2}$m (18 feet) tall with a long neck which enables it reach up to the leaves of trees and look out for danger. The lion is found in Africa and parts of Pakistan. Many herbivores abound in the tropical savannas with very tall grasses on which they feed.

In the tropical savannas and deserts are animals like the buffalo, zebras (the lionâ€™s favourite prey), antelopes, gazelles (eaten by cheetahs), sandfox, and many insects and reptiles. The Cape buffalo is the most dangerous of all game animals, while the cheetah is the fastest mammal, with speed up to 112km per hour.

Many animals live on high mountains and are well-adapted to the extreme cold on such mountains. Among them are the brown bear, the â€˜Rocky Mountainâ€™ goat in U.S.A., which is the only goat specie that wears a white coat all year round. Others include snow-finches, eagles, the ibex found in the mountains of the Alps (i.e. in Switzerland etc.). In the high Asian Plateau are the yaks, the little and giant pandas of western China, which feed on bamboo shoots *(See Fig. 7.28B).*

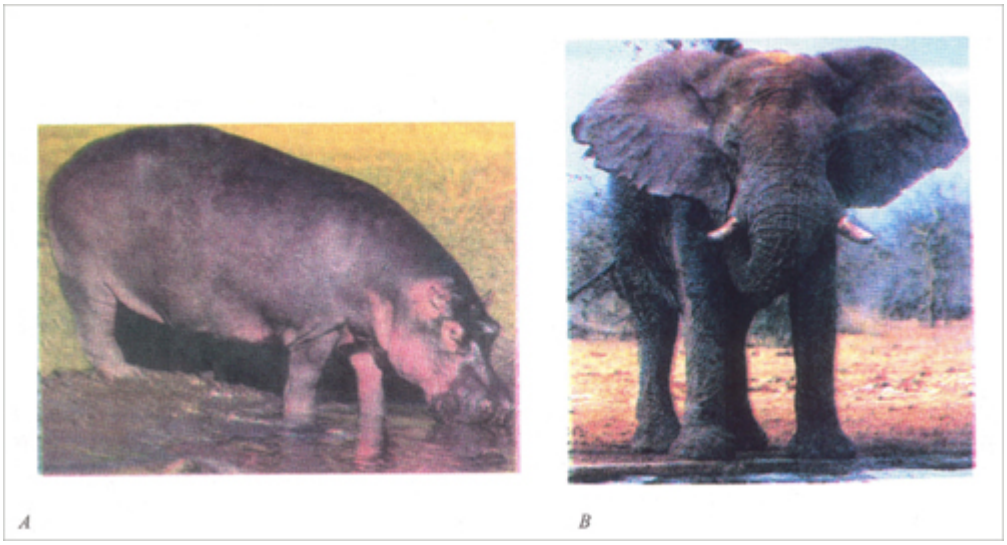

Fig 7.19 Some tropical forest animals. A Hippopotamus; B. African elephant.

In the temperate regions, and the Alps, where it is extremely cold

most of the year, are animals highly adapted to cold climate. To the edge of the arctic regions stretches a belt of forest of fir, spruce and birch (the coniferous forest). Many animals live in this forest. The greatest of them all is the moose — the largest of all living deer. Its antlers are about 6 feet apart.

Fig 7.20 Seals are found in the cold regions such as Tundra

Beyond the tree-line, stretches the tundra with vast plains covered with ice and snow for most of the year and permanently frozen underground. During the short arctic summer, often less than three months, the snow melts and the tundra has a rich, short plant carpet with many pretty flowers. Reindeer spend most of their time in the tundra and some of their time at the edge of the forest. In winter, they dig the ground with their antlers to obtain mosses and lichens under the snow. The wolf, their greatest enemy, follows the herd of reindeer most of the time.

Fig 7.21 The air around this factory is highly polluted.

In the more northern and coldest regions of the arctic tundras, lives the most hardy plant-eating animal of all the musk ox. Covered by nature with fat and fur to withstand the most bitter cold, the polar bears prowl the snow of the arctic regions or swim along the ice floes of the polar seas in search of their major prey, the seal. The seal, the sea lion, and walrus are adapted to the cold sea life. *(See Fig. 7.20).*

Birds and insects are found in all parts of the world including the polar regions. Certain animals found in the forests are not found in the savannas and vice versa. Similarly, certain animals found in cold deserts are never found in hot deserts. For example, while reindeer, seals and walruses are found in the tundra, camels, horses and civet cats are found in hot deserts.

Pollution of the atmosphere

Any process or activity which leads to a harmful increase in the quantity of a substance in the environment is *pollution*. The harmful substance is called a *pollutant.*

The world population, which doubles every 35 years and increases by about 200,000 per day, threatens to outstrip the food supply and deplete the non-renewable energy supplies and raw materials. Besides, the increasing world population tends to render the biosphere uninhabitable by the destruction and pollution of the natural environment. Indeed, every increase in world population results in a disproportionate demand on the worldâ€™s energy and mineral resources. It also adds disproportionately to the quantity of pollutants in the biosphere.

Air pollutants

Air pollutants include carbon(II) oxide (CO), sulphur(IV) oxide (SO_2), oxides of nitrogen, smoke, smog, and dust particles released into the atmosphere from factories *(See Fig. 7.21). Table 7.2* summarizes the sources of the principal air pollutants.

Table 7.2 *Sources of major air pollutants*

Source	**Pollutants**
Motor vehicles	Oxides of nitrogen, carbon(II) oxide, lead compounds etc.
Industries	Dust particles, lead compounds, sulphur(IV) oxide.
Mines, city traffic and building construction sites	Dust particles
Domestic fires and power stations	Sulphur (IV) oxide and smoke from wood, coal, oil, natural gas and other organic compounds

Effects of air pollutants

Carbon(II) oxide

This gas readily combines irreversibly with the haemoglobin of the

blood to form a compound carboxyhaemoglobin which reduces the oxygen-carrying capacity of the blood. The body metabolism is thereby damaged and may result in death within few minutes.

Sulphur(IV) oxide

1. It is poisonous to plants and lowers their yields.
2. It reduces many plantsâ€™ growth rates. For example, it prevents lichens from growing on tree trunks in polluted areas.
3. It may damage respiratory organs (e.g. lungs) and cause respiratory diseases.
4. It forms tetraxosulphate(VI) acid in rain water which makes the soil highly acidic and adversely affects plantsâ€™ growth.
5. Being acidic in solution, it corrodes building surfaces and eroding the brick work.

Oxides of nitrogen

1. These form substances which can poison animals and plants.
2. They cause eye irritation in humans.
3. They form acidic solutions with water which corrode metals and walls of brick buildings.
4. In very high concentration, nitrogen(IV) oxide (NO_2) can cause the death of animals.

Smoke

1. Its carbon particles can damage the lungs and may also cause discomfort in humans.
2. Smoke cover could reduce photosynthesis and plant yields can consequently be reduced.
3. It causes fog which reduces visibility.
4. Smoke particles make streets and buildings dirty.

Smog

Smog is a mixture of smoke and fog. It is caused by a layer of warm air developing above a region of colder air. The warm layer prevents the colder air from escaping. This is called *temperature inversion. (See Fig. 7.22).*

1. Smog is unpleasant and dangerous
2. The London smog of 1925, which lasted five days, caused about 4,000 deaths.
3. It reduces visibility.
4. It reduces the hours of sunlight, thereby reducing photosynthesis and plant yields.

Dust

1. Micro-organisms which cause diseases (e.g. bacteria and viruses) might be inhaled along with dust particles.

2. It may irritate the respiratory organs e.g. lungs.
3. It may contain particles (e.g. pollen grains) which may trigger off bouts of lung disorders such as asthma.
4. Dust in water spoils the quality of drinking water.
5. Dust in the atmosphere reduces visibility and the intensity of sunlight.

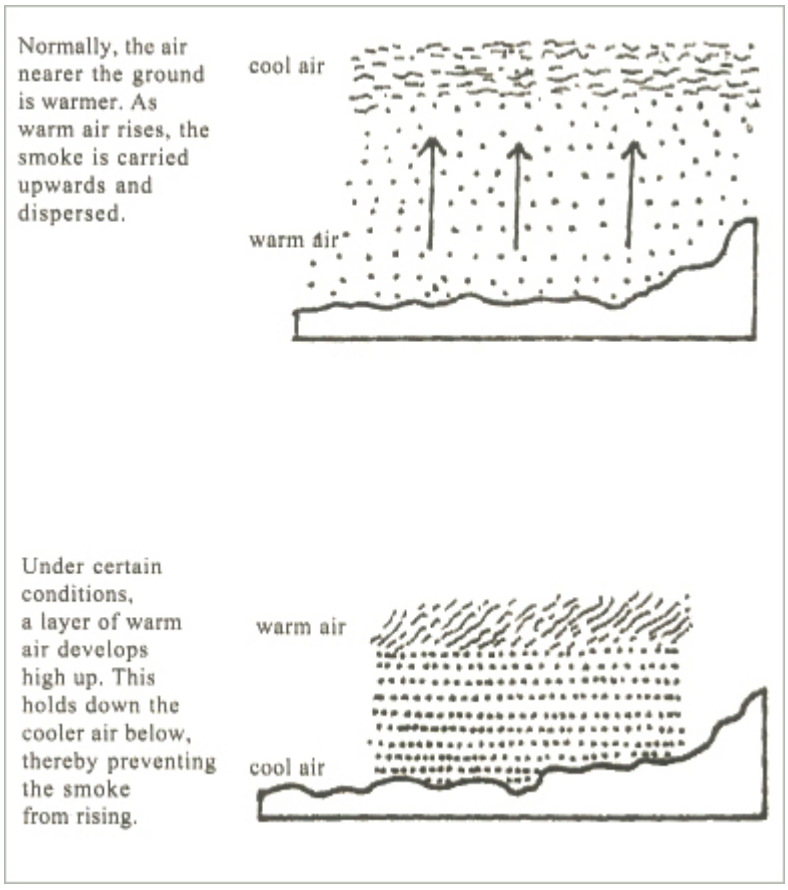

Fig 7.22 How smog is formed

Effect of noise

Any unpleasant or unwanted sound in the air is called noise. Road traffic, factories, foundries, mines, electronic sound gadgets, electric generators are some of the sources of high-intensity noise. *(See Fig. 7.23).*

1. High-intensity noise can cause headache and discomfort.
2. It may prevent some people from sleeping properly.
3. High-intensity noise, after a prolonged period of time, can permanently damage the eardrums and cause deafness.
4. Noise pollution quickens heartbeat and blood circulation thereby causing restlessness.

Water pollution

Water in estuaries, lakes, rivers and seas may be polluted by detergents, insecticides, artifical fertilizers, herbicides, domestic and industrial wastes, crude oil and untreated sewage.

Table 7.3 *Main water pollutants and their effects*

Water pollutants	Effects
Agricultural wastes e.g. herbicides, pesticides, insecticides and fertilizers	Occasionally, excess of these materials drain into fresh water and kill the animals in it. These substances lead to oxygen deficiency which kills aquatic organisms. The presence of nitrates in drinking water is poisonous to babies. Washing of pesticides from soil and crops into rivers and streams cause the death of many fishes. Mercury compounds from industries in seas cause human diseases and kill humans who eat animals from such seas.
Industrial wastes	Toxic to humans who use untreated water from flowing rivers and streams. Could cause death of humans who feed on contaminated aquatic animals e.g. fishes. Some are poisonous to aquatic animals and plant, e.g. lead, mercury, cyanides and phenols.
Untreated sewage	This contains micro-organisms which can cause diseases (e.g. cholera and dysentery) when humans drink water polluted by it. It can kill many aquatic organisms. The odour from sewage is unpleasant to humans. Humans who eat fishes, crustaceans etc. from sewage-polluted water may suffer ill-health because such organisms might have absorbed toxic substances from the water into their bodies.

Effects of oil spillage

Often, oil escapes when oil tankers are being loaded or unloaded. It may be liberated into the seas and seashores in great quantities when an offshore rig explodes or an oil tanker is wrecked.

Oil usually kills most animals and plants living in areas where oil spillage occurs. In 1980, a large oil spillage occurred near Akassa in Rivers State of Nigeria and killed fishes in nearby creeks on which the local fishermen depended for their livelihood. It also contaminated drinking water thereby causing discomfort and the disruption of normal life. *(Fig. 7.24).*

Fig 7.23 Effects of oil spillage

Soil pollution

The soil is polluted primarily by the dumping of garbage or refuse. This comprises discarded household materials like bottles, plastics, cans, metallic containers, papers, food remnants and, in some cases, human and animal faeces. Refuse dumps are sources of unpleasant odours and breeding places for many disease vectors and disease causing micro-organisms (Chapter 8).

Again, the soil might be polluted by some air pollutants, e.g. compounds of lead, industrial and agricultural wastes such as herbicides, fungicides, insecticides and pesticides. Sometimes, these substances contaminate the soil and may harm or kill the plants grown on such soil. These substances might be passed on to humans when contaminated crops grown on polluted soil are consumed.

Fig 7.24 Refuse disposed of indiscriminately

Conservation of natural resources

Natural resources include the plants, animals, minerals, soil, water, sunlight and air in the world. *Conservation* is the preservation of natural resources from human destructive activities and the wise use of such resources.

In clearing lands for agriculture, people destroy natural ecosystems in communities. Bad farming techniques have destroyed some of the previously fertile areas of the earth surface. Intensive farming results in leaching and erosion, loss of soil fertility, loss of crumb structure due to over-use of chemical fertilizers and the killing of beneficial insects by the persistent indiscriminate use of insecticides (Chapter 10). These practices disrupt the balance in the ecosystem.

With the increasing growth of human population and development of high tech weapons, large wild mammals have been exterminated in many places. With the improvements in fishing techniques, over-fishing has occured in many fisheries and indiscriminate whaling has almost sent whales into extinction.

Urbanization renders land unproductive. People living in cities and towns also make demands on land – building roads, ports, railways and airports. They make demands on nearby and distant lands as sources of food and raw materials used in industries. Hence, with the ever increasing human population, the conservation of natural resources is becoming increasingly difficult.

The need for conservation

Conservation is necessary for many reasons which includes the following:

1. To prevent the wanton destruction of the natural environment and promote sensible use of natural resources.
2. To preserve rare and valuable species of animals and plants for future generations.
3. To preserve naturally beautiful sceneries and landscapes for their aesthethic values.
4. To promote the recycling of some scarce mineral resources.

Ways of ensuring conservation

1. Agencies for conservation

The governments of various countries have agencies which are responsible for conserving natural resources. In Nigeria, these include the Forestry Departments of the States and Federal Ministries of Agriculture and Natural resources, Nigerian Conservation Foundation and Forest Reserves Authorities. The Nigerian Conservation Foundation was established in 1982 primarily to conserve our forests and wildlife.

These bodies take care of Game Reserves and Forest Reserves. Game reserves are where certain rare animals are preserved e.g. Yankari, Borgu and Kainji Game Reserves in Nigeria. *(See Fig. 7.26).*

Forest reserves are plantations of selected plant species such as cassia, teak and *Terminalia* spp: In Nigeria, examples are Onigambari Forest Reserve and Olokemeji Forest Reserve. These reserves are managed by the Oyo State Ministry of Agriculture and Natural Resources. By conserving forests, wildlife is also conserved. Wildlife refers to all kinds of animals that live in the forests, rivers and streams.

Fig 7.25 Yankari game reserve

In many countries, certain areas set aside for the protection of animals and plants are called National Parks. Examples are Tsavo National Parks in Nairobi, Kenya and Serengeti Park in Tanzania. In these parks are large animals such as elephant, giraffe, lion and the white rhinoceros which is close to extinction.

2. *Conservation education*

To enable many people to be aware of the need for conservation, various governments have mounted different campaigns. In Nigeria, for example, there are advertised campaigns on the television and radio with such slogans as Plant two trees where one was felled,â€™ and Plant a tree everday. There are also campaigns against bush burning and poaching in many countries worldwide.

3. *Conservation laws*

To ensure the conservation of our natural resources, various governments have enacted conservation laws. In Nigeria, as in many countries, such laws are those against the indiscriminate burning of bushes or forests, felling of trees, hunting of game in game reserves, fishing and the exploitation of minerals by individuals. There are international treaties to preserve many animals such as whales and seals against extinction and to protect migratory birds such as the Canadian geese.

Whaling nations such as Japan, Britain and U.S.A. have legislated against the killing of whales, particularly the blue whales. Due to the refusal of some whaling nations to stop killing the blue whales since 1963, the annual yield has reduced from 6,000 whales per year to almost nothing. The blue whale is the largest of all the whales. It is hunted for its oil used for the manufacture of soap and margarine and is eaten by the Japanese as a source of protein.

The enforcement of the conservation laws is carried out strictly in many advanced countries, e.g. Britain and U.S.A. This is also true of some African countries.

Benefits of conservation

The benefits of conservation include the following:

1. It helps to protect the natural environment from indiscriminate destruction and fosters wise use of natural resources.
2. It helps to combat soil erosion and desert enchroachment. For example, in some parts of Sokoto, Borno and Bauchi States in Nigeria, there is the Sahara desert enchroachment. Reafforestation projects being undertaken by the Bauchi State Government and the Federal Government to build shelter belts to stem desertification began in 1987. This project is estimated to cost about ₦19 million.
3. It helps to protect rare and useful species of animals and plants from extinction. Examples are the white rhinoceros of the East African National Parks, the Koala bears and pelican, the rare orchids in Australian reserves and the Giant Panda of Tibet, kept in London Kew Garden, which was faced with extinction in China around 1980. *(Fig. 7.28B).*
4. It helps to have planned harvesting of animals and plants. For example, in Britain, game laws limit the season for hunting and fishing, specifying the kinds of animals, minimum size of animals

and maximum quantity which may be hunted and caught.

5. It helps to prevent indiscriminate exploitation of mineral resources by individuals.
6. It helps to prevent the destruction of natural ecosystems by limiting agriculture and industrial activities to certain parts of the environment.

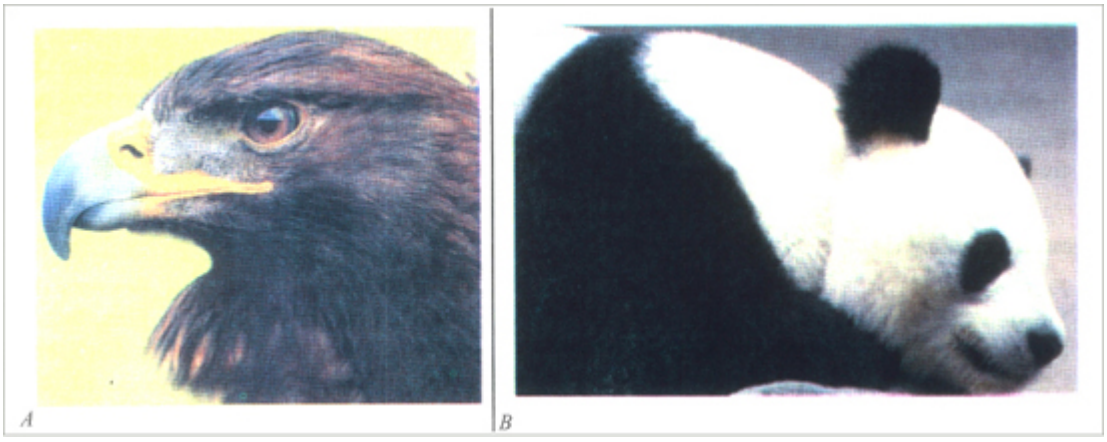

Fig 7.26 A. Golden eagle: One of the wildlife being conserved. B. The giant Panda of Tibet which eats bamboo leaves in the hills of western China in now faced with extinction.

Ways of conserving forests

The importance of forests is inestimable. While some trees provide timber for building houses, wood for furniture, pulp for the manufacture of rayon, paper and paper products, other trees are useful as sources of dyes, oils, turpentine and drugs. Forests provide natural habitats for wildlife, hence, the conservation of forests conserves wildlife too. Forests also prevent soil erosion and so prevent floods. The water their leaves lose as a result of transpiration, helps to increase the quantity of rain that falls. Hence, deforestation leads to a decrease in rainfall.

The destruction of land by man and plant diseases can be prevented by well-planned conservation projects set up by Departments of Forestry in most countries and with the help of local conservation societies and individuals.

Among the useful measures for conserving forests are the following:

1. Wise management of forest. This includes planned tree-cutting which should be done in a manner that avoids injuring the undergrowth. This will facilitate the rapid growth of young seedlings.
2. Reafforestation. This refers to the planting of new trees in areas badly destroyed by fire or diseases, where the natural plant successions will not appear. Different varieties of young trees that would normally grow together are planted. *(Fig. 7.27).*
3. Protection of young growing trees.
4. Restricting cutting of trees to those that are mature.
5. Combating and preventing plant diseases.

6. Preventing careless fires and controlling accidental forest fires, with forest fire-fighting equipment.
7. Educating the public on the usefulness of forests and the importance of conservation.

Suggested Practicals

1. Food pollution

(a) Moisten a piece of bread with water.
(b) Leave it in an open place in your classroom.
(c) Observe what happens to the bread after a few days.
(d) Suggest reasons for the change in appearance of the bread.
(e) How would you identify the organism responsible for the change?

2. *Demonstration of water pollution*

(a) Set up a series of jars containing the same quantity of clean water.
(b) Place into each jar, a small quantity of living things like tadpoles, insect larvae, etc.
(c) Put a substance that is likely to be a pollutant into each jar e.g. kerosene, acid, detergent, palm oil, etc.
(d) Observe the behaviour of the organisms for a while, and over a few days.
(e) Is the behaviour of any of the organisms abnormal? Does any of them die? Which ones? What conclusion can you draw?

Summary

1. The relationship that exists between two or more individuals in a community is called association. Parasitism, saprophytism, symbiosis and commensalism, are examples of associations that are common in a community.
2. Plants and animals show various adaptations to aquatic and terrestrial habitats.
3. The possession of air spaces in tissues, waxy cuticles on leaves, air floats in leaves and stems, and adventitious roots are some of plantsâ€™adaptations to aquatic habitats.
4. Terrestrial plants generally possess the following adaptive features: thick, waxy cuticle or hairs on leaves, thick barks, leaves modified into thorns, spines or a smaller size, succulent stems and sunken stomata to conserve water.
5. Aquatic animals generally possess the following adaptive features: gills, lateral lines streamlined body, fins or webbed toes, ability to burrow into damp places and hairs for attaching themselves to vegetation.
6. Terrestrial animalsâ€™adaptive features include the possession of thick skin or cuticle; lungs for breathing; hairs, feathers and scales for body temperature regulation, sweat glands in mammals for excretion and body temperature regulation.
7. A bony fish and a tadpole are similar structurally in possessing a

tail and tail fin and streamlined body for movement, gills for breathing, and opercula to protect the gills.

8. The geographic distribution of animals and plants vary from the equator to the poles. The tropical rain forest has the richest species of plants and animals. Few trees and animals adapted to extreme cold are present in the arctic regions.
9. The nature of the soil, the quantity and distribution of rainfall determine the geographic range of animals and plants worldwide.
10. Pollution is any activity that increases the quantity of harmful substances in the environment.
11. Sulphur(IV) oxide, carbon(II) oxide, oxides of nitrogen, smoke, smog and dust are the main air pollutants which have adverse effects on animals and plants.
12. Motor vehicles, industries, mines, domestic fires and power stations are main sources of air pollutants.
13. The main water pollutants are agricultural wastes (e.g.herbicides, pesticides, insecticides and fertilizers), industrial wastes and untreated sewage, all of which adversely affect plants and animals.
14. Natural resources in the world include animals, plants, minerals, soil, water, air and sunlight.
15. Conservation is the protection of natural resources from human destructive activities and the sensible use of such resources.
16. Conservation is generally ensured by conservation agencies (e.g. Forestry Departments, Forest Reserve Authorities), conservation laws and conservation education.
17. The conservation of forests ensures the conservation of their wildlife.

Objective Questions

1. The association between two organisms in which one benefits and the other is neither harmed nor benefits from the relationship is
   A. symbiosis.
   B. parasitism
   C. saprophytism
   D. commensalism.
   E. predation
2. Which of the following is not an adaptation of plants to aquatic habitat? The possession of
   A. thickened and succulent stems.
   B. breathing roots.
   C. air spaces in tissues.
   D. waxy cuticles on leaves.
   E. long stems and petioles to expose leaves and flowers.
3. All the following are adaptations of animals to aquatic habitat except the possession of

A. gills for breathing.
B. streamlined body.
C. lungs for breathing.
D. lateral lines for detecting vibrations.
E. ability to burrow into moist places.

4. Which of the following is an air pollutant?
A. Detergent.
B. Smoke
C. Crude oil.
D. Untreated sewage.
E. Insecticide.

5. Forests can be conserved in all the following ways **except** by
A. reafforestation.
B. wise forest management.
C. protecting young growing seedlings.
D. preventing careless fires in forests.
E. deforestation.

Essay Questions

1. Explain the meanings of the following terms and give two examples of their practice.
(a) a parasite.
(b) a saprophyte.
(c) symbiosis.
(d) commensalism.

2(a) State **five** adaptations each shown by plants to (i) terrestrial and (ii) aquatic habitats.
(b) State **five** adaptations each shown by animals to aquatic and terrestrial habitats.
(c) Describe how a named bony fish is adapted for movement.

3(a) In a tabular form, list the structural differences between a bony fish and a tadpole.
(b) Briefly explain what you understand by the terms *tolerance* and *geographic range.*
(c) How are plants and animals distributed throughout the world.

4(a) State **four** effects each of the following pollutants: (i) sulphur(IV) oxide, (ii) oxides of nitrogen, (iii) smoke, (iv) smog, (v) noise (vi) untreated sewage.
(b) Briefly discuss **three** ways of ensuring conservation.
(c) What are the benefits of conservation?