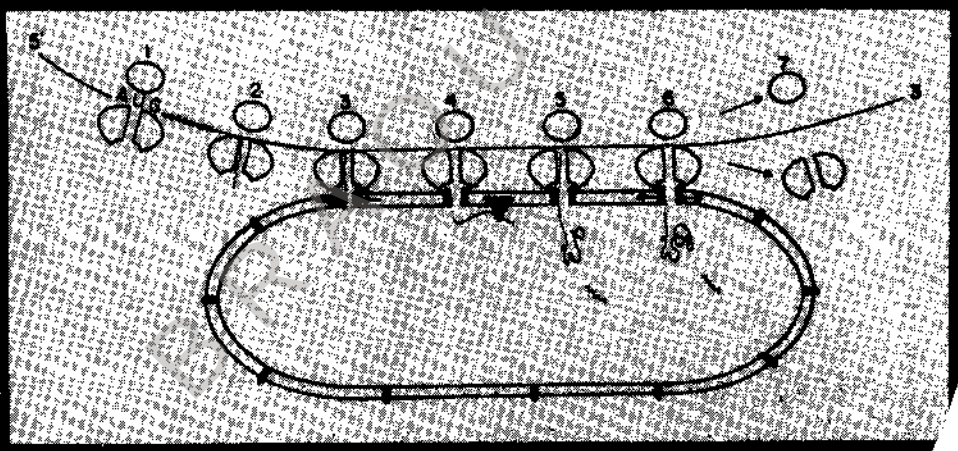
ANDHRA PRADESH OPEN UNIVERSITY

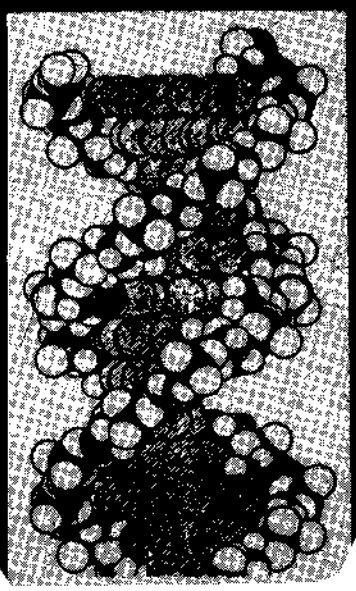
BS3_Z3

Zoology

ECOLOGY AND PHYSIOLOGY

BLOCKS : 5 & 6





BLOCK – V
ECOLOGY

ZOOLOGY

ECOLOGY, PHYSIOLOGY

BLOCKS 5 – 6

BLOCK V	ECOLOGY
BLOCK VI	PHYSILOGY

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PREFACE

This book deals with the topics in Cytology, Genetics, Evolution, Zoogeography, Ecology and Animal Physiology included in the syllabus for the thrid year of the Zoology course offered by the Andhra Pradesh Open University. These topics generally cover the "Core" area of the subject to be studied in the third year of the three year degree course in Science (B.Sc.). The syllabus for the sake of convenience is divided into several Blocks each of which comprise a number of units. Each Block generally covers a specific area of the subject. The units are prepared by specialists in accordance with the format so designed as to enable the student to read and understand them without much difficulty. Each unit brings with a statement of its objectives followed by synopsis and has at its end assignments intended to test the students comprehension of its subject matter. Technical terms with which the student may not generally be familiar are given at the end of each unit under the head "Glossary".

The course material of this paper is divided into Six Blocks. The Blocks are in turn divided into thirty six units. Block-I deals with the important topics in Cytology. The topics in Genetics are included under Block-II.

Important topics like human syndromes, inborn errors of metabollism and operon concept are also included under this Block.

Block – III deals with the general topics on evolution like theories, evidences, synthetic theory etc. Unit – 19, evolution of man and horse is given. Principles of Zoogeography is, given in Block-IV.

Block – V deals with Ecology. Besides general chapters, important topics like pollution and wild life conservation are included under Ecology.

The last Block is devoted for the topics on Animal Physiology. Special topics like Nutrition, Neurotransmitters, Biological rhythms and Immunological responses are given under the Seventh Block.

The University hopes that this material will help the students to get acquainted with the topics on Cytology, Genetics, Evolution, Zoogeography, Ecology and Animal Physiology.

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UNIT - 21 INTRODUCTION TO ECOLOGY – FUNDAMENTAL CONCEPTS OF ECOSYSTEM, FOOD CHAINS, ENERGY FLOW, TROPHIC LEVELS

Contents

21.1 OBJECTIVES

To explain the meaning of ecology, concepts of ecosystem and energy flow within the ecosystem. At the end of this unit you will be able to explain

- the components of Ecosystems
- energy flow in Ecosystems etc.

21.2 INTRODUCTION

The word **'ecology'** is derived from the Greek word, *oikos* meaning house or habitation and *'logos'* meaning study. Thus literally it means 'at home'. The study of living organisms, their environment (both physical and biotic components) including the inter species interactions constitute ecology.

The study of ecology of a an individual is called **autecology** and the sturdy of the groups belonging to a same species is called **Population ecology**. The **aquatic ecology** includes freshwater, estuarine and marine; **terrestrial ecology** includes forest, grassland, cropland and desert.

Since man is influenced by environment like other organisms,the study of general principles of ecology provides the background for understanding the human relation. By applying certain ecological prnciples, forestry, agriculture, horticulture, pest control, aquaculture, etc, be thoroughly developed. Knowledge of ecology is essential to the solving of certain problems like erosion, disposal of wastes, control of chemical and radioactive fallout, pollution of environment, etc..

21.3 ECOSYSTEM

Ecosystem can be said to be the functional unit in ecology. It includes the study of living organisms and the nonliving environment, each influencing the other, and both are necessary for the maintenance of life.

The term, ecosystem, was first coined by A.G.Tansley in 1935. Karl Mobius considered the community of oyster reef to be **biocoenosis** in 1877.

From the trophic (nourishment) point of view ecosystem has two components, namely, an autotrophic component in which the light energy is fixed through photosynthesis and a heterotrophic component in which the rearrangement, utilization and decomposition of complex molecules occur. From the structural point of view the ecosystem has four basic units.

1) **Abiotic substances**: They include the inorganic and organic compounds of the environment. Carbon, nitrogen carbondioxide, water, hydrogen and phosphates which are involved in nutrient cycles form the inorganic compounds. proteins, carbohydrates, lipids, amino acids form the organic compounds. In addition, temperature, light, humidity and other climatic factors are also included.

2) **Biotic substances**: They include the producers, consumers and decomposers.

i) **Producers**: These are autotrophs, mostly green plants which manufacture the complex organic substances (carbohydrates) from simple inorganic substances.

ii) **Macroconsumers**: These are heterotrophs, mostly animals, which feed on other organisms or the organic material. They can be primary consumers (herbivores) that feed on the primary consumers.

iii) **Microconsumers**: These are heterotrophs, mostly bacteria and fungi, also called saprotrophs of decomposers. They break down the complex composition.

Thus one of the important features of ecosystems is the interaction of autotrophic and heterotrophic components. The organisms involved in these processes are stratified one above the other, the autotrophic metabolism occuring in the brown belt. This type of separation leads to possible classification of energy circuits into i) grazing circuit – direct consumption of living parts ii) organic detritus circuit-accumlation and decomposition of dead material.

21.3.1 The pond ecosystem

A pond or a lake constitutes the best example of an ecosystem (Fig 21.1)

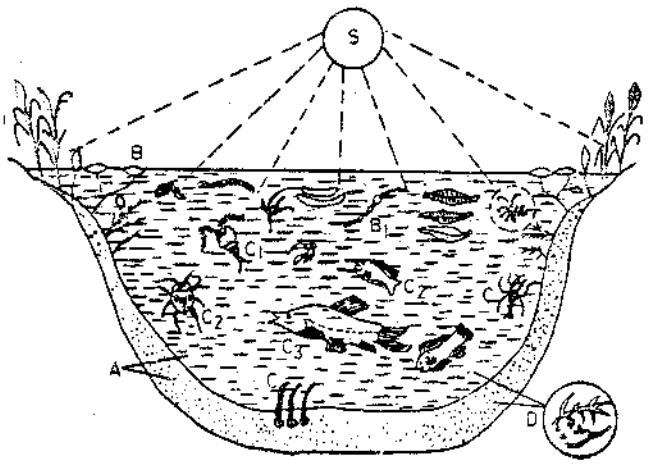


Fig 21.1 Four basic Units of Ecosystem A: abiotic substance, B: Producers - rooted and floating plants B_1 producers Phytoplankton; C: Primary consumer (herbivores) bottom forms: C_1 Primary Consumers (herbivores)-Zooplankton; C_2 Secondary consumers (Carnivores) C: tertiary Consumers (Secondary carnivores) D: decomposers- bacteria & fungi.

The abiotic substances of a freshwater pond are water, dissolved oxygen, carbondioxide, inorganic salts like phosphates, nitrites, chlorides of sodium, potassium, calcium, etc., and a group of organic compounds like amino acids, humic acids, etc.

Lakes and ponds are vertically stratified in relation to the intensity of wavelength, absorption, pressure, temperature etc. They are as follows:

1. **Littoral zone:** It is the shallow water region into which the light can penetrate. The upper layers are oxygen rich and warm called **epilimnion.**

a) **Producers**: Rooted plants and phytoplankton. Rooted plants with floating leaves: eg, Waterlilies *(Nymphea), Nelumbo, Trapa, Potamageton,* etc.

Rooted plants with submerged leaves: Mostly pond weeds e.g. *Valisnaria, Elodea and Myriophyllum, Ceratophyllum. Hydrilla, Chara, Nitella, Spirogyra, Zygnema, Oscillatoria. Rivularia.* etc, In addition, there are some protozoans like *Euglena, Verticella, Stenter,* etc.,

b) **Consumers:** In the peripheral regions, snail, midge larvae are the primary consumers. Dragon fly, Damsel fly larvae are the secondary consumers (carnivores). But in the benthic region, a number of consumers exist. For example, Crylish, Isopod, Clams, Worms, and free swimming fauna (Nekton) constitute the *Paramaecium.* larvae of *Culex, Gerris*, etc. beetles, water snakes, fish likes sunfish, salamanders, turtles, Zooplankton offers a typical example with the *Cladocerons,* water flies *Daphnia, Simocephyalous, coppods* and *ostracods, rotifiers* etc.,

The floating members (Neuston) of the littoral zone consist of surface insects like beetles and water strides.

Decomposers protozoans, nematodes, copepods, etc

2. Limnetic zone

It extends upto 10 meters from water surface. This is also called **sublittoral zone.** The communities in this include plankton, nekton, and a few neuston. The term euphotic zone refers to both littoral and limnetic zones.

a) **Producers** : Phytoplankton includes the members of *Chlorophyceae, Cyanophyceae* : algae like dinoflagellates. *Euglena and Volvox*. Usually, they appear as pond blooms in early spring and in the later part of autumn.

b) **Consumers** : The primary consumers are copepods, Cladocerans, Rotifers, Cyclops is the most subundant form. Many crustaceans are plankton feeders and some are predators. Blooms of zooplankton appear immediately after the phytoplankton. The nekton (secondary consumers) are mostly fish.

Profundal Zone

It is characterised by the absence of light and hence they depend on the members of limnetic and littoral zones for food. In return, the profundal zone provides nutrients which are carried out by currents and swimming animals to other zones, producers and consumers are lacking in this zone. The saproyhytes or decomposers constitute the communities. Bacteria and fungi are abundant. The animal consumers are benthic-chionomid larvae, annelids, clams, planktonic forms-plankton larvae. Most of the bacteria act as decomposers, while a few are pathogenic.

Ponds show a clear stratification having an upper production zone and a lower decomposing or nutrient generating zone. In the upper most layers (the first two matters), photosynthesis exceeds respiration. In the bottom layers of water where the light intensity is less only respiration occurs.

21.4 ENERGY FLOW IN ECOSYSTEMS

Energy may be defined as the capacity to do work. The changes energy in ecosystems involving transmission and utilisation at different trophic levels constitute the energy flow circuits.

There are two kinds of energy: potential and kinetic. While the Potential energy is the energy at rest.. Kinetic energy is due to motion and results in work.

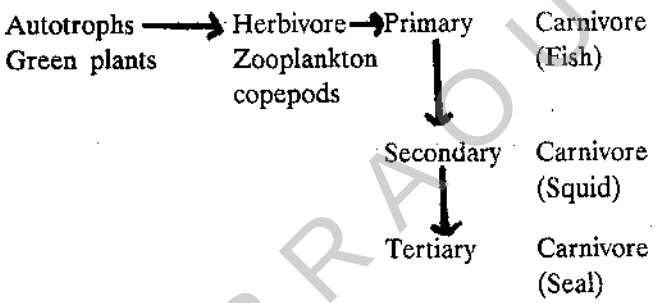
The utilization of energy is described by two laws of Thermodynamics. The first is called **law of conservation of energy** which states that energy is neither created nor destroyed. This means that energy is simply transformed from one place to another or from one form to another.

The second law states that spontaneous transformation of energy into potential energy is not 100% efficient. For example, when an animal takes in potential energy as food, it gets converted into heat. At every step, while transferring energy from one organism to another, a large part of it is reduced to heat.

The transfer of food energy from plants (source) through repeated eating and being eaten is referred to as **food chain**. The shorter the food chain, the greater is the energy available.

A simple food chain may have 3 or 4 links:

Aquatic ecosystem:



Terrestrial ecosystem:

Plant ⟶ Mouse ⟶ Snake ⟶ Hawk

These carnivores are linked with several food chains. Thus the food chains are interconnected with one another. This interchange of various food chains is called **food web.**

Basically two types of food chains are in existence:

(1) grazing food chains and (2) detritus food chain.

1) Grazing food chain

It starts from green plants and ends with the carnivore by passing through the herbivore.

Autotrophy ⟶ Herbivore ⟶ Primary carnivore ⟶ Secondary carnivore

This chain is called predator chain. Similarly parasitic chains also exist where small organisms consume large ones without killing them completely.

2) Detritus food chain

The transfer of energy from dead organic matter into microorganisms and then into their predators is termed detritus food chain.

In the detritus food chain, energy flow occurs continuously rather than as a stepwise flow. In the grazing food chain energy storage is in the tissues of living beings, but in detritus food chain the energy may be stored outside the organisms.

These organisms ingest the organic matter and excrete the reminder as simple organic molecules. The waste thus excreted from one organism may be immediately utilised by a second organism and the process repeated. Sometimes instead of the breakdown of complex substances into simple ones the original wastes may be converted directly into CO_2 and water. In the majority of instances the organic matter is converted to humic acids or humus.

As we pass from one step to another in the grazing food chain, the number and mass of organisms get limited by the amount of energy available. Since some energy is lost as heat in each transformation,the step becomes progressively smaller. The producer level forms the base and the successive levels make the apex and thus the figure assumes the shape of a **pyramid** and this is called the **'ecological pyramid'.**

The ecological pyramids may be of 3 types:

1. Pyramid of numbers

It illustrates the population density, relationships within and among the trophic levels. The number of animals at the base are more than at higher levels and decreases at each trophic level due to reduced growth rate and predation.

The pyramid of numbers ignores the biomass and does not indicate the energy transformed. e.g., pond or lake ecosystem. The lowest trophic level is occupied by diatoms, which are abundant. The second trophic level is occupied by copepods, the third and fourth are occupied by smaller and larger fish. There is considerable reduction in the number of animals from the base to the tip of the pyramid.

2. Pyramid of Biomass

Biomass is defined as the total weight of dry matter present in the ecosystem at any given time. This type of pyramid shows decrease in biomass from lower to higher trophic levels. In terrestrial ecosystem, the tip are autotrophs, herbivores, primary, secondary and tertiary carnivores, etc.,

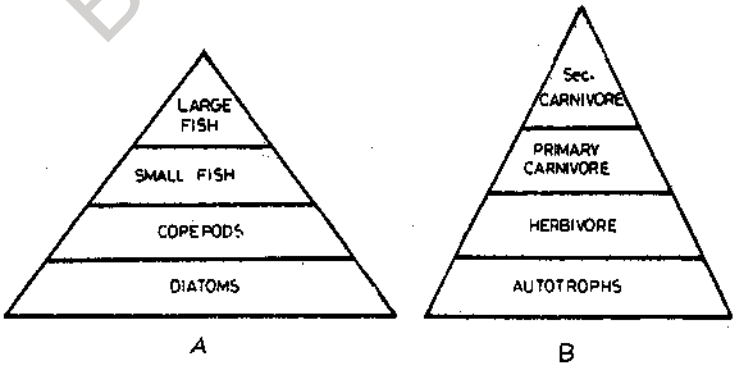


Fig. 21.2 Economical Pyramid A - The upright Pyramid of numbers in a pond B - The upright Pyramid of numbers in crop field

3. Pyramid of energy

In indicates the amount of energy flow at each tropic level in the ecosystem as well as the role played by different organisms in the transfer of energy. Greater amount of energy is available at producer level than at the primary consumer level. So the amount of energy decreases from the base to the apex of the pyramid.

Check Your Progress

1. The transfer of energy from dead organic matter into microorganisms and then into their predators is termed _____.

2. The carnivores are linked with several food chains. Thus the food chains are interconnected with one another. The interchange of various food chains is called _____

21.5 SUMMARY

1. Ecology is the study of organisms and their environment. Ecological principles help in human advancement. Ecosystem is the basic functional unit in ecology. In the ecosystem nutrients are cycled through biotic and abiotic components.

2. Abiotic substances include organic and inorganic compounds.

3. Biotic substances include the producers, consumers and decomposers. These are called trophic levels.

4. Energy within the ecosystem flows through circuits. The transfer of energy within the components of ecosystem is called food chain.

5. The ecological pyramids represent the relationship of populations within and among the trophic levels.

21.6 CHECK YOUR PROGRESS - MODEL ANSWERS

1. Detritus food chain

2. 'Food Web'.

21.7 MODEL EXAMINATION QUESTIONS

I. Answer the following in about 30 lines each:

1. Describe the functional aspect of ecosystem.

2. Define ecosystem and describe the components of pond ecosystem.

3. What is ecology? Explain its significance.

4. Describe different kinds of ecological pyramids.

5. What is food chain? Describe different types of food chains.

UNIT - 22 ECOLOGICAL FACTORS

Contents

22.1 OBJECTIVES

This Unit deals with three important abiotic factors - temperature, light and water. At the end of this unit you will be able to explain:-

- temperature tolerance in animals,
- mechanisms regulating the body temperature,
- effect of temperature on animals and adaptations to overcome cold and heat,
- similarly you will be able to explain in detail, the other two parameters of ecological importance.

22.2 INTRODUCTION

The environment is a complex of several factors. Charles Darwin first described the influence of abiotic and biotic factors on the organisms.

The abiotic factors can be classified into two classes, namely, physical factors (temperature, light, water, wind, etc. and chemical factors (pH, nutrients, etc.).

22.3 TEMPERATURE

It is one of the most important and essential ecological factors. It acts as a limiting factor for growth and distribution of organisms.

Various species shift between homeothermy and poikilothermy and these are known as heterotherms: e.g., pigmy mouse which aestivates or hibernates according to changes in temperature. Humming bird become nocturnal in hot weather.

Effect of temperature on animals

1. **Metabolism:** Most of the metabolic activities in animals are regulated by enzymes which in turn are influenced by temperature. Increasing in temperature up to certain limit increases the enzyme activity thereby increase the metabolic rate. Most of the enzymes show increase in enzyme activity from 17°C to 48°C and later on show retardation.

   An increase in temperature by 10°C causes two to three-fold increase in the rate of a biological process. This is called "Vant Hoff's law."

2. **Development:** In general the eggs and larvae of terrestrial species require a higher temperature than adults.

3. **Growth:** Adult trouts do not grow untill the water is warmer than 10°C. The length of oyster increase from 1.4 mm to 10.3 mm when the temperature increases from 10° C to 20° C.

4. **Morphology:** a) In warm humid climates many insects, birds and mammals have darker pigmentation than when living in cool and dry climates. This phenomenon is called **'Glober rule'.** (b) Temperature can effect the relative size of certain parts of the body. Birds and mammals living in colder regions attain greater body size than those living in warmer regions. This is called **'Bergmann's rule'.**

The extremities like tail, ears and legs of mammals become shorter in cold climates. This is called **'Allen's rule'** e.g. Mice reared at 31°C have longer tails than those of the same strain reared at 15°C. Temperature is known to influence the number of vertebrate in certain species of fish, which obay the **'Jordon's rule'** e.g., the fish living in 4-8°C have 56 vertebrae while the same species living in temperature of 10-11°C possess 54 vertebrae.

The relationship between seasonal changes in temperature and the body form may be explained by a remarkable phenomenon called *'Cyclomorphosis'*. It is best exhibited by certain cladocerans. e.g., *Daphina.* These crustaceans show striking differences in the size of the helmets or the head projections between winter and summer months (Coker, 1931). In winter the head is round in shape. During spring a helmet like projection develops and attains it's maximum size in summer. During autumn it gets reduced and disappears altogether in winter to resume the usual shape of a round head (Fig. 22.1) Such a kind of cyclomorphosis shows a clear relationship between the temperature and the morphological changes. Two hypotheses were put forward to explain this cyclomorphosis.

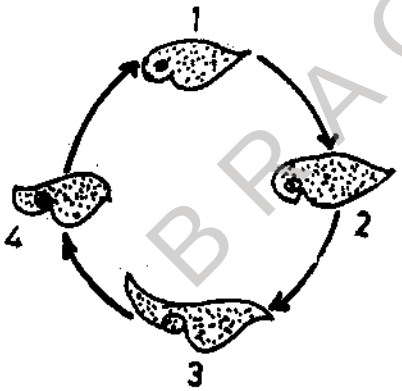


Fig. 22.1 Cyclomophosis in Daphnia 1. Winter 2. Spring 3. Summer 4. Autumn.

1. **Buoyancy hypothesis:** As the temperature of water rises during summer, the buoyancy of water becomes reduced. Therefore, to aid the floatation process in summer, certain adaptations like projections of the head occur.

2. **Stability hypothesis:** According to this, the helmet acts like a rudder and gives greater stability to the animal.

Adaptations to temperature

Animals become dormant to overcome the effects of temperature.

The term. **'hibernation'** is used to describe the situations in which metabolism is reduced during winter. Many poikilothers hibernate in cracks and crevices or in mud. In homeotherms, during hibernation, body temperature, metabolism, respiration, heart beat are reduced. For this slow activity the animal derives energy from organic reserves like glycogen. Hedgehogs,

bats and rodents are some of the mammals which undergo hibernation . Hiberation consists of low temperature of the body (hypo-thermia) accompanied by sleep. Hibernation is first induced by cold environment and later regulated by internal harmones.

Aestivation refers to the reduced activity or dormancy during summer to avoid excess heat in summer. It is seen only in some invertebrates and in certain mammals: e.g., Heteropteran bugs, the snail, Ariophanta. Many insects undergo diapause, a condition during which the morphological growth and development of animal are suspended or retarded.

In animals thermal migrations do occur. the journeys under taken by animals that enable them to escape from extremely hot or cold situations are called 'thermal migrations'. e.g: round squirrels do not move out of their burrows to avoid the severity of temperature in winter or in summer. Frogs turtles and amphibians make short trips into or out of water for cooling or warming. Many fishes and aquatic animals leave the shore in summer; others migrate into deep water during winter to avoid low temperatures. Insects migrate from north to south. Migration is well exhibited by birds. In their cases in addition to temperature, other factors like food, breeding climate, etc., are responsible.

22.4 LIGHT

Light is a form of radiant energy from sun. The radiant energy is trapped and utilized by green plants through photosynthesis. Unlike temperature, light is a non-lethal factor and has a specific direction in its flow.

In addition to visible light, sun emits other radiations of different wave lengths-cosmic rays, gamma rays, X-rays, UV rays, infra red, radio waves, electromagnetic waves. Of bulk of solar radiation, visible light forms only a narrow region of electromagnetic spectrum (Fig. 22.2)

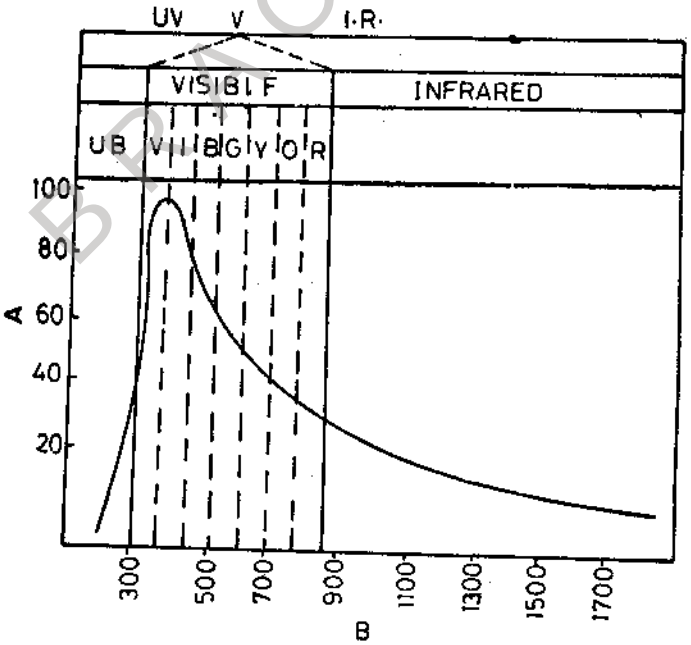


Fig. 22.2 Electromagnetic Spectrum of light.

About 10% of the light reaching water is reflected back and only 20% penetrates into the water. The longer rays are absorbed by surface water while the shortest rays penetrate deep. Depending on the penetration of light, oceans are divided into euphotic zone (upto 50 meters depth), disphotic zone (between 80-200 meters) and aphotic zone (below 200 meters). In

oceans algae are distributed according to the depth of light rays; green algae lie in intertidal zone: brown algae in somewhat deeper layers and red algae in deep oceanic waters of which they are a characteristic feature.

Effects of light on organisms

Metabolism: The light absorbed by the animal results in ionization of protoplasm and thereby increases the enzyme activity and the general metabolic rate. Cave animals show a less metabolic rate than others. The best example of the photochemical reaction is the photosynthetic process occuring in plants.

Pigmentation: The pigmentation of skin is associated with light. The pigments seen in chromatophores are directly controlled by the intensity of light. Certain aquatic animals lose their colour when removed from light. Cave dwelling amphibians and fishes have little or no colour but when exposed to light, they tend to develop pigmentation on their bodies.

Animals protect themselves from enemies by pigmentation. This is called protective colouration. Some reptiles, amphibians, fish, crustaceans, insects are able to change their colour in order to match their surroundings.

Orientation: Oriented locomotory movements towards and away from source of light is called 'phototaxis'. The movement of an organism towards the source of light is said to be photopositive or positively phototactic. *Euglena* and *Ranatra* move towards the source of light while *planaria*, earthworm, copepods, siphonophores. etc., move away from the source of light i.e., negatively phototactic. When only one part of an organism shows movement positive to the light source, it is called Phototropism flagellum in *Euglena* and polyp of coelenterates move towards light.

The movement of animals at a constant angle towards the source of light is called light compass reaction or **celestial orientation.** Such orientation has been observed in fishes, turtles, lizards. birds. etc.

Photoperiodism: The photoperiod is measured in terms of the length of the day. Regular cyclical operation of light (day) and dark (night) are known to influence behavior and metabolism of animals. These responses of different organisms to the rhythmical occurance of light and dark is called 'photoperiodism'. Similar to diurnal periodicity there exists seasonal, lunar periodicity, etc. Most of the mammmals are diurnal and only a few like bats and rodents nocturnal.

The rhythmicities are exogenous and endogenous. Organisms respond to exogenous factors like light, intensity, humidity, temperature, tides, etc. The endogenous rhythmicities and innate and little affected by temperature and chemical inhibitors. The Physiological properties of animals like appetite, sleep, awakeness, etc., are also under the influence of diurnal rhythms.

Development and Growth: Light in some cases accelerates the development for example, Salmon larvae do not develop in the absence of light. In some cases absence of light enhances the development e.g., *mytilus* larvae.

With increase in depth, the size of the eyes increases in organism upto the upper limit of lightless zone, below which the eyes are smaller; and eyes are completely degenerated in bottom dwellers. Many fishes have large telescopic eyes, some crustaceans at 800 m depth are able to see the objects with the adjustment of rods and cones the pigments in the retina of the eye. In terrestrial nocturnal animals like owls and geckos, there are large protruding eyes.

Due to the lightlessness animals may become carnivores. They have large mouths, teeth and elastic stomach and abdominal walls.

Bioluminiscence

The light of biological origin is called 'bioluminiscence', also popularly called 'phosphorescence'. Luminious animals are reported from protozoa through chordata. Luminiscence in animals is the result of a chemical reaction in which a substrate is oxidized giving rise to light.

Light production may be:

intracellular	(e.g., *Nactiluca, Ophiothrix*)
or extracellular	(e.g., *Chaetopterus, Balanoglossus)*
or symbiotic bacteria	(e.g., *Loligo, Sepia, Teleost)*

Rober Boyle (1677) first noticed the occurrence of bioluminiscence in fungi. But **Dubios** (1887) extracted the light producing substance called **'luciferin'.**

Production of light is duc to a chemical reaction:

Luciferin + Luciferase (Substrate) ⟶ Luciferin (Enzyme) — Luciferase complex

This complex in the presence of O_2 gives light.

The light produced by animals is said to be cold light, since no heat is evolved.

In deep sea habitat, it is the only source of light. In fireflies it is used to recognise the opposite sex and to communicate mating signals. It also acts as a lure to attract prey and as a warning to frighten the predator.

22.5 WATER

Water is the medium of aquatic environment. Any change in the quality of water in terrestrial or aquatic ecosystems may have a profound effect on its biotic community. The main sources of water are rainfall, humidity, moist, fog, etc.,

It is a universal solvent and is the chief component of the living cell. It exists as gas, liquid or solid.

In pure water the number of H^+ and OH^+ ions are equal showing neural (7.0)pH. Some waters have excesses of H^+ and are said to be acidic (o-6.9pH), while others have excess of OH^- ions and said to be basic (7.1-14.opH).

The water having the soluble salts of calcium and magnesium such as chlorides, sulphates and bicarbonates is called 'hardwater'. If these salts are absent, water is said to be soft in nature. The hardness or softness can be detected with the leather we get with soap. Hardness of water may be temporary or permanent.

The continuous circulation of water between the atmosphere and earth's surface is known as 'hydrologic' cycle. The ocean is the reservoir of water. it gets evaporated by solar radiation.

All organisms have to maintain a certain amount of water in their bodies. The maintenance of water level between internal environment is called osmoregulation.

Aquatic environment

In the aquatic ecosystem animals face the problem of excess water. In fresh water fishes, osmotic concentration of salts in blood is greater than that of surroundings, i.e., hypertonic. In them water enter the body through mouth and gills. In the marine medium there is water loss from the body, since the osmotic concentration in the sea water is higher than that of

body fluids, i.e., hypotonic. Depending on the tolerance of salinity, animals are classified as euryhaline or stenohaline.

Organisms living in pond, on lake develop a variety of methods or adaptations to cope with the drying or fouling of water. Some invertebrates like protozoans, sponges, and crustaceans, develop resistant spores. *Daphnia* reproduces rapidly before the water gets dried. Some fishes undergo such physiological changes as would enable them to live in grass or mud: from example, *Protopterus* can live in mud, and cocoon in drought. It secretes a substance around the body which prevents water loss from the body. Amphibians live in burrows and go through their dormancy phase.

Terrestrial environment

The water problem in terrestrial environment is acute. Animals adapt themselves to various devices so as to minimise the loss of water. Animals get water by drinking, by absorbing through skin, from their food, and from the water produced by metabolism. The following adaptive features may be seen.

1. **Impervious skin:** Animals living in dry areas (like deserts) have thick impermeable body covering. Such integument is seen in insects. birds and mammals. Ruminants and rodents do not have the sweat glands. *Phrynosoma* exhibits a spiny skin. Desert dwellers show in digging mechanism. Certain amphibians, and earthworms restrict themselves to swamps, moist soil or similar damp places.

2. **Internal lungs or tracheal system:** The mode of respiration has some relations to water. Gills in crustaceans are provided with a water retaining carapace. It serves as a liquid environment for the gills. The scales on the fish are impermeable to water or exchange of gases, which are limited to gills. The internal lungs in snails, spiders, amphibians, reptiles, birds and mammals and the tracheal system in insects have the capacity to save water.

3. **Selective food:** Most of the herbivores depends on the food having a large amount of water. For example, for goat, and the carnivores get the water from the blood of their prey. Insects feed on those parts of the plants which have a high water content. Most of the animals make use of the water released through the oxidation of fats, and carbohydrates. The camel in the desert can live for 11 days without drinking water as the water obtained from the oxidation of fat in its hump and the water in special compartments of stomach its water requirement.

4. **Dry excretion**: Water saving insects, reptiles and birds excrete the dry nitrogenous wastes as solid uric acid.

5. **Suspended animation:** Animals with simple organization like rotifers, nematodes,snail, etc.,retain their vitality in dry environment. Other animals like frogs, etc.,aestivate during draught and are active during the moist season of the year.

Many animals adapt themselves to the burrowing habit in order to avoid water loss. Birds and mammals migrate when they face the scarcity of water.

Check your progress

1. Animals which can regulate their body temperature are called _____, those which can not maintain constant body temperature are called_____.

2. The term _____ is used to describe the situations in which metabolism is reduced during winter._____refers to the reduced activity or dormancy during summer to avoid excess heat in summar.

22.6 SUMMARY

1. Animals are classified as eurythermal or stenothermal on the basis of their tolerance of changes in temperature. Similarly, animals which can regulate their body temperature are called homeotherms; those which cannot maintain constant body temperature are called poikilotherms.

2. Temperature effect on animals may be seen in their behaviour, metabolism, growth, development, size of the body parts, etc. They undergo aestivation (summer sleep and hibernation (winter sleep)to overcome the effects of unfavourable temperature.

3. The non-availability of light affects the metabolism, pigmentation,growth, development, and orientation of the animals. Biological light is called 'Bioluminiscence'.

4. The circulation of water between atmosphere and earth's surface is known as 'hydrologic cycle'.

5. A number of adaptations like dry excretion, suspended animation, impervious skin, selective food, change in mode of respiration, type of food, etc., are seen in terrestrial animals to counteract the loss of water.

22.7 CHECK YOUR PROGRESS -MODEL ANSWERS

1. homeotherms, poikilotherms

2. 'hibernation'
   Aestivation

22.8 MODEL EXAMINATION QUESTIONS.

I. Attempt the following in about 30 lines each:

1. Discuss the importance of temperature and light as ecological factors in animals.

2. Enumerate the adaptations to temperature seen in animals.

3. Give an account of biological light- its occurrence, mechanism of production, and significance.

4. 'Water is the medium of aquatic environment'- Discuss.

5. Discuss homeothermy and pokilothermy.

II. Write notes on the following in about 10 lines each:

1. Thermal stratification 2. Dormancy 3. Cyclomorphosis 4. Allen's rule 5. Jordon's rule 6. Eurythermy 7. Stenothermy 8. Electromagnetic spectrum 9. Photoperiodism 10. Bioluminiscence 11. Universal solvent 12. Hydrological cycle.

UNIT - 23 COMMUNITY STRUCTURE AND ECOLOGICAL SUCCESSION

Contents

23.1 OBJECTIVES

This unit deals about the community structure. At the end of this unit you will be able to explain about:

- community composition,
- species diversity
- ecological niche
- community stability, stratification etc.,
- the causes of ecological succession, types of succession, climax.

23.2 COMMUNITY STRUCTURE

23.2.1 Introduction

Community is a group of different kinds of populations living in a given area or a physical habitat. **Clarke** (1967) defined community as the group of plants and animals inhabiting a natural area. It was described as **'biocenose'** by **mobious** (1880). The biotic community along with environment forms the **ecosystem.**

The components of communities are populations and the population is an assemblage of individuals belonging to a single species. According to **Kendeigh** (1974), the community may be distinguished as major or minor. Major communities are large, relatively independent and self sustaining units. Major communities are called societies which are dependent on neighboring ones.

A Community has the following characteristics:

23.2.2 Species diversity and dominance

Even though all organisms in a community are equally important in their function, relatively few species exert influence by virtue of their number, size, production, etc. Some spacies are found only in one community - **exclusive species** - whereas other live in many communities - **ubiquitous species**. Of the total number of species in a commmunity very few are abundant in individuals or biomass. The dominant species there-few in number account for the energy flow in each trophic group. But it is the large number of species that determine the species diversity. In a forest community trees are dominant. Grasses play a similar but a resticted role in a prairie community, mussels and barnacles on the rocky sea shore etc.

23.2.3 Community composition

a) **Size:** Communities may be large covering thousands of square kilometers: e.g., Oceanic community. Some may be small like a lake or a desert covering hundreds of square kilometers. Other may have still smaller communities. A horse shoe crab with a dozen species of molluses worms and barnacles attached to its shell comprises a microcommunity.

b) **Trophic Structure:** The trophic structure determines the pattern of movement of energy and nutrients through the community. The major communities may trophic (feeding) levels like those of producers, consumers, transformers and decomposers. Most of the plants are consistent in that they synthesize their food material except a few like epiphytes and insectivorous plants, that consumes are not so consistent. They may eat herbivores or carnivores. Some other animals like frogs show variation. Within the life cycle tadpoles are herbivorous while adults are carnivorous.

c) **Number and Variety of Species:** Each community maintains a perfect balance between producers and consumers. Each trophic level may be represented by one, few or many species. deep sea or a desert may have few species with a small number of individuals but some habitats having a less number of species and more of individuals in each species can also be seen.

23.3.4 Ecological niche

The functional role or the specific position of a species within the community is called the ecological niche. as per Odum, the ecological niche includes not only the space occupied by an organism but also its role in a community, i.e. how it transforms energy, behaves, and responds to physical and biotic environment. Thus the habitat of an organism may be compared to the address of a person and the niche to his profession.

Two aquatic bugs, the notonecta and corixa, may live in one and the same habitat but occupy different trophic niches. Notonecta is an active predator feeding on other animals, while corixa feeds on decaying vegetation.

When the niches overlap to a large extent, natural selection operates through competition and results in the elimination of one species. Generally, no two species in a community occupy the same niche. This phenomenon is called **'Gause's principal.** In such cases one is always superior to the other and the other is drivan out of existence through competition.

Organisms which occupy the same ecological niches in different geographical regions are known as ecological equivalents. For example, the Antelope of N.America is ecologically equivalent to the kangaroo of Australia, since both are grazing herbivores of grasslands. Some species occupy a broad ecological niche. For example man has been a herbivore, a carnivore and an omnivore in most of the time.

23.2.5 Community stability

Some communities like tropical rain forest and coral reef are stable. Their populations remain constant over long periods of time. Other communities like Tundra are variable as the environmental fluctuations operate on them. As per Hairston et al (1968), the stability of a community is related so the microenvironment and community diversity.

23.2.6 Ecotone and edge effect

The demarcation between two communities is possible when the dominants of adjacent communities show clear differences. Such a junction zone between two or more communities is called **'ecotone'**. e.g., border between forest and grassland. Ecotones may be narrow or wide. The ecotone has species seen in both the overlapping communities and the species characteristic of its own. The tendency of the ecotone in possessing the species found in neither or the major communities is called **'edge effect'**. For example, the owl depends on the forest for nesting and on grassland for food (field rodents).

23.2.7 Factor Compensation and ecotype

Organisms may develop certain adaptations to temperature, light, water, oxygen, etc. Such factor compensation occurs at both species and community levels. Species with wide geographical ranges always develop locally adapted populations called ecotypes which have genetically a different tolerance range and optima in response to environmental factors (odum, 1971). Frogs at one extreme of distribution undergo rapid development at a low temperature while others at another extreme of distribution show a much retarded development at a higher temperature.

23.2.8 Community stratification

Stratification refers to the vertical or horizonatal layers of organisms and the result of their activities upon the environment.

a) **Vertical stratification:** In the grassland community three strata, namely, subterranean, floor and herbaceous, may be recognised. The subterranean contain roots of plants and provides permanent residence to soil bacteria, protozoans, nematodes, worms and the burrowing animals. The floor stratum contains vegetation, rhizomes of grasses and animals like insects, reptiles and rodents. The herbaceous stratum is formed of upper parts of grasses and herbs and the animals include a variety of insects, birds and ruminants.

   In the pond and lake three zones are recognised which are littoral, mimetic and profundal zones. Vertical movement of plankton affects its distribution. Thus vertical stratification is a common feature of many biotic communities.

b) **Horizontal stratification:** Singing birds divide the community into territories, and each male of a species establishes and defends an area in which the pair nests and feed. the interaction among the birds has brought about a distribution which is regular rather than random.

c) **Temporal stratification**: Biotic communities show differentiation (stratification) in time also. Different groups of species occur at different times during the seasonal cycle. Seasonal and daily differentiation occur in forests. One group of insects are active during the day and another group at night and a third group during the twilight transition of morning and evening. The warblers, fly catchers and other insectivorous birds are active during the day; the bats at night and hawks at dusk.

23.3 ECOLOGICAL SUCCESSION

When a community comes into existence, it shows growth, reproduction, maturity and senescence and finally death. When it perishes, the area will be occupied by another community. This process of one community replacing another occurs so long as the stable community occupies the area. The process is called ecological succession or ecosystem development. In succession, the entire sequence of communities from its inception to the terminal product is collectively called **'sere'** and the individual transitional communities are called **'seral stages'** or **'seral communities'**. When succession starts from a barren area such as bare rock or open water it is called primary succession. If an advanced successional stage is destroyed and the recovering stages reach the climax community it is called secondary succession. While the primary succession is a long term process, the secondary succession occurs quickly and proceeds rapidly. In the succession the first community or organisms to become established are called pioneer communities'.

23.3.1 Causes for succession

The causes for ecological succession may be physical and biotic. The erosion or deposition by wind, precipitation, flowing water, waves etc. from the physical factors of succession. Increase in parasites and predators reduce the abundance of prey. Consumers are reduced due to scarcity food; physical nature of the habitat also changes. After the death of plants the material. returned to the soil changes the pH, moisture content, etc. The excretion, dead and decomposed bodies of living being, aeration by burrowers all increase the humic acids. Changes in temperature, relative humidity also tend to alter the community.

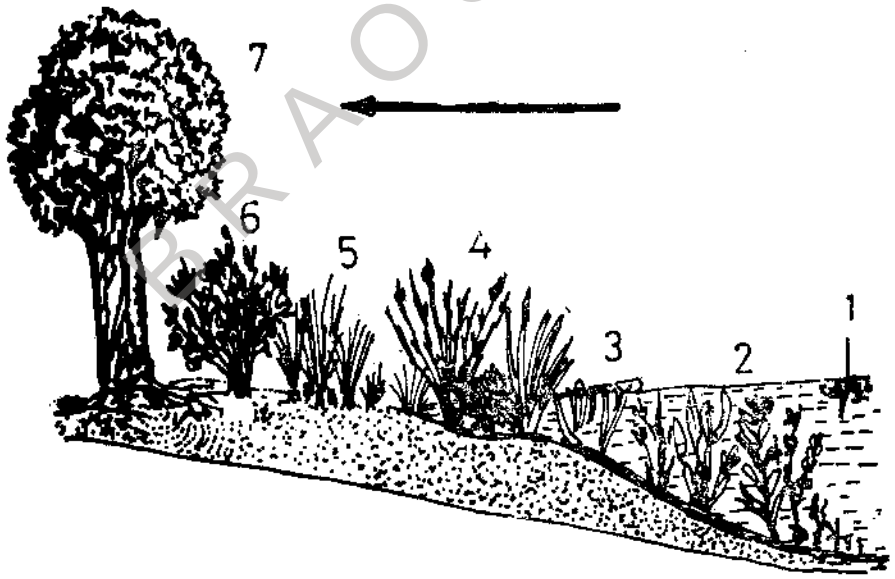


Fig. 23.1 Succession from a pond 1. Phytoplankton 2. Submerged Stage 3. floating Stage 4. Reed Swamp Stage 5. Sedge meadow Stage 6. Shrub Stage 7. Tree climax.

An example of primary succession is a pond and its community getting converted to dryland with entirely different communities. In the pioneer stage the newly formed ponds are barren at bottom. the first organisms to apper are the phytoplankton and zooplankton. They add organic matter to the bottom: The vegetation along the margin may move to deeper water and so the margin of pond also is reduced. some vegetation is carried from an adjacent land. At this stage some submerged plants appear along with certain flies and crustaceans. The death of these plants leads to more humus at bottom and binds with mud. The water becomes

shallow and unsuitable for submerged plants and they are replaced by Pistia. Nymphea etc. Animals found are snails, beetles, amphibians, etc. Further shallowing of ponds leads to the emergence of water plants, and Mayfly or dragon flies complete their nymphal stages on the submerged stems. Then the water scorpion, water bug and other beetles appear. Annelids, kingfisher like birds ducks, weavers, etc., become common, Animals carry the materials to pond. Plants make the water still shallower, sediment also is washed so that the hydrophytes can grow. These changes bring in the permanent pond to a temporary one which dry up in summer. Then the snails which can aestivate make their appearance. If the climate is dry, a grassland is produced. If it is moist, a woodland with shrubs and small trees are formed.

A volcanic explosion occurred on the 7th of August, 1883 on the Indonesian island Krakatoa causing part of the island to disappear. This may be taken as an example of secondary succession. The reminder was covered with volcanic debris to a depth of 60 meters and light was not practicable. One year later the grass and single spider ware found. By 1908 about 202 species have taken up residence on the land. It increased to 880 species by 1934 and a young forest developed on one part of the island. Seadings of beech, maple and other tolerant species that exist as minor members grow into mature trees with the removal of pines. The pine seedlings are unable to develop in the shade of mature trees. Once the mature pines are gone, the species composition of the forests changes completely paving the way to the emergence of a community of mixed woods. Thus secondary succession originating in the old fields produce a transient community of pines but eventually the typical climax forest was restored.

23.3.2 Climax

The community that ends a succession is termed **'climax'**. As succession proceeds from the early pioneer community to the climax, productivity tends to increase. There is a difference of opinion among ecologists as to whether the optimum productivity occurs in the serial stages or in the climax stage. **Whittakar** (1953) states that the productivity is greater in the late serial stages than in the earlier ones while **Olson** (1963) has found that in many ecosystems, productivity as measured by the accumulation of energy in organic matter will continue to show a net increase until the climax is reached and even beyond. **Bliss** and **Cantilon** (1957) have found an increase in productivity from the pioneer to the second stage of development and thereafter a decline. Another way of regarding productivity and succession is to consider the ratio at productivity to the utilization of organic matter by all the organisms of community. During the serial stages productivity is greater than utilization but when the climax is reached, productivity will equal utilization **(Olson,** 1963).

To summarise, succession involves at least four basic concepts:

1. There is a dynamic shifting of species on the composition of the community.
2. The species changes in an orderly way. It may be possible to predict what type of community would follow an existing one.
3. The sequence of changes of communities is directional. Each succeeding community type is more like the climax type at least in physical characteristics.
4. The ultimate community type is the climax community.

Check Your Progress

1. The functional role of the specific position of a species within the community is called_____

2. The demarcation between two communities is possible when the dominants of adjacent communities show clear differences. Such a junction zone between two or more communities is called _____

3. The tendency of the ecotone in possessing the species found in neither or the major communities is called _____

23.4 SUMMARY

1. Community is an assemblage of different populations living in a given area.
2. Community has characteristics like the species diversity and dominance, community composition, ecological niche, and community stability.
3. Community has vertical, horizontal and temporal stratification.
4. The ecological succession can be brought about by physical and biotic factors.
5. Communities usually end in a succession called climax.

23.5 CHECK YOUR PROGRESS - MODEL ANSWERS

1. ecological niche
2. ecotone
3. 'edge effect'

23.6 MODEL EXAMINATION QUESTIONS

I. Answer the following in about 30 lines:

1. What is biotic community. Explain its different characteristics.
2. What is meant of ecological succession. Enumerate various processes of ecological succession with one example.
3. Describe the various stages in the development of climax successions in nature.

II. Answer the following in about 10 lines:

1. What are the causes for succession.
2. What do you mean by community stratification.
3. Explain ecological indicators.
4. Write about ecological niche with a suitable example.
5. What factors do you consider important in community composition.

UNIT- 24 POPULATION ECOLOGY

Contents

24.1 OBJECTIVES

The objectives of this unit is to know the characteristics of population namely the natality, mortality etc. At the end of this unit you will also be able to explain

- the growth form of population and the factors that influence growth.

24.2 INTRODUCTION

According to **Krebs** (1976) a population may be defined as a group of organisms of the same species occupying a particular area in a given time. The word population is derived from a latin word populus meaning 'people'. It is a self regulating system that helps in maintaining stability in ecosystem. The study of population is called demography. The study of number of organisms and the factors that determine their distribution and abundance is called **population ecology.**

The characteristics of a population include: 1. Those that it shares with an organism called biological attributes. 2. Those that are unique of its own-Unique attributes. Mostly these are statistical i.e. the biological features expressed as statistical functions.

24.3 BIOLOGICAL ATTRIBUTES

1. Population has a definite structure and composition at any given time. Any population usually consists of the larvae, juvenile, mature, breeder, the spent; male and female, small, medium and large sized individuals. They may belong to different races, varieties, subspecies etc. Since number of adults, sub-adults, males or females vary from time to time it may be said that the composition of population also varies with time.

2. Population exhibits ontogenic characters in normal conditions. Therefore we can say it has history similar to individuals.

3. Like organisms population has to face the impact of environmental changes.

4. Population grows, differentiates and maintains itself as does the organism.

Unique attributes

These attributes are meaningful only at the group level and therefore unique of population and cannot be related to a single individual.

24.3.1 Population density

The density of a population is the total number of individuals per unit area or volume. For ex. 100 trees/ha; 20,000 diatoms/cu m of water not 100 pounds of fish/acre of water surface etc. When size of the individuals of a population is uniform, density is expressed in numbers, when the size is variable then the density is represented as biomass.

Population density is the total number of species within a natural habitat. It is a numerical concept and can be expressed by the equation:

$D = \frac{n/a}{t}$ where D = Density

t n = number
a = area
t = time

24.3.2 Population growth

The growth form of a population is influenced by natality, mortality and dispersion.

Natality: It is the inherent capacity of a population to increase in numbers. it includes the production of new individuals under ideal conditions by means of asexual division germination, hatching or by birth.

Natality is the number of individuals born per female per unit time. In case where individuals are born, the birth rate is equal to natality.

Birth rate 'b' = $\frac{\text{No. of births per unit time}}{\text{Average population}}$

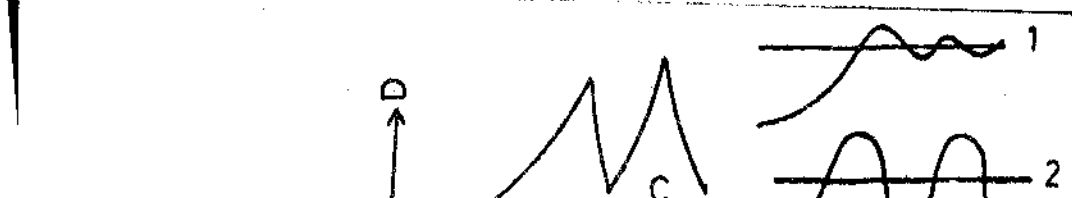
Mortality: It is the force that decreases the individuals or it is the population declining factor. As natality is expressed as the rate of gain or birth of individuals in a unit time, morality is expressed as loss of individuals in unit time or the number dying in a given time. The ratio of death (d) is expressed as;

$d = \frac{\text{No. of deaths per unit time}}{\text{Average population}}$

The age at which death occurs is sigificant because birth rate will fall if death occurs mostly among mature individuals. Further the age of death would alter the structure of population. When more young ones are born than the habit can support, the surplus must either die or leave the area.

specific mortalities at different ages of life history could help in determining the forces underlying the population mortality. A complete picture of mortality in a population can be represented by a statistical device called life table. Life table is the format for describing mortality rates in a population. it was first introduced by **Pearl** (1921).

Life tables are useful for computing the average longevity of a population, for showing the age composition, for showing differences between species, for showing the critical stages in



life cycle at which mortality is high, for showing success of a species in a biotype, and in the control of pests.

Curves may be plotted from data of life table. The number of individuals of a population at the beginning of age interval are plotted on horizontal and the number of survivors at time interval on vertical and the resulting curve is called survive curve.

In nature three types of survivorship curves are obtained:

1. Convex type, in which population mortality rate is low until the end of life span. Ex. large animals and man.

Population characteristically increase in size in a (i) sigmoid 'S' shaped or logistic fashion (ii) 'J' shaped

In the 'J' Shaped growth form population density increases rapidly and then stops suddenly. In the sigmoid type it increases slowly and then more rapidly and finally very soon slows down gradually until equilibrium is reached. Simple growth form of a self limiting population is said to be logistic and expressed in the form of 'S' shaped curve called **'logistic curve'**. The level beyond which no major increase can occur represents saturation level or carrying capacity (k).

24.3.6 Population fluctuation

When population complete their growth and arrive at asympote level, the density tends to fluctuate above and below this level. The irregular or asymmetric deviations from the mean numerical stability deviations are called oscillations. The fluctuations may result from changes in physical environment and interaciton within the population or between the closely interacting populations. In nature seasonal and annual fluctuations can be noted.

Seasonal changes are typical of most freshwater and oceanic plankton populations ex. plankton blooms. Such blooms are larger in spring and caused as a result of various external nonbiological factors.

Oscilations exhibit regularity for which reason they are referred as cycles. Species exhibiting such cyclic variations are called cyclic species. Oscillations may be the result of intrinsic factors such as predation, disease.Violent oscillations are common in populations which show 'J' shaped growth form and damped oscillations are characteristic of 'S' shaped growth form.

24.3.7. Population regulation

In a simple ecosystem, populations are regulated by physical components of the environment like weather, water currents, floods, storms etc. Many plants and animals have the intrinsic self regulatory mechanisms such as failure of reproduction and self inflicted mortality for controlling the size of the population. Populations grow when natality exceeds mortality and they decline when mortality exceeds natality. The limitation of animal number is affected by the interaction of two processes : density independent and density dependent factors.

The density independent factors are those, the effects of which are independent of size of the population. These are extrinsic factors which tend to regulate the density of a population under different conditions. An increase in the number of species on a habitat say ocean, does not affect the temperature or salinity of water, but changes in these factors are brought about by agents correlated to density. The density dependent factors are intrinsic or biotic. Some of the density dependent factors are competition, reproduction, predation, emigration and disease.

Populations always try to evolve towards self regulation. Direct density dependence can only regulate any population. The effect of combination of factors involved in density dependence

24.3.8 Home range and territoriality

Home range is an area which is regularly traversed by an individuals in search of food, mate etc. The portion of it which is actively defended from the entry of the members of the same species is called territory. The territory may be well seen in social organisms like hive of bees, colony of ants, by a breeding pair or by a single individual. Territory is well established in vertebrates and certain arthropods which have complicated reproductive behaviour like nest building, egg laying or protecting the young. The return of an animal to its territory is referred to as homing. This is familiar among birds many species of insects, and certain crustaceans.

Check your progress

1. _____ is the number of individuals born per female per unit time.
2. Birth rate 'b' =
3. Loss of individuals in unit time or the number dying in a given time is _____

24.4 SUMMARY

1. Population is a group of organisms of the same species in an area.
2. Population has two characteristics: the biological and unique.
3. Population growth is influenced by birth rate (natality), death rate (mortality) and dispersion.
4. Population may be classified based on the age distribution.
5. The population shows 'J' or 'S' shaped curves when the density and time are plotted in a graph.
6. Populations may show the period of positive growth, equilibrium, fluctuations (or) oscillations, and period of negative growth or extrinsic.
7. ...lation is regulated by density independent and density dependent factors.

...R PROGRESS - MODEL ANSWERS

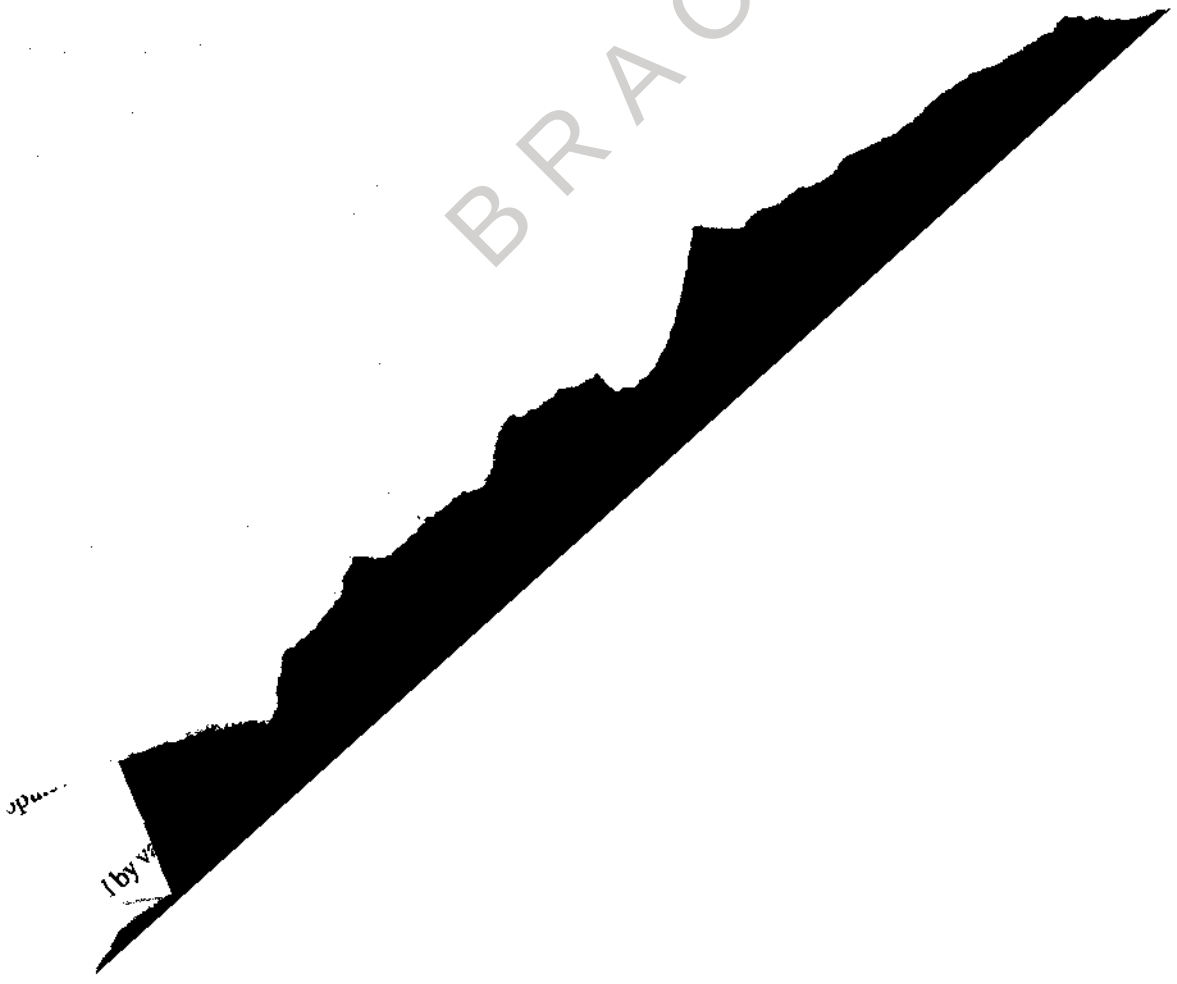
...NS

...letion.

...rious factors.

II. Answer the following in about 10 lines.

1. Explain the types of age pyramids.
2. Write about biotic potential.
3. Describe the survive curves of the animal populations.
4. Distinguish 'territory' from 'home range'.
5. Write about age distribution in man and other animals.



UNIT 25 ENVIRONMENTAL POLLUTION – RADIATION HAZARDS

Contents

25.1 OBJECTIVES

The objectives of this unit is to explain the major concepts of environmental pollution and the measures to control it. At the end of this unit you will be able to discuss in detail about the

- sources of air, water, soil and noise pollution and their effect on animals and man
- radiation hazards on human health.

25.2 INTRODUCTION

Environmental pollution may be defined as an undesirable or harmful change in the physicochemical or biological characteristics of biosphere. These changes may directly or indirectly affect man or through his consumption of water and agricultural and other biological products, as well as his physical possessions or his opportunities for recreation and appreciation of nature. Pollution and contamination are the two terms sometimes used interchangeably. Contamination is the presence of harmful substances or organisms that may cause disease or discomfort to a human being. Polluted material need not necessarily be contaminated. The presence of a small amount of pollutants (agents that cause pollution) may have a graced influence on human health.

Pollutants are of two types

1. **Non degradable** : Aluminium cans, Hg salts, phenolic compounds and DOT which do not easily breakdown or change into simpler components. These are stable and accumulate by way of biogeochemical cycles
2. **Biodegradable** : They are unstable substances of domestic sewage which can be decomposed by natural processes. They can be removed by natural waste treatment mechanisms.

Pollutions has been a major cause of hazards and a check is necessary to save human civilization from destruction. it has been observed that because of pollution there is an increase

in mortality and sickness from environmentally concerned respiratory disease, mental disorder, gastric ill effects and cancer. Usually, pollution may be aquatic terrestrial or aerial. A brief account of the sources and health hazards caused by different kinds of pollution in the environment is given hereunder:

25.3 THERMAL POLLUTION

A number of industries require water for cooling and the resultant warm water is discharged into lakes or rivers. The large amount of waste heat that is carried as hot water may cause thermal pollution. It produces distinct changes in the organisms living near the streams or rivers. Increase in temperature by $10^{o}C$ may double the rate of number of chemical reactions and decay in the organic matter, rusting of iron etc., and finally lead to a significant exchange of salts in the organism. Thus thermal pollution can affect the members of aquatic environment.

25.4 AIR POLLUTION

Air is a mixture of gases consisting of approximately 78-80% of nitrogen, 21% of oxygen, 1% of argon, 0.03% of carbondioxide and a number of minor gaseous elements like neon, helium, methane, krypton, etc. Owing to some natural processes or human activities the concentration of gases increases in the air and then the air is said to be polluted

Severe air pollution may affect human health and may be responsible for fatal diseases in them. Lung diseases among coal miners who inhale mine dust for years is a striking example of it. The pollutants may cause many diseases such as Emphysema, chronic bronchitis, lung cancer and respiratory diseases among children. When the levels of pollutants in air increase beyond permissable limits there is an increase in the incidence of bronchitis, sore throat and eye irritations and in frequency of their occurence.

Air pollution can be caused by the combustion sources, industrial and community activities, personal habits like smoking, etc. The combustion sources include (1) power plants, domestic heating equipment which produce sulphur dioxide, nitrogen oxides and (2) Motor vehicles which produce photochemical oxidant type like carbon monoxide and lead etc. Cigarette smoking is a personal pollution of the inhaled air. It contains a high concentration of CO an polycyclic aromatic compounds such as benzopyrine. It is related to chronic respiratory diseases and the cardiovascular diseases.

Some of the air pollutants are SO_2, CO and oxides of nitrogen.

SO_2 : Originates from the combustion of coal and generally it induces irritation in respiratory epithelium and in the eyes. It is responsible for cough, pharyngitis, headache, etc.

SO2 in atmosphere does not for long remain in a gaseous state. It reacts with the moisture to form H_2SO_4 and produces acid rain that falls on the earth; the pH values of the rain reaching far below (2.8). Such environmental acidity may affect the fish, and other aquatic animals and inhibit the forest growth.

CO : Its main source is release from the gasoline engine and the burning of coal. It combines with Hb to form carboxyhaemoglobin and reduces the oxygen transport. The nervous system is affected at levels of 2.5% of carboxyhaemoglobin.

Symptoms of the low level of CO poisoning are headache and psychomotor impairment. But advanced stages are indicated in nausea, heart palpitations and difficulty in breathing.

Oxides of Nitrogen

Robinson & Robins (1971) have estimated that biological production of NO and NO_2 amounts to 1 billion metric tons annually while man's combustion processes produce 48 million metric tons of NO_2 annually.

Sometimes the atomic oxygen (O) combines with hydrocarbons (methane, toluene, ethane) in the presence of sunlight and forms the photochemical smog (the combined effect of ozone, formaldehyde, PAN). The eye, nose and throat irritations associated with this type of pollution are felt instanteneously.

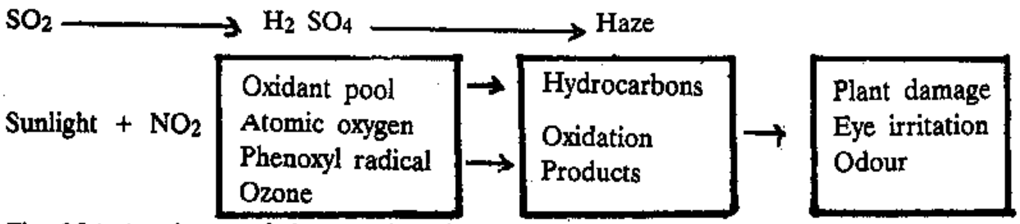


Fig. 25.1 A scheme of the reactions involved in photochemical air pollution

Measures to control air pollution

1. The device… …h as positive crank case ventilation, valve and catalytic converter which reduce exhaust by … …obiles are being tried out in some advanced countries.
2. Particulate … …s may be controlled by electrostatic precipitators which are capab…
3. Gaseous … …educed by finding the alternate chemical means based on … …y of gases.
4. In India … …entral and the State levels to issue or revoke licences …
5. The legi… …ing of smoking fuels fo…

25.5 WA…

Water is sai… …ndering it less suitable … its normal state. It … …ter, or such disc… …ation is most … …s, drainage of … decomposable … …ng waters. This … …ame of water) of … …e organic matter. … …treated domestic … chemical of the … …des, herbicides, … …ic protozoans, bacte…

Sewage … …hosphates of detergent…

Industrial wastes usually contain traces or large quantities of raw materials, intermediate products, final products, co-products and byproducts of any ancillary or processing chemicals used. In India most of the rivers or streams are pollutted with industrial effluents. Waste waters of different industries such as petrochemical complexes, fertilisers, oil refineries, synthetic material plants for drugs fibre rubber, plastics etc. may contain detergents solvents, cyanides, heavy metals and organic acids, dyes, pigments, phenolic compounds, tanning agents, sulfides and ammonia. Of the compounds mentioned, many are biocidal and toxic. The chemicals of industrial wastes are toxic to animals like crab snail, effects on the structure and functions of the liver, kidney; reproductive and respiratory system. mercury, a is used in a number of is 0.03 mg/litre, but in the contaminated waters like Minimata bay in Japan, the levels are as high as 1-10 ng/litre. In the 1950's in Japan illness and death occurred among fisharman who ingested fish, crab, shell fish contaminated with methyl marcury from Japanese coastal industries. The mercury poisoning produced a crippling and fatal disease called 'Minimata disease'. In the initial stages, numbness of limb, lip, tongue, deafness,loss of vision, cellular degeneration in brain, cerebral cortex occurred and this led to coma (South wick, 1976). The consumption degeneration and it was reported from Handigdu, karnataka. The disease is identified as Handigodu syndrome.

Water related hazards from ingestion of biological agents

The biological agents transmitted through water are pathogenic bacteria, viruses, parasites and other organisms.

Table 2 : Shows disease attributed to ingestion of water borne bacteria

Disease	Causative organisms
Cholera	*Vibrio choterae*
Typhoid	*Salmonella typhi*
Gastroenteritis	*Shigella, Proteus sp, etc.* .
Diarrhoea	*Entamoeba coli*
Leptospriralis	*Leptospira* sp

2. **Viruses** multiply in the alimentary tract of man and may be excreted through faces. The viruses found in sewage and polluted waters are poliovirus, echoviruses, virus of infectious hepatitis, adenovirus and reovirus, etc.,

3. **Parasites**: *Entamoeba histolytica*, the causative agent for intestinal amoebiosis and amoebic liver abscess is present whereever sanitary conditions are poor (WHO committee on amoebiosis, 1969). The guinea worm which causes dracontiasis is transmitted through wells and ponds infested with copepod intermediary host. *Ascaris lumbricoides* may also be waterborne although ingestions of contaminated coil is the main route.

4. i) **Schistosomiasis:** It is a chronic disease, that causes serious pathological lesions, saps energy, lowers resistance and reduces output of work. Artificial lakes, reservoirs, may have increased populations of freshwater snails and a corresponding increase in schistosomiasis. In man three species of helimenths *Schistosoma mansoni, S.japonicum, S. haemotabium* are responsible for the incidence of the disease. The eggs released through faeces and urine hatch as miracidea, reach water and make their way into the snails (*Biomphalaria, Bulinus, Oncomelania).* They energy from snails as cercaria and enter man through the skin.

ii) **Ancylostoma duodenale:** It is the round worm responsible for ancylostomiasis. The eggs passed through faeces of infected person hatch and larvae develop into the filariform which is infective to man.

iii) **Leptospiralis** is by bacterial infection from vertebrates to man through direct contact with water.

Diseases transmitted by water associated insect vectors:

i) The most widespread is malaria which is caused by water associated vectors.

ii) **Onchocerciasis or riverblindness:** The disease is transmitted by blackflies (Simulium sp) and is of considerable economic importance in the vicinity of breeding grounds for vector where large resident populations may become partially or totally blind.

iii) **Filariasis caused by Wuchereria bancrofti.** It is widely distributed in Africa and Asia specially due to increased urbanization and industrialisation. With vast movements of populations and the breeding of the major vectors the mosquito- *Culex pipiens, fatigans* have greatly increased.

25.6 NOISE POPULATION

Noise is generally defined as a sound without any agreeable musical quality or as an unwanted or undesired sound. Noise is produced by machines, traffic noise by truck and cars. Use of radio, public address system, music, etc., may pollute the environment. Noise from supersonic jets also produce harmful effects.

Effects of noise

1. Prolonged exposure to noise is known to lead to deterioration of the internal ear and subsequently deafness.
2. Noise produces annoyance and interferes with rest and sleep.
3. Physiological effects of noise include dilation of pupils, the paling of skin, the tensing of muscles, the diminishing of gastric secretions, increase in diastolic blood pressure, nervousness, irritability and anxiety, hypo or hyper glycemia and effects on the endocrine system. The physical pain results at a level of 140 perceived Noise decibals (PNdB) which is the threshold level of pain. And sound above 70 dB resting for more than 300 milliseconds can interrupt deep sleep.
4. Noise may effect the performance of psychomotor tasks.

Control of industrial noise

1. Defining permissible sound limits.
2. Measuring the noise at workplace, at source and in reducing the same at source.
3. Creating acoustic zones to prevent air borne propagation of noise.
4. By sound proofing and in using personal protection devices.
5. In communities, traffic constitutes the major noise nuisance and in the house personal equipment like radio, TV, etc. Noise from various forms of transport and its transmission at home may be reduced :

i) by controlling the emission of noise.

ii) by controlling the transmission of noise through proper planning and the use of traffic engineering techniques.

iii) by controlling the reception of the noise at home.

25.7 SOIL POLLUTION

Soil and land pollution is caused by insanitary habits, various agricultural practices, improper disposal of solid and liquid wastes and also by atmospheric pollution.

Contamination of soil by agricultural chemicals

Fertilizers are used with the intention of raising crops but incidentally may contaminate the soil with their impurities. It can also be polluted with industrial wastes that contain the organic chemicals. In the past few years herbicides, insecticides, and fumigants have broughtahnt a number of changes in the soil.

Herbicides

A non persistant 2,4 -D and highly persistent 2,4,5-T is used as and indiscriminate killer of vegetation and there is evidence to suggest that 2, 4, 5-T may being about teratogenecity of human features.

Insecticides

They are of 3 types, the inorganic, natural substances and synthetic organic compounds. The organic compounds are of 2 types- the *organophosphorous* and *arsenic*. The natural substances are derived from 2 plants. (1) *Rotenone-from the roots of Derris elliptica*. It is non persistent but toxic to fish, (2) The flowers of *Chrysanthemum* yield pyrethrum. It is non-persistent and non-toxic to most of the animal groups. In some cases it is an ideal insecticide.

The widely used are organochlorines, e.g., DDT. It is highly toxic to insects;but the freshwater fish also is most vulnerable to it. It metabolizes into DDE AND DDD. Its ability to build up in food chain is well developed as.

In Zooplankton	...	0.4 ppm
Needle fish	...	2.07 ppm
Herons	...	3.57 ppm
Gulls	...	75.5 ppm

DDT inhibits the $CaCO_3$ deposition in oviducts of certain birds and thin shelled eggs.

BHC is a mixture of several isomers of which the BHC (Lindane)is lethal to many animals. Others are dieldrin, aldrin, endrin,endosulphon and heptachlor. A number of them are transformed in the soil.

25.8 METAL POLLUTION

Of the metals important are Cd, Pb and Hg.

Cadmium

It is not essential for human body. The sources are soil, vegetation and food. It can enter as a contaminant from mines, chemical industries, electroplating, super phosphate fertilizers and cadmium containing pesticides.

Chronic Cd poisoning produces proteinuria and affects the kidney. It is known to affect the testis of laboratory animals and mammals. The cadmium released from mines for contaminated water and paddy. This leads to the out break of an epidemic with is called **Itai- Itai disease (ouch-ouch)** because of the painful symptoms resulting from multiple fractures. Besides skeletal deformation, it leads to loss of body weight,proteinuria and glaucoma.

Lead

Occurs naturally in plants and soil. Man made sources include lead smelting and refining, brass manufacture, storage batteries,paints,agricultural application of lead aresenate, incineration of lead plastics,etc. It is released in the form of aerosol into the air from automobiles. The average content of lead in human food is 0.2 mg/kg. Although the safe limit for lead is 80 Ug/100g of blood, even at lower levels(30-40 U g/100 g blood) inhibition of enzymes involved in the synthesis of seem can be shown to occur.

Mercury

Man made sources are mines, alkali plants, pulp and paper, plastic, electronic industries, drugs, etc. Burning fossil fuels and great amounts if it to atmosphere. The level of Hg in blood is striking index of its concentration in the body. In Drosophila organic mercury can produce mutations,chromosomal abberations. Mercury poisoning occurred on a major scale in Japan due to the discharge of industrial wastes in Minimata Bay. **Minimata disease** occur mostly in fisherman who eat the fish containing methyl mercury.

25.9 RADIATION HAZARDS

The discovery of X-rays by W.K.Roentgen and their application in many fields has led to the realization that the radiation has dangerous effects on living cells.

Ionising radiation may be divided into 2 groups:

1. Electromagnetic radiation (X-rays and gamma rays,;
2. Corpuscular radiations like alpha, beta particles (electrons),and protons which are electrically charged whereas neutrons have no charge. The radiation emitted by these two groups have similar pathologic effects.

Biological effects of ionizing radiation

Information regarding this is obtained from

1. Patients who underwent diagnostic procedures with X-rays and radioisotopes.
2. Occupationally exposed person (e.g., radiologists, workers involved in mining of radioactive ores).
3. Member exposed to the atomic bomb explosion of nuclear weapons.

Bacq and **Alexander** (1961)have given detailed descriptions of different types of radiation and their biologic effects.

Ionizing radiation influence the biological system in two ways.

1. The effect of highlevels results in death of a severe injury, whereas
2. low levels cause long term effects such as mutations, carcinogenesis which appear months or years after exposure.

The radiation effects are indicated by the onset of illness, early lethality, destruction of bone marrow, damage to intestinal tract associated with diarrhoea, haemarrhage, CNS systems, dermatitis, sterility. But much less is known about the effects of small doses like 100 rad. In respect of how low doses leukaemogenesis and carcinogenesis are at present considered the most serious long term risk. The long term effects following high doses are cataract formation, neurological damage and general shortening of the lifespan.

Radiation injury at cellular level

Even though the nature of the lesions caused by radiation in cells has not been discovered, DNA, RNA, RNA protein complex, cell membranes and related organelles are regarded as the primary targets of radiation injury. It is also evident that nucleus is the most vulnerable part. Cell division is affected even at low level. The available mutagenic effects of radiation suggests that genetic DNA is an important target of radiation.

Chromosomes

As a result of irradiation, the chromosomes at metaphase appear sticky and clumped and the boundaries between them are lost. At anaphase, incomplete separation of chromatids is accompanied by bridges of chromatic material between the cells. This lead to incomplete division of chromosome material in the daughter cells. Another effect is the breakage of chromatids or whole chromosomes. The broken fragments may be deleted or may rejoin the original chromatid or other broken chromatids causing several kinds of chromosomal abberations. e.g., abnormal chromosomes like ring chromosomes multicentric, etc.,

Effect on embryos

The embryos are more sensitive to the action of X-rays in their early phase of development, before the organogenesis. Even if the immediate effect of radiation resulting in cell destruction not much there may be much consequences as malformations.

Check your progress

1. Define the following:
    1. Non degradable
    2. Biodegradable

25.10 SUMMARY

1. Environmental pollution is an undesirable change in the physicochemical and biological characteristics of biosphere.
2. Pollution is caused by solid, liquid and gaseous wastes. In addition, heat, noise and radioisotopes also contribute to the pollution.
3. Air pollution is mainly from the oxides of sulphur, nitrogen and carbon. When they exceed their tolerance limits they cause deleterious effects on animal and plant life.
4. Water is contaminated by industrial wastes, sewage, agricultural run off and also the presence of pathogenic organisms. Noise is generally defined as unwanted sound. The agricultural chemicals such as pesticides, and herbicides may remain as residues in non-target organisms and finally reach man to cause number of abnormal situations. Certain heavy metals discharged from the industries as effluents also may affect the organisms living nearby.

25.11 CHECK YOUR PROGRESS - MODEL ANSWERS

1. non degradable aluminium cans, Hg salts, phenolic compounds and DDT which do not easily breakdown or change into simpler components. These are stable and accumulate by way of biogeochemical cycle.

2. Biodegradable: They are unstable substances of domestic sewage which, can be decomposed by national processes. They can be renewed by national waste treatment mechanisms.

25.12 MODEL EXAMINATION QUESTIONS

I. Answer the following in about 30 lines.

1. Write an essay on the environmental pollution and its control methods.
2. Describe the sources of water pollution. Enumerate the effect of water pollutants on the aquatic life and on man.
3. Write an essay on air pollution. Discuss the methods to control air pollution.
4. Describe the radiation hazards of human health.

II. Answer the following in about 10 lines.

1. Enumerate the biological agents that are transmitted through contaminated water.
2. Distinguish nondegradable pollutants from degradable pollutants.
3. What do you mean by thermal pollution.
4. Explain noise pollution.
5. Metal pollution and its effect on biological systems.

UNIT-26 WILD LIFE MANAGEMENT

Contents

26.1 OBJECTIVES

This unit explains the meaning of wild life, the causes for extinction of plants and animals and the management principles. At the end of this unit you will be able to describe in detail about the

- measures taken by Government to conserve the wild life that are endangered
- the importance of sanctuaries and national parks to India
- Objectives, management and the achievements in respect of Tiger project, Gir Lion sanctuary, Crocodile breeding Project.

Wild life refers to animals and birds inhabiting our forests. The love and regard for wild life is a part of India's culture. Yet many of the agencies are faced with the threat of extinction. The wild life in India includes 500 mammals, 3000 species of birds, besides an innumerable number of reptiles, fishes, insects and other animals. Under the schedule I of Wild Life (protection) Act, 1972 as many as 66 species of mammals, 38 species of birds and 18 species of amphibians and reptiles (including 3 species of crocodiles) are held to be as rare and endangered. The cheetah has become extinct. The Bengal tiger population is drastically reduced (from 40,000 to 1827 in 1972). The lion is confined only to a few areas. The deer like Hangul in Kashmir, Swamp deer in M.P are now included in the list of endangered species. The antelope and the black buck which were in thousands some 50 years ago is now confined to small pockets surviving under the strict protection. Among birds, the species which are regarded as having become extinct are the pink-headed duck, mountain quail and Jerdon's courser, (Recently spotted in cuddapah region). The great Indian bustard and the white winged wood duck have become so rare that they may soon become extinct.

The Siberian crane, a visitor to Bharatpur sanctuary (Rajasthan) in winter, as now found in reduced numbers. The gangetic gharial, the estuarine crocodile are reaching the point of extinction. Even though these are only a few examples, several hundreds of the animals in world have become extinct.

However,extinction is a biological phenomenon depending on the circumstances. Each species exists for a certain period and ultimately becomes extinct. One of the important causes of extinction or depletion of numbers is the destruction of a species as a result of commercial exploitation.Many plants are also subjected to extinction due to the ignorance of their potential and ecological functions.The major causes of extinction in the recent past in respect of both

plants and animals are environmental changes due to the destruction of natural habitats, deforestation, grazing and urbanization.

In an ecosystem producers, consumers and decomposes are linked in food chains. Various food chains are joined at different tropic levels forming complicated food webs. In this intricate food web the function of each organism is important. Destruction of a particular link in the food chain in the web may lead to imbalance which may threaten the existence of man himself. Wild animals are subjected to indiscriminate killings to meet man's needs for flesh,skin, fur for medicinal value, protection of domestic animals from predation etc.

In view of the necessity to conserve wild life the Govt. of India (1952) constituted a Board for wild life. The objectives are a) preserving wild life and b) creating natural parks and sanctuaries.

Under this scene, protection has given to Indian lion, snow leopard Cheetah and others. Later **in 1972, the Wild Life Protection Act was promulgated.** The Act prohibits hunting, killing, capturing, trapping , injuring wild animals in the forest, and in the public or private lands. The Act has a provision for setting up National parks and sanctuaries where wild life can receive protection. Under this Act :

i) the hunting of tiger, black buck, leopard, wolf,pangolin,wild buffalo, the great Indian Bustard, crocodile etc, is prohibited.

ii) the hunting of other animals like cheetah, sambar, gaur, bear etc.,is regulated through the issue of licences by the Chief Wild Life Warden.

iii) in case of violation of the above mentioned, provision is made for imposing of a fine of Rs. 2000/-as penalty and imprisonment for 2-6 years.

iv) the Act prohibits the trading of live animals, their meat,skin etc.

v) In the Wild Life Act a new section for the creation of biosphere reserves has been incorporated enabling the Central Govt. to declare appropriate areas as biosphere reserves in consultation with the states concerned.

The man and Biosphere (MAB)programme was evolved with the objectives of (1) maintaining the integrity and diversity of biotic communities of plants and animals with in the natural ecosystem, (2) safeguarding the genetic diversity of the species and (3) providing areas for ecological and environmental research, as well as education and training.

Legislation

1. The forests and protection of wild life animals and birds are included in the 42nd amendment to the constitution in 1976.
2. Legal and illegal trade of endangered species in India is regulated.
3. The Govt. promulgated in 1980 the Forest Conservation Ordinance which prohibits the conversion of a forest land and diversion to other purposes.
4. A separate Department of Environment was created.
5. A separate training course for wild life management was started at the Forest Research Institute, Deharadun.
6. The Govt. is empowered to declare any area as sanctuary or national park. In India 19 national parks and 202 sanctuaries are in existence
7. In any sanctuary or national park there should be 3 zones:

i) **Core zone:** Entry into this is restricted except for purposes of research (population estimation, etc).

ii) **Intermediary zone** Used by wild Life for grazing. Visitors are allowed into this.

iii) **Buffer zone:** The place where facilities for camping tourists are provided.

8. Section 33 of the Wild Life protection Act (1972) authorises the Wild Life Chief Warden to control, manage and maintain all sanctuaries.

Thus the basic idea of establishing sanctuaries is to preserve the ecosystem of forests available in the sanctuary and work in such a manner that a congenial habitat is provided for wild life.

The projects planned for the preservation of endangered species are briefly discussed here under:

26.3 PROJECT TIGER

Tiger conservation in India is attempted not only to save the endangered species but to preserve the biotopes of sizable magnitude. It was initiated as a Central Sector scheme in 1973 with 9 reserves. Two more reserves have since been added and under these 11 reserves the population of tigers has gone up from 268 in 1972 to 613 in 1977 . The project covers 2.10 percent of the total forest area (15,800 sq kms) in 10 States. The reserves are Manas (Assam), Palamau (Bihar), Similipal (Orissa), Corbet (U.P.) Ratambhore (Rajasthan), Kanha (M.P.) Melghat (Maharastra), Bandipur (Karnataka), Sunderban (West Bengal), Periyar (Kerala) and Sariska (Rajasthan).

Management

The management strategy has been to identify the limiting factors of the habitat through intensive antipoaching. Fire protection, elimination of cattle grazing, eradication of weeds, soil conservation measures, etc.

The guiding priciples of management are as here under:

1. To elimenate all forms of human exploitation.
2. To restore and damage caused by man to the ecosystem and bring it up as close to its natural level of functioning as possible
3. To build up the wild life population upto the intrinsic supporting limit of the habitat.
   To encourage research on the habitat and wild animals.
4. The project was given the status of a centrally sponsored scheme Later the **World Wild Life Fund** (WWF) provided financial assistance amounting to US $ 1 million. It is administered by the steering Committee appointed by Govt. of India. The execution of the project is done by the State governments of respectivereserve areas.

Achievements

1. Fire breaks are maintained along the external boundaries of reserves and core areas. Several fire observation towers are erected.
2. A communication system is installed to convey messages of anti-poaching, animal monitoring. etc.
3. Relocation of human settlements outside the reserves in order to avoid hindrance to the development of preserves.

4. to provide water, several steps like the construction of dams, digging of seasonal waterholes, deepening of the wells and fitting them with pumps and wind mills,, etc have been done.

5. Grazing has been completely stopped in core areas of all tiger reserves.

6. Improvement in soil conservation measures and the preserving of the environment paved the way of the dispersal of prey and predator populations.

7. One of the main aims of the project is the promotion of research into the wild life. It was taken up the methodology and the programming for monitoring, research and documentation of data were finalised.

Besides conserving tiger and the entire ecosystem, protection is given to other threatened species. The Indian one horned Rhino, clouded leopard, wamp deer, gaur, four horned antelope, black buck, crocodile and Gharial.

26.4 GIR LION SANCTUARY PROJECT

The project area is 258.71 sq. km. The lion population in 1979 numbered 205 including the cubs. Gir forest in Saurashrta of Gujarat is a unique line of the line (panthera leo persica), it harbours the remnant populations of many species which once constituted the wealth of India including the spotted deer, sambar, Indian gazelie, nilgai, wild boar and four horned antelope.

The shooting of the species continued till the population was reduced to 15. With adequate timely protection measures the population has increased to 20.

Gir sanctuary faced the problem of over-grazing by domestic live stock specially during the monsoon months. due to this the natural wild animals like sambar, nilgai, etc., have become rare. The natural regeneration of trees left out inhibited by the domestic livestock. In the absence of natural prey lions come to feed on cattle, which led to the owners poisoning the lions. Considering these facts, the govt. of India issued orders in 1971, that a) The sanctuary should be closed to grazing by domestic live stock; b) a physical barrier should be provided for the area; and c) The gir resident maldharis should be shifted to places outside the sanctuary.

Distinctive Features of the project

In the year 1972 the project was sanctioned by the Govt. of Gujarat with the following objective :

1. To encourage wild life especially the endangered lion in the Gir forests.

2. To preserve all non-human elements of the existing ecosystem in their natural relationship.

3. To minimise human interference and to provide recreational facilities to tourists.

4. to present over-grazing.

5. To improve the condition of the maldharis and phase their resettlement outside the sanctuary.

Results achieved so far

The construction of a wall and the raising of the live hedge along the main block of sanctuary kept out the migratory cattle. The improvement of the habitat and the minimising of the human interference stepped up the wild life population tremendously (see the table given below).

Species	Number of wild animals in Gir as on		
	1970	1974	1977
Panther	-	155	161
Hyaena	-	71	84
Spotted deer	4564	4517	8431
Sambar	278	706	760
Blue bull	1068	1528	2036
Wild boar	109	1922	2365
Four horned antelope	256	977	1042
Gazella	227	195	330
Monkey	-	3938	6895
Lion	177 (in 1968)	180 (in 1974)	205 (in 1979)

26.5 CROCODILE BREEDING PROJECT

There are three species of crocodiles in India.

1. Salt water or estuaries crocodile *(Crocodile porosus)* :
2. Fresh water swamp crocodile or Mugger *(Crocodylus palustria)*.
3. The Gharial *(Gavialis gangeticus)*.

As the result of the demand of the luxurious leather market and the use of spohisticated hunting methods the crocodile population has drastically declined. Crocodile hunting is largely banned now in India. The Wild Life Protection Act (1972) lists both species of crocodile and the Gharial in its schedule. According to the FAO report (1974) only management will restore the population of the crocodile quickly and it appear that without management the gharial will become extinct. They have a high facundity level and long reproductive life and under effective control and sound management, crocodile could rapidly build up their numbers.

A crocodile Breeding project was proposed with the following objectives:

1. To locate the best available areas for crocodiles in India
2. To collect the eggs soon after they were laid and transport them to protected areas for hatching, rearing the young till they attain the size necessary for putting them back in their natural habitat.
3. To improve the technical competence to achieve to objective No. 2 as stated above.
4. To set up a net-work of sanctuaries suited to the three crocodilian species.
5. To build up expertise in the management of wild life sanctuaries throughout the country.
6. Crocodile rearing centres have been developed in eight states. The most important of which are the following :

1. Satkoshia Gorge wife sanctuary - Orissa - Gharial
2. Biatarkanika - Orissa Salt water crocodile

3.	Kukrail	Lucknow	Gharial
4.	Katoh	Chambal river	Gharial
5.	Nandankaman Biological Park	Orissa	All three species
6.	Katernia ghat wild life sanctuary	U.P	Gharial
7.	Sunderbans	West Bengal	Salt Water
8.	Guindy part	Madras	Mugger

So far 27000 gharials have been hatched in the rearing stations. In all 324 gharials, 168 salt water crocodiles and 218 muggers were released into the wild by various centres of crocodile breeding and management projects.

Important Wild Life Sanctuaries and national Parks in India

S.No.	State	Name of Sanctury/ National park	Animals protected
1.	Andhra Pradesh	1. Pakhal Sanctuary (Warangal Dt.)	Tigers & Bison
		2. Tadvai Sanctuary (Warangal Dt.)	Bison, Tiger
		3. Kawal Sanctuary (Adilabad Dt.)	Tiger, Cheetah, Indian gazelle
		4. Kolleru (W. Godavari Dt.) Nelapat, Pulicat (Nellore Dt.) Telineela-puram (Srikakulam Dt.) Pocharam (Medak) Bird Sanctuaries.	Migratory birds like painted stroks, pelicons, flamingos, etc.
		5. Nehru Zoological park Hyderabad. Mahaveer-Vanasthali, Hyderabad. Indira Gandhi Zoo Vizag, Chakali-gattu Deer Park, Guntur	Zoo parks only, with lions. Deer Safari parks and dolphinarium & Marine notcurnal animals complex corner and crocodile breeding farms.
		6. Srisailam-Nagarjunasagar.	Tiger & Crocodiles.
		7. Kinnerasant Sanctuary (Khammam Dt.)	Tiger, Bear and Deers.
		8. Kondapally National Park (Krishna Dt.)	Deer
		9. Crocodile Breeding Center, Hyderabad.	Crocodiles

		10.	Papi-hills Sanctuary (E.Godavari)	Crocodiles Tiger, Bison.
		11.	Ettipothal Crocodile Farm (Guntur Dt.) ,	Crocodiles.
2.	Arunachal Pradesh	1.	Namdapha Wild Life Sanctuary	Dear
		2.	Pakhui Wild Life Sanctuary	Deer
		3.	Lali Chapori Wild Life Sancturary	Deer
		4.	Itanagar Wild Life Sanctuary	Deer
3.	Assam	1.	Manas (North Kamrup)	Wild buffalo and Rhinoceros
		2.	Kaziranga Sanctuary	Rhinoceros
4.	West Bengal	1.	Jaldapara Sanctuary (Jalpaigiri)	Rhinoceros
5.	Bihar	1.	Hazari-Bagh National Park	Tiger & Horned game Tiger Reserve
		2.	Palmau National Park	
6.	Gujarat	1.	Gir forest Sanctuary	Indian Lion
7.	Karnataka	1.	Bandipur Sanctuary	Elephant & Bison
		2.	Sri Rangapatnam Thittu Sanctuary	Birds (Local & migratory)
8.	Kashmir	1.	Dachigam Sanctuary	Kashmir Stag
9.	Kerala	1.	Periyar Game Sanctuary	Elephant & Bison
10.	Madhya Pradesh	1.	Shivaputi National Park	Chinkara
		2.	Kanha National Park (Mandia Dt.)	Swamp-Deer, Bison & Tiger.
11.	Maharashtra	1.	Taroba National Park (Chanda Dt.)	Tiger, Deer & Boar
12.	Manipur	1.	Kabul-Lampu Sanctuary	Manipur Deer
13.	Nagaland	1.	Itanagar Wild Life Sanctuary	Tiger, Sambar, Elephant and Trgopan Blythe
		2.	Pulie-Bedge Wild Life Sanctuary	Tiger, Sambar, Elephant and Tragopan Blythe

14.	Orissa	1.	Simlipal Tiger Reserve	Tiger, Deer
15.	Rajasthan	1.	Bharatpur (Bird) National Park	Migratory birds
		2.	Rathambore and Sarike Tiger Reserve	Tiger
16.	Tamilnadu	1.	Mudumalai Sancturary	Elephant & Bison
		2.	Vedanthangal Bird Sanctuary	Migratory Birds
17.	Uttar Pradesh	1.	Corbet National Park	Elephant & Tiger
		2.	Chandraprabha Sanctuary (Varanasi)	Introduced Lion
		3.	Rajaji Game Sanctuary (Saharoapur)	Introduced Lion
		4.	Dudhwa National Park	Tiger
		5.	National Chambal Sanctuary	Crocodile

Check Your Progress

1. What is Wild Life Protection Act

26.7 SUMMARY

1. To understand the meaning of wildlife, the causes for extinction of plants and animals and the management principles.
2. Measures taken by government to conserve the wild life that are endangered.
3. To understand the importance of sanctuaries and national parks in India.
4. To know the objectives,management and the achievements in respect of Tiger project , Gir Lion sanctuary,crocodile breeding project.

Synopsis

1. Wild life refers to the animals of forests, birds , reptiles,amphibians,fishes and the plants that we came across in our surroundings.
2. Some of the animals, facing the threat of extinction are Bengal tiger, Lion, Hangul deer in Kashmir, Swamp deer in Madhya pradesh, Black buck, pink dreaded duck, mountain quail, Siberian crane etc.
3. To preserve wild life and to create natural parks and sanctuaries wild life board was constituted in India in 1952.
4. Wild life was included in 42 and amendment of the constitution in 1976.
5. Several projects have been launched to protect the endangered animals.

26.8 CHECK YOUR PROGRESS - MODEL ANSWER

1. In 1972, the wildlife protection Act was promulgated.

   The Act prohibits hunting, Killing , capturing , trapping injuring wild animals in the forest, and in the public or private lands. The act has provision for setting up National parks and sanctioners where wild life can receive protection.

26.9. MODEL EXAMINATION QUESTIONS

I. Answer the following in about 30 lines

1. Write an essay on wildlife management.
2. What measures do you suggest for conserving the endangered species.
3. Name a few sanctuaries, their location and the animals protected under each of them.
4. List out the important endangered species of mammals.

II. Answer the following in about 10 lines.

1. What is the significance of 'Tiger project'.
2. What is the importance of Gir lion sanctuary.
3. How crocodiles conserved under Crocodile breeding project.
4. Write about National parks in India.

GLOSSARY

(Evolution and Zoogeography)

Achelulean	Lower paleolithic culture characterised by bifacial tools with round cutting edges.
Apes :	Tailless or shor ttailed old world, Semi erect primates also known as anthropoid apes. Gorilla, chimpanzee Gibbon etc.
Artefacts (artifatcs)	Simple object (as a tool or ornament) showing human work hum,an work man ship - a product of any civilization.
Aurignacean	Upper paleolithic culture marked by finely made artefacts of stone and bone, paintings and engravings.
Biogenesis	Living things come from living things.
Beagle	Name of the shop in which Darwin travelled.
Blastula	Stage of development when embroy is a hollow sphere of cells arranged in a single layer.
Blubber	A layer of thick fat under the skin of whales.
Backward bulge of cranium	Asign of higher human development whereby the of cranium brain projects behind the foremen magnum and consequently the cranium also bulges correspondingly.

Barrier	A factor that tends to restrict the free movement, mingling or interbreeding of individuals or populations.Generally refers to a material or physical object or set of objects that democrates or serves as an obstruction.
Crust	Upper surface of the earth.
Cervical Vertebrae	Vertebrae present in the neck region of vertebrates.
Continental Islands	Usually large islands situated close to main land masses and which are known to be in physical contact with them in the past.
Continental shelf	A shallow, submarine plane of varying width forming a border to a continent and typically ending in a steep slope to the oceanic abyss.
Discontinuous distribution	A peculiar type of distribution where a closely related group of animals are situated in widely separate areas on the earth.
Dispersal	The process or the result of spreading or organisms from one place to another.
Diastema	A space between teeth in a jaw, especially refers to the hap between the incisors and premolars and particularly in circumstances where canine tooth is absent.
Digitigrade	Walking on the digits with the posterior of the foot more or less raised. (Cats, Dogs etc are examples)
Foremen magnum	The opening in the skull through which the spinal cord passes to become Medulla oblongata, the hind most part of the brain.
Gastrula	Two layered and later three-layered embronic stage of development.
Gene frequency	Number of occurences of character representing a gene in a population.
Glacial age (Ice age)	A time of wide spread of glaciation or advance of ice sheets from the poles (This was pleistocene age- also called age.)
Hernia	A protrusion of an organ or part , through connective a wall of the cavity in which it is normally enclosed or located.
Hypsodont	Teeth of the category having high crowns as in horse.
Isolation	Separation of one species from another so that they are unable to inter breed. It may be due to distance or some barriers.
Island fauna	Having a restricted or is date natural range or habitat in (generally)oceanic islands.
Mutation	A stable change of a gene such that the changed character is inherited by off spring cells.
Mimicry	The resemblances of organisms to others or inanimate objects in form, colour or action. A protective adoptation.
Mousterian	Lower paleolithic culture characterised by well made flask tools often considerable the work of Neanderthal man.

Natural selection	Intensive selection by nature weeding out unadapted forms and bringing out modifications through successive generations which make the organism fit to live in an environment.
Nictitating	Thin, transparent eyelid-like membrane in aquatic vertebrates which opens and closes laterally on eyeball.
Nuchal crests	See sagittal crests.
Origin	The act of being created or born. Every species must have a "slow"beginning one or other area of the world at one time or other.
Prodigality	Tendency of producing large number of offspring by asexually or sexually.
Patagium	Wing-like expansion of skin between digits of the forelimb and other parts of body which helps in gliding movements.
Pneumatic bone	Hollow, vacuolated bone which is filled with air.
Plantigrade	Walking on the sole with the heel touching the ground as in man or bear.
Population pressure	The organisms inhabitation a particular locality i.e. a group of interbreeding organisms is called as a population . When a particular or given geographic area is unable to support the increased number of population, the pressure is said to build up.
Rumen	First part of the stomach in cud-chewing herbivorous mammals with two or four digits.
Rattle	Epidermal modification of end part of taill in rattle snake. It becomes hollow and dry. Produces warning sound when snake moves.
Receding forehead	A primitive human character. In modern men this is vertical . In primitive forms or species the forehead slopes back or recedes back restricting the development of fore brain. The seat of intelligence or modern man.
Struggle for Survival	Survival of the fittest. Competetion between all organisms, between individuals and physical environment.
Serological tests	Precipitative tests. Tests conducted on the blood plasma of different organisms to know their closer kinship.
Synthetic Theory	Modern theory of evolution.A proper blending of theory of Natural selection of Darwin and theory of inheritance by Mendel.
Selection	Natural selection explained by Darwin.
Sagittal crests	Elevated part of the skull in the region of skull . A primitive human character where powerful neck muscles are attached .
Simian gap	A strong wedge in the incisors and canines in the upper jaw of apes into which the lower canines fit . This is absent in the humans.
Simian shelf	A strong wedge in the front part of the lower jaw of Apes to support the canines and grinding teeth. This absent in human species.

Supra orbital ridges	Bony ridges situated above the orbits. This is a prehuman or primitive human, and simian character.
Thyroid gland	Endocrine gland situate in the neck region of vertebrates. It secretes thyroxine hormone containing iodine which promotes growth and metamorphosis.
Unguligrade	Walking on the tips of digits or hoofs as in cattle horses etc.
Variation	Differences between two organism. or parts of organisms.
Wallace line	A hypothetical or imaginary line or boundary separating the diatic fauna from those of Australasia (as well as flora) and forming a common boundary of Australia and oriental. Biogeographic regions. (See the Text for this as well as Lydekker's and Weber's lines).

GLOSSARY

(Ecology)

Abiotic factor	Ecological factors of nonliving nature.
Aestivation	A situation in which organisms spend the unfavourable seasons.
Autotrophic	Organism capable of producing organic materials from inorganic materials.
Association	Unit in community characterized by uniformity of species composition .
Benthos	Organisms resting at the bottom sediments.
Biological clock	Occurrence of processes in organisms in a rhythmic way.
Biochemical oxygen demand (BOD)	Amount of dissolved oxygen required by micro organisms in water.
Biodegradable	Capable of being decomposed by bacterial action.
Characteristic species	Species limited to certain community so that they can be used to identify the type of community.
Climax	The community capable of perpetuation under the prevailing climatic and edaphic conditions.
Community	Groups of population of plants and animals living together in a given space.
Carrying capacity	It is the density level at saturation or equilbrium.
Competition	An interspecific or in traspecific interaction
Chlorinated hydrocarbons	Synthetic organic compounds containing Carbon, Hydrogen and Chlorine ex. DDT, chloriane, Deildrin etc.
Density	Number of individuals in relation to space.
Epilimnion	Upper layer of warm water in a stratified lake.

Ecosystem	It is a unit of biosphere consisting of living and nonliving substances interacting to produce exchange of materials between them.
Ecotone	Transition Zone between the diverse communities.
Ecotype	A sub species adapted to a particular set of environmental conditions.
Erosion	Wearing away of earth's surface by wind and water.
Hypolimnion	Lower layer of cold water in a stratified lake.
Herbicide	Chemical that kills or injures plant life.
Lentie habitat	Habitat with standing water ex.,pond.
Lotic habitat	Running water bodies ex.,spring,interface.
Littoral zone	Shallow water region with light penetrate to bottom.
Limnetic zone	Water zone with effective light penetration.
Life Table	Tabulation presenting complete data on mortality rates of a population.
Logistic curve	'S' Shaped growth curve of a population.
Neuston	The organisms which live at air water interface.
Nekton	Large active swimming organism.
Plankton	Animals or plants which can not overcome currents.
Phytoplankton	Plankton forms of plant material.
Periphyton	Animals or plants that are clinging to stem or leaves or rooted plants.
Profundal zone	Water zone at the bottoms beyond the penetration of light.
Photoperiodism	Responses of animals and plants to light and darkness .
Population	Group of interacting individuals in a given space.
Pesticide	An agent that kills the pest Ex.Insecticide.
Pollution	An unfavourable alteration of the environment.
Radiosotope	An isotope that disintegrates emitting radiation energy.
Synecology	Community ecology
Self regulation	Population regulation in which the increase is prevented by the internal adjustments in behaviour , physiology within the population .
Thermocline	The subsurface layer of the lake.
Thermoregulation	Regulation of constant body temperature.
Territory	An area that is defended against the intrusions of others of same species.
Teratogen	A chemical substance that can cause developmental malformations in an embryo or foetus.
Zooplankton	Plankton forms of animals.

BLOCK – VI
PHYSIOLOGY

Unit - 27 CARBOHYDRATES, PROTEINS AND FATS - BIOLOGICAL OXIDATION

Contents

27.1 OBJECTIVES

This unit is to know the basic chemical composition of living organisms and their chemical nature.

By the end of this unit you will be able to describe:

- carbohydrates, classification of carbohydrates and their metabolism
- similarly proteins and lipids, their classifications and metabolisms
- and Biological Oxidation.

27.2 INTRODUCTION

All living organisms are mainly composed of organic substances like carbohydrates, proteins, fats and nucleic acids. Besides, minerals like sodium, potassium, calcium, phosphorous, iron etc., are also present in the living organisms.

As you know, food is an essential requirement for animals, to get energy for sustaining, the growth and maintenance. Food is also mainly consists of carbohydrates, proteins, fats, minerals, vitamins etc., plants synthesise carbohydrates by way of photosynthesis and this becomes basis for the production of rest of the organic substances. Animals get these food substances directly or indirectly from the plants.

In this present chapter it is attempted to discuss the basic chemical nature of carbohydrates, proteins and fats. And also an elementary idea of their metabolism and functional significance will also be discussed.

27 3 CARBOHYDRATES

Carbohydrates serves a as a main source for energy for all living organisms. Substances like sugars and starch are some of the best examples for carbohydrates. Chemically speaking

Here 'R' represents the alkyl or aryl chain present in the amino acid. - COOH represents the acidic group, where as - NH_2 represent the basic group.

Depending upon the chemical nature (i.e.,'R'), amino acids are divided into neutral, acidic and basic amino acids.

Neutral amino acids	:	Leucine, Phenylalanine Cystine.
Acidic amino acids	:	Glutamic acid. Aspartic acid.

carbohydrates generally consists of carbon, hydrogen and oxygen elements in their molecules in the proportion of 1:2:1 and can be represented by a general formula.

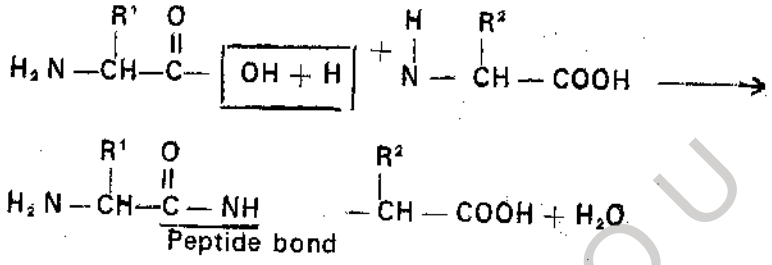
$$C_n (H_2O)_n$$

Carbohydrates may be defined as aldehyde or ketone derivates of polyhydric (more than one-OH group) alcohols or as compounds that yield these substances on hydrolysis.

27.3.1 Classification of Carbohydrates

Generally carbohydrates are classified as mono, di and polysaccharides, based on the number of saccharide units present. The term saccharide is coined for some carbohydrates like sucrose (cane sugar), glucose, fructose etc. because of their nature of sweetness.

Example :



Many such peptide bonds between different amino acids give rise to proteins.

27.4.1 Structure of Proteins

Protein structure can be considered at levels of organisation.

1. Primary structure

It is the sequence of amino acids arranged in the protein molecule.

2. Secondary structure

It is the folding of polypeptide chains into coiled or plated structures held together by hydrogen bonds-or folding stabilized by disulp hide bonds.

Tertiary structure

It is a long peptide chain coiled and variously folded in itself resulting highly specific three dimensional configuration by the various weak molecular forces within the protein. The various forces involved in the maintenance of tertiary structure are hydrogen bonds. Van der weal's forces, disulphide bridges and ionic bonds.

4. Quaternary structure

The union of different polypeptides to give a functionally active molecular structure.

Eg: Formation of Haemoglobin from four polypeptide chains

Metabolism

In animals, after protein digestion, the amino acids are absorbed into the blood circulation and reach liver and other tissues. In liver, the amino acids can be utilised for energy production. In the process of amino acids break down the ammonia formed from the amino group is converted to urea and will be excreted. Besides, the amino acids are also utilised for the protein synthesis and other biologically important substances.

27.5 LIPIDS

Lipids are important dietary constituents. They include fats, waxes etc. The name 'lipid' is given to these heterogeneous compounds because of their insoluble nature in water. But