BIODIVERSITY

Chapter 3

Major Concept

In this Unit you will learn:

- Definition and Introduction of Biodiversity
- Aims and Principles of Classification
- History of Classification Systems
    - Two-Kingdom Classification System
    - Three-Kingdom Classification System
    - Four-Kingdom Classification System
    - Five-Kingdom Classification System
- The Five Kingdoms
- Binomial Nomenclature
- Conservation of Biodiversity

Nature has made the man with intelligence and he is always concerned with his aims to be achieved. He designs the things for this purpose into sequence. Similarly biologists mapped the whole diversity of organisms exist on earth, into simple groups. To understand about the characteristics of specific organisms individually, is simply called classification.

Classification is actually based on the similar and dissimilar characteristics what organisms shared with each other and by this biologists can easily study and identify the organisms.

3.1 DEFINITION AND INTRODUCTION OF BIODIVERSITY

Biodiversity is the combination of two words; **Bio (life), diversity (variation)** thus it is defined as; "The biodiversity or biological diversity is the degree of variation within or among the species exist on different regions of the earth". It is comprised of different organisms such as bacteria, protozoans, algae , fungi , animals and plants.

3.1.1 Importance of Biodiversity:

Biodiversity provides many beneficial products which includes fiber, oil, dyes, rubber, water, timber, paper and food. It also stabilizes the ecosystem by recycling the nutrients, reduces the amount of pollution by means of forest. Biodiversity also plays an important role in drug discovery and medicinal resources. Medicines from nature account for usage by 80% of the world's population. It also beautifies the nature with lots of tress and animals found in different regions which enhances the tourism.

Pictorial view of major biodiversity on earth:

Angiosperm plant

Gymnosperm Plant

Hornworts Liverworts Mosses

Figure: 3.1(a) variety of plants on earth.

Polar bear

Desert hopping mouse

Blue Bird

Cobra

Figure 3.1.(b) variety of different animals on earth

Can you identify other life on earth?

3.2 AIMS AND PRINCIPLES OF CLASSIFICATION

A system of classification is necessary because of the abundance of the variety of life on earth. There are currently around 1.5 million species that have been described and have been given scientific names. In future, more can be identified if they are found.

To study such a diverse pack of organisms exist on earth, biologists classified the organisms into groups and sub groups. This grouping of organisms is called **biological classification**.

3.2.1 Principles of Classification:

Some organisms share similar fundamental characteristics or functions. It is further explained by means of **Morphology** (external features of an organism) in which we study the organisms on the basis of their **Homologous** (similar in structure and have different functions) and **Analogous** (different in structure and have same functions). As shown in fig 3.2 a and b.

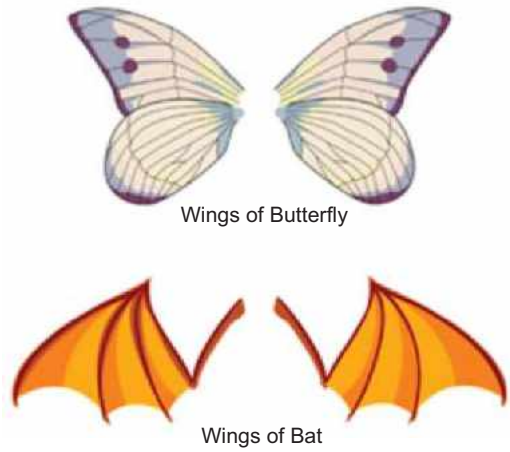


Figure 3.2 (a) Analogous structure

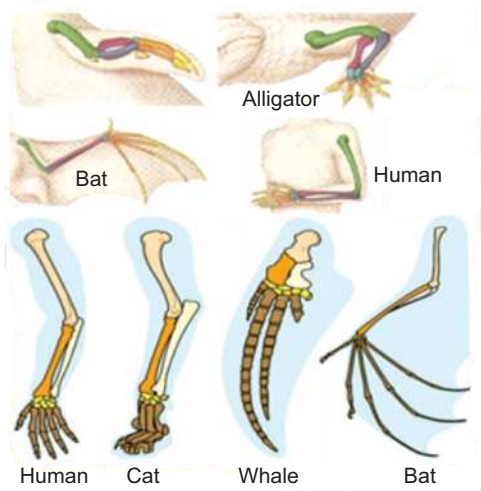


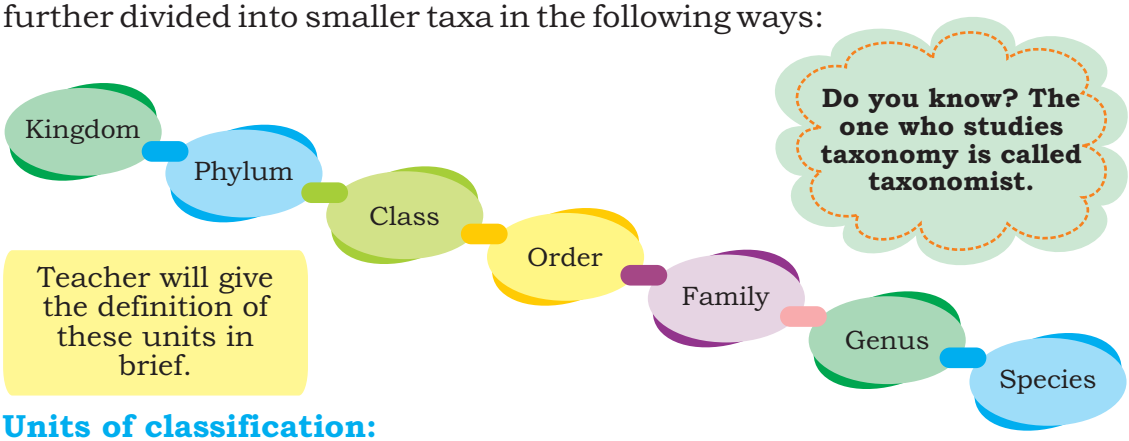
Figure 3.2 (b) Homologous structure

Have you seen the arm of a man and wing of a bird?
Which type of structure is this?

Sometimes it is impossible to classify organisms using morphological characters, therefore scientists use other characteristics to classify organisms which include; Cytology and genetics in which organisms are classified on the basis of cellular study, genetic constitution and their development pattern. Biochemistry is also employed in which the chemical substances of the organisms are compared.

Taxonomic Hierarchy

The groups into which organisms are classified are known as taxonomic categories or taxa (singular taxon). The taxa are arranged in ascending order and form a ladder, called taxonomic hierarchy. All organisms are classified into five kingdoms, so the kingdom is the highest taxon of classification. On the basis of similarities, each kingdom is further divided into smaller taxa in the following ways:



Units of classification:

The smallest and basic unit of classification is species. Taxonomic studies consider a group of individual organisms with the fundamental similarities as a species. Thus all the members of the particular species share the similar characteristics and can naturally interbreed to produce a fertile offspring. Closely related species are grouped together into genera (singular-genus). Similar genera are grouped together into families, families into orders, orders into classes, classes into phyla or division and phyla or division into kingdoms.

Simple Classification of two Organisms

Taxa	Human	Pea
Kingdom	Animalia	Plantae
Phylum	Chordate	Magnoliophyta
Class	Mammalia	Magnoliopside
Order	Primates	Fabales
Family	Moninidae	Fabaceae
Genus	Homo	Pisum
Species	Sapiens	Sativum
Scientific name	Homo sapiens	Pisum sativum

3.2.2 Aims of Classification:

Biologists classified the organisms in order to make them study easily, so the science of classification is called **Taxonomy**.

(Tazm=group, Nomy=naming)

The main aims of this branch are;

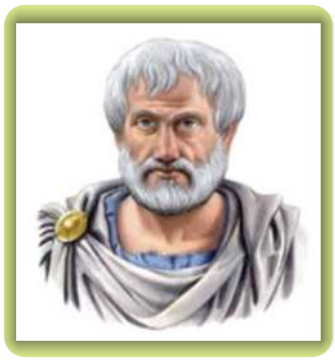
- To determine similarities and dissimilarities among organisms so that they can be studied easily.
- To find the evolutionary relationship among organisms.

Use internet to search out THREE different species belongs to same Genus.

3.3 HISTORY OF CLASSIFICATION

The system that we still use today for giving scientific names to plants and animals has many founders, from the Greek philosopher **Aristotle** to the Swedish physician and botanist **Carolus Linnaeus**. Taxonomy's first father was the philosopher Aristotle (384-322 BC), sometimes called the "father of science." It was Aristotle who first introduced the two key concepts of taxonomy as we practice it today: classification of organisms by type and binomial definition.

Aristotle was the first to attempt to classify all the kinds of animals in his book on Animals (Historia Animalium in Latin). He grouped the types of creatures according to their similarities: animals with blood and animals without blood, animals that live on water and animals that live on land.



Aristotle

Abu usman Umer Aljahiz

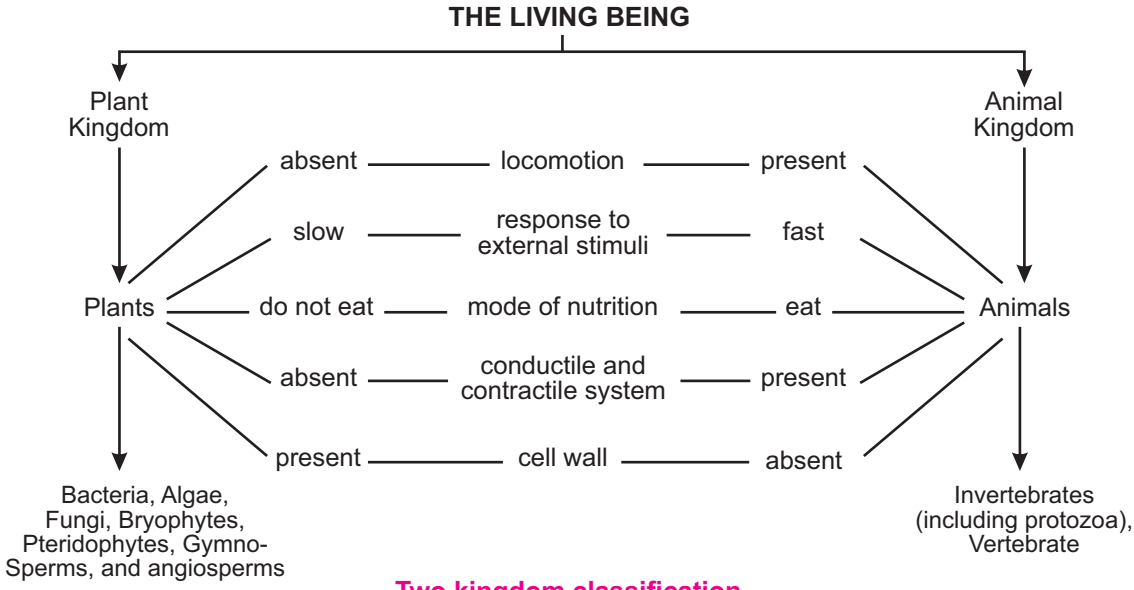
Abu Usman Umer Aljahiz was the first eminent Arab zoologist of the Muslim world.

He used to slaughter animals for studying the internal organs of their bodies. He also opened the abdomen of pregnant animals to find out the number of embryos and the location of each one of them in the body. His Encyclopedic work in seven big volumes **Kitab al-Haywan (Book of Animals)** is the most famous work on zoology, in which he has described in detail, the kinds of animals, their behavioral characteristics and their diseases and treatment.

Carolus Linnaeus is considered as the father of Taxonomy.

3.3.1 Two Kingdom classification:

Previously the organisms were classified into two groups; all the organisms possess cell wall were placed in plant kingdom and all the organisms do not possess cell wall were placed in animal kingdom.



Two kingdom classification

3.3.2 Three Kingdom classification

Ernst Hackle in 1866, introduced a new Kingdom named as Protista to accommodate the organisms exhibiting characters either common to both plants and animals, or unique to their own such as Euglena, Bacteria were also placed under this kingdom.

In 1937, ***Édouard Chatton*** clearified the concept of procariotique and Eucariotique to describe the cellular characteristics of organisms.

In 1930s, electron microscopy revealed, two distinct patterns among single celled organisms:

Kingdom Protista

- Lower protists prokaryotic unicellular Bacteria and Cyanobacteria
- Higher protists eukaryotic unicellular or multicellular organisms such as fungi algae except blue green algae

3.3.3 Four kingdom classification:

After the clear concept for kingdom Protista, Copeland (1959) came forward with a four kingdom system to classify the living beings. He designed a new kingdom named as Monera to place all the lower protists which include prokaryotic unicellular organisms and remaining single celled eukaryotic organisms were included in Protista.

THE LIVING BEING

Kingdom Monera	Kingdom Protista	Kingdom Metaphyta	Kingdom Metazoa
Lower protists (Prokaryotic protists)	Higher protists (Eukaryotic protists)	Plants (Eukaryotic)	Animals (Eukaryotic)
Becteria and Blue Green algae	Algae and Fungi	Bryophytes, pteridophyte, Gymnosperms and Angiosperms	Invertabrates and Vertebrates

Four Kingdom classification

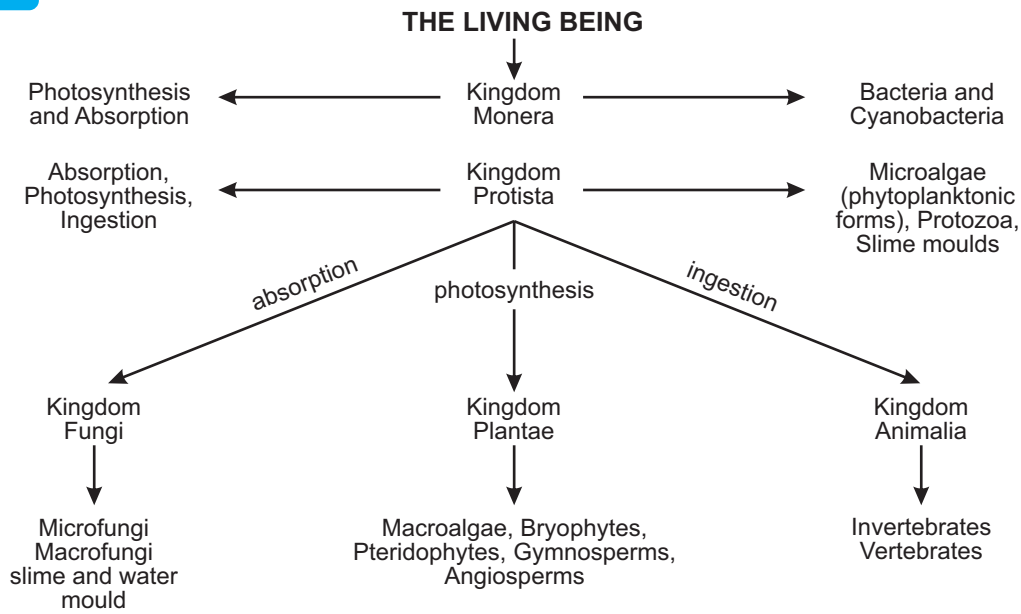
3.3.4 Five Kingdom Classification:

Robert Whittaker in 1969 classified the organisms into Five kingdoms which clearly categorized fungi into a separate kingdom.This system of classification was based on;

- Cellular structure and body organization; unicellular Prokaryote, Unicellular and multicellular eukaryotes.
- Mode of nutrition; autotrophs (plants), Ingestive heterotrophs (animals) and absorptive heterotrophs (fungi).

Draw a linkage chart to show the establishment of Five Kingdom System that includes Two to Five Kingdom classification.

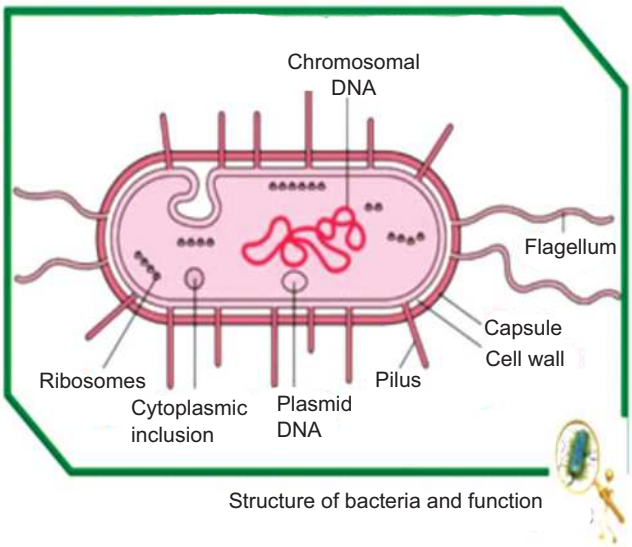
3.4 THE FIVE KINGDOMS



Five Kingdom classification

(i) Kingdom Monera:

It includes all the prokaryotes i-e Bacteria and cyanobacteria.



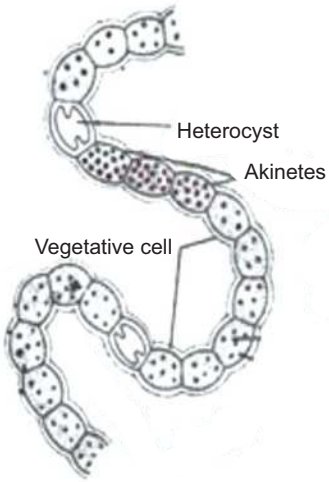
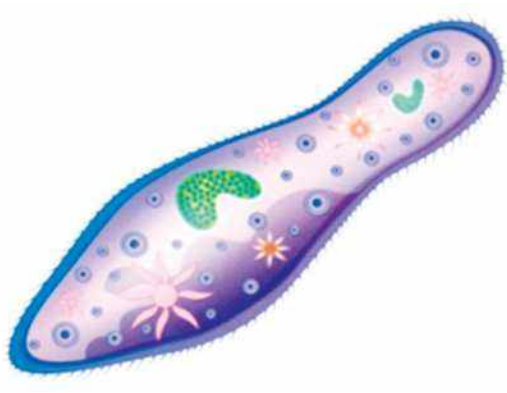


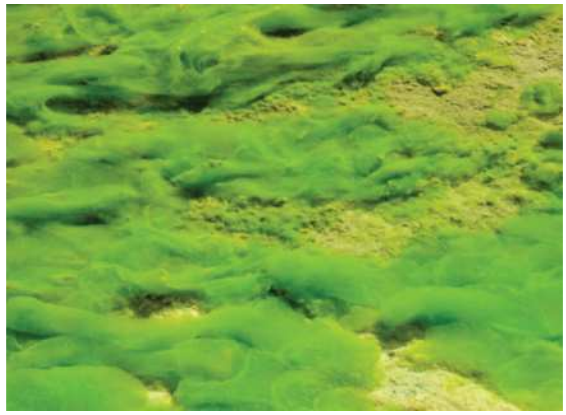
Figure 3.3 Bacteria and cyanobacteria

(ii) Kingdom Protista:

It is the place for all the eukaryotic unicellular organisms, except yeast which some of them have the features of both plant and animal like. Most protists are aquatic. It includes protozoa and unicellular algae.



Paramecium



Algae

Figure 3.4 protozoa and algae

(iii) Kingdom Fungi:

It includes all the multicellular eukaryotic fungi. They are Achlorophyllous, absorptive heterotrophs. They have cell wall made up of mainly chitin. They have a body called Mycelium which is made up of a thread like structure called hyphae.

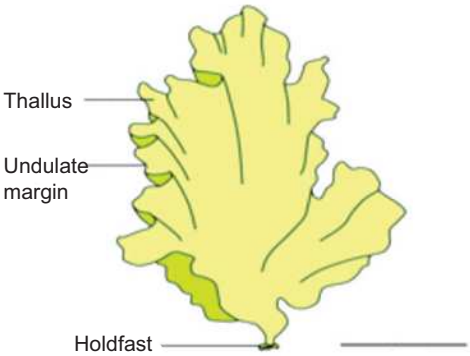
Mushroom

Mucor

Figure 3.5 Examples of fungi

(iv) Kingdom plantae:

It includes all the multicellular, eukaryotic, photosynthetic organisms. They have cell wall mainly made up of cellulose. It includes multicellular Algae, bryophytes, pteridophytes, gymnosperm and angiosperms.



Ulva lactuca

Bryophytes

Figure 3.6 Plants type

(v) Kingdom Animalia:

All animals are multicellular, eukaryotic which are ingestive heterotrophs without cell wall. It includes all vertebrates and invertebrates except protozoa.

Star fish

Kangaroo

Figure 3.7 Animals type

Table: Comparative characteristics of Five kingdom life.

Five Kingdoms					
Characters	**Monera**	**Protista**	**Fungi**	**Plantae**	**Animalia**
Cell type	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Cell wall	(Polysaccharide + amino acid) or cellulose	Present in some	Present (without cellulose)	Present (cellulose)	Absent
Nuclear membrane	Absent	Present	Present	Present	Present
Body organisation	Cellular without bonded organelles	Cellular	Multicellular/ loose tissue	Tissue/ organ	Tissue/organ/ organ system
mode of nutrition	Autotrophic (chemosynthetic photosynthetic) and Hetero-trophic (sapro-phyte/parasite)	Autotrophic (Photosyn thetic) and Hetero-trophic	Heterotrophic (Saprophytic/ Parasitic)	Autotrophic (Photosyn thetic)	Heterotrophic (Holozoic/ saprophytic etc.)

Structure of Virus:

Virus is non cellular obligate endoparasite (lives inside host cell). It does not have cellular organization but do have nuclear material either DNA or RNA. It has protein coat called capsid that encloses the nucleic acid. It reproduces only inside the host cell. Due to its non-cellular nature it cannot be placed in any of the five kingdoms. It causes number of diseases in plant like tobacco Mosaic Disease etc and animals like, cold, flue, dengue, polio, hepatitis, AIDS etc.

Prions and viroids are also non-cellular particles so cannot be placed in five kingdom classification system

3.5 BINOMIAL NOMENCLATURE

Carolus Linnaeus Swedish naturalist and explorer who was the first to frame principles for defining natural genera and species of organisms and to create a uniform system for naming them. The advantages of scientific over common names are that they are accepted by speakers of all languages, that each name applies only to one species, and that each species has only one name. As common names cause many problems to identify the organisms as different regions have different languages for the same thing for example; common name of onion in Urdu is 'Piyaz' but in other regions it is also known as 'ganda' or 'basal' etc but in scientific language it is known as **Allium cepa**.

This avoids the confusion that often arises from the use of a common name to designate different things in different places or from the existence of several common names for a single species.

Table: Biological name of some common plants and animals.

COMMONE NAME		BIOLOGICAL NAME
	PLANTS	
1.	Onion plant	*Allium cepa*
2.	Mango plant	*Mangifera indica L.*
3.	Neem plant	*Azadirachta indica*
	ANIMALS	
1.	Frog	*Rana tigrina*
2.	Cat	*Felis catus*
3.	Housefly	*Musca domestica*

Through a system of nomenclature in which each species of animal, plant or others receives a name of two terms of which the first identifies the genus to which it belongs and the second the species itself or its specific names.

Principles for binomial nomenclature:

Some of the rules which are universally adopted for writing scientific name of a species are:

- Scientific name of any organisms should be italicized when printed, such as *Homo sapiens* and when handwritten these are underlined.
- The first word of the name is generic always started with capital letter, while second term is species which is never capitalized.
- When the scientific name is written first time, it is written full but when it is repeated several times, it is abbreviated. For example; The scientific name of the red rose is *Rosa indica*, it is abbreviated as *R.indica*.
- Sometimes the author name appears after species name which means the species was described by Him. For example; (mango plant) *Mangifera indica* L. It means *Mangifera indica* was first described by ***Linnaeus***.

Use internet to search a scientific name of potato, matar, china rose and Dog.

3.6 CONSERVATION OF BIODIVERSITY

Pakistan is one of few countries in the world to have every kind of geological structure. The geography of Pakistan is a blend of landscapes.

You'll find plains, deserts, forests, hills, and plateaus. There are coastal areas along the Arabian Sea and mountains of the Karakoram Range in the north part of Pakistan.

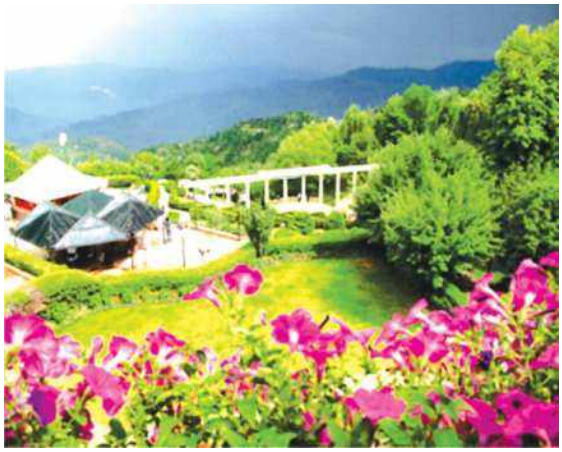


Figure 3.8 Beautiful views of Pakistan

This diversity contains diversified habitats and landscapes that support a rich biodiversity of both fauna and flora (animals and plants respectively). Arid and semi-arid regions covering almost 80% of the total land area of the country possess significant portion of country's biodiversity. During the last two-three decades, a number of animal and plant species have become threatened or endangered mainly due to over-exploitation and loss of natural habitat. Factors like deforestation, overgrazing, soil erosion, salinity and water logging are posing major threats to the remaining biodiversity of the country. The continuing loss of forest habitat, with its associated fauna and flora, will have serious implications for the nation's other natural and agricultural ecosystems. To overcome all these problems biodiversity should be paid attention in order to save the organisms from being endangered. **"Conservation simply is the way of caring, saving the species, inhabit on earth from dangers"**.

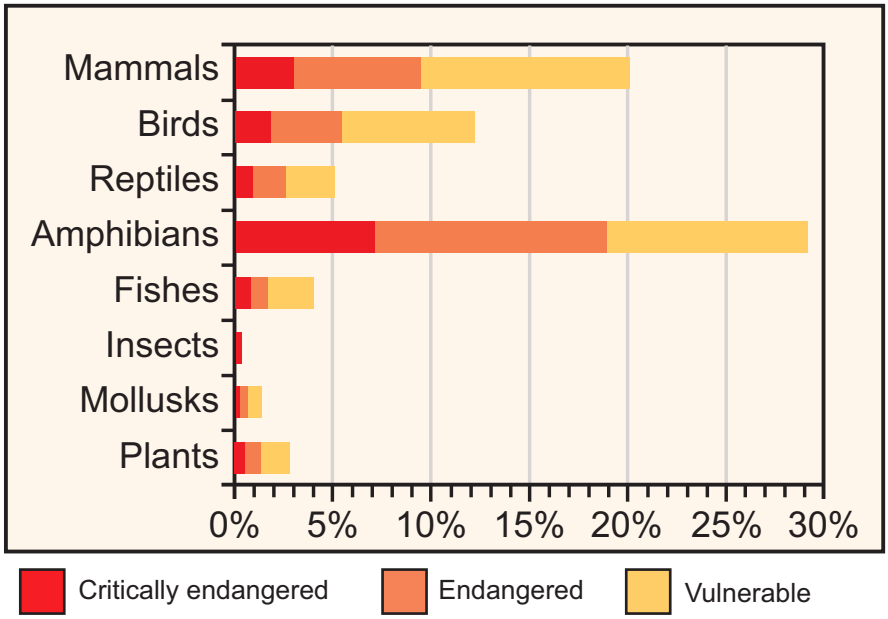
3.6.1 Reasons to conserve Biodiversity

Biologists warned that global ecosystem would be collapsed if biodiversity continues to be reduced at the same rate. Therefore, it is mandatory to conserve life on earth in order to make nature stable.

Some of the key points are highlighted below:

- Human should **conserve biodiversity** because of its benefit for example services and biological resources which are essential to live our life on earth.
- Biodiversity boosts ecosystem productivity where each species can easily survive in their habitat, if the one will not conserve biodiversity, so food chain and ecosystem will be imbalanced.
- With more plants, trees and animals, the soil improved and became stronger - less prone to erosion, drought and flooding.

Graph: Reporting the data to show the biodiversity at risk.



3.6.2 Problems associated to conserve biodiversity in Pakistan:

The article from 2009"Biodiversity in Pakistan Key issues", identified some of the primary challenges to implement Biodiversity Action Plan (BAP) are:

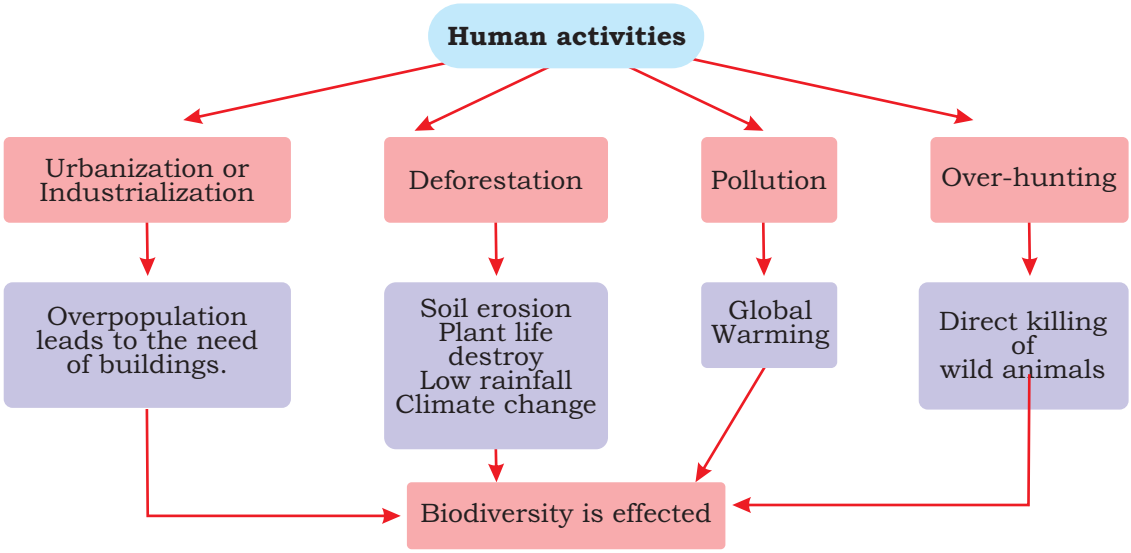
- Lack of awareness of environmental issues on the part of decision-makers and civil society.
- Weak governance (slow decision-making processes, inability to conceptualize policy, and lack of distinction between public and private interests).

- Weak capacity of government departments (lack of individual capacity and incentives for performance).
- Lack of funding.

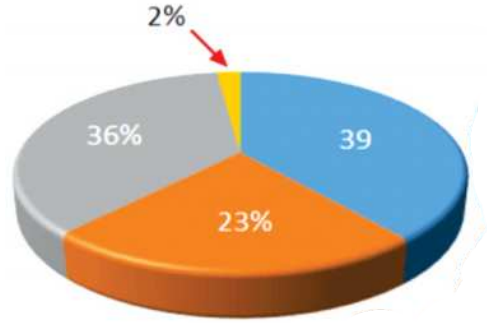
3.6.3 Problems associated to conserve biodiversity due to human intervention:

The International Union for Conservation of Nature (IUCN) reported that 75 percent of genetic diversity of agricultural crops has been lost, 75 percent of the world's fisheries are over exploited, and one-third of coral reefs are threatened with extinction. Man is the factor, which is directly involved in the destruction of biodiversity. The table below show some of the human intervention in the loss of biodiversity.

Table: Impact of human activities on Biodiversity.



Causes of Animal Extinction (Pie Chart)



Habitat Destruction

Hunting & Other Types of intentional Killing

Other Causes

Introduction to Invasive Species

Climate changes are not the only pressure on our environments. Habitat loss and degradation, pollution, overexploitation, and invasive species also play significant roles in biodiversity decline. These pressures are because of human invading activity.

3.6.4 Deforestation-causes and its effect on Biodiversity

Forests cover 31% of the land area on our planet. They produce vital oxygen and provide homes for people and wildlife. Many of the world's most threatened and endangered animals live in forests, and billions of people rely on its benefits. Forests offer food, fresh air, clothing, medicine and shelter. Forests play a critical role in reducing climate change because they act as a carbon sink soaking up carbon dioxide that would otherwise be free in the atmosphere and contribute to ongoing changes in climate patterns. But man is destroying this natural beauty by cutting them down for his sake and comfort. **"The cutting down of trees for the conversion of forest into non forest land is known as Deforestation"**.

Figure 3.9 Deforestation

Causes of Deforestation:

Deforestation is done deliberately due to the Mining, paper making, urbanization, timber, for making roads and Agriculture Expansion & Livestock breeding.

Effects of Deforestation:

Deforestation result with the great loss in Biodiversity such as; increase in the concentration of green house gases (carbon dioxide,

Methane, water vapopur, Nitrous oxide etc.) which leads to Global warming, temperature will be high that causes glaciers melting which is the reason of raising sea level and causes flood. It is also the reason of habitat loss of wild life. Soil erosion, low rainfall due to no transpiration are also the result of Deforestation.

3.6.5 Endangered and extinct species

Due to human activities such as entertainment or food, animals are becoming endangered (at risk of extinction in future) or some have gone extinct (surety of not finding the last individual of that species in ecosystem). Some of the endangered species are mentioned below:

Long Billed Vulture

Green Sea Turtle

Snow leopard

Marco polo sheep

European Otter

Baluchistan Forest Dormouse

Indus river dolphin

Asian black bear

Sindh Ibex (Markhor)

Figure 3.10 Endangered species of Pakistan

Summary

- Biodiversity or biological diversity is the degree of variation with or among species exist on different regions of the earth.
- Biodiversity provides many beneficial products including fibre, oil, dyes, ruber, water, timber, paper and food.
- Classification of organisms takes place on the basis of mological character or cytological character or genetical character.
- Morphological classification occur on homologous (Similar in structure) or an analogous characters (different in structure but similar in function).
- The groups of classified organism called taxon(Pl: taxa).
- The smallest and basic unit of classification is species. It is a group of organism which are similar in structure, can interbreed to provide fertile and visible off spring.
- The arrangement of taxa in ascending order to form a ladder called Taxanomic hierarchy.
- The science of classification is called Taxanomy.
- The father of Taxanomy is *Carolus Linnaeus.*
- *Carolus Linnaeus* gave the concept of binomial Nomenclature.
- In the beginning living organism were classified into two kingdom plant and animal kingdom.
- *Ernst Hackle* in 1866 introduced thee kingdom system.
- *Copeland* in 1959 classified living organism in four kingdoms.
- *Robert Whittaker* classified organism in 5 kingdoms, Monera, Protista, fungi, plantae and animalia.
- Lack of awareness of environmental issues, weak governance, etc are the main problems associate to conserve biodiversity.

Review Questions

1. Encircle the correct answer:

(i) Which of the following is the correct way of writing a scientific name of an organism?

(a) *Houbara bustard* (b) E.coli

(c) Alium Cepa (d) canis lupis

(ii) Select the mismatched

(a) Plantae → Pteridophyta (b) Fungi → Mucor

(c) Protista → Paramecium (d) Animalia → Amoeba

(iii) Identify the correct sequence of classifying an organism.

(a) Species → Genus → Kingdom → Phylum → Class → Order → Family

(b) Kingdom → Phylum → Class → Order → Family → Genus → Species

(c) Kingdom → Phylum → Class → Family → Order → Genus → Species

(d) Species → Genus → Class → Phylum → Order → Kingdom → Family

(iv) All are involve in classification except

(a) Analogous (b) Homologous (c) Cytology (d) Genetics

(v) In the taxonomic hierarchy choose the term which encompasses all other in the list

(I) Genus (II) Species (III) Order (IV) Class

(a) I and II (b) II (c) II and III (d) IV

(vi) In four kingdom classification, kingdom Metaphyta includes all of the following except.

(a) Algae (b) Angiosperm

(c) Gymnosperm (d) Bryophyta

(vii) In five kingdom system virus placed in

(a) Monera (b) Protista

(c) Plantae (d) None of these

(viii) Biological name of cat

(a) Felis catus (b) Azadirachta indica

(c) Alium Cepa (d) Canis lupis

(ix) Members of which kingdom have cell wall and are all heterotrophic

(a) Monera (b) Protista (c) Plantae (d) Fungi

(x) Biodiversity is effected with

(I) Pollution (II) Deforestation (III) Over hunting

(a) I only (b) II only (c) I and II (d) I, II and III

2. Fill in the blanks:

(i) Degree of variation within or among the species exists on different regions of the earth called _____.

(ii) _____ Species are given scientific names.

(iii) _____ Structures have different functions (physiology) but having similar internal architecture.

(iv) Science of classification is called _____.

(v) Most protists are _____.

(vi) _____ are achlorophyllous and absorptive living organism.

(vii) _____ is non-cellular obligate parasite.

(viii) Scientific name of any organism should be _____ when printed.

(ix) Cutting down of trees called _____.

(x) Animals which are at the risk of extinction in future called _____.

3. Define the following terms:

(i) Analogous (ii) Classification (iii) Species

(iv) Family (v) Metazoa (vi) Mycelium

(vii) Hyphae (viii) Genus (ix) Endangered species

(x) Kingdom

4. Distinguish between the following in tabulated form:

(i) Plant kingdom and Animal kingdom

(ii) Monera and protista (iii) Fungi and Plantae

5. Write short answers of following questions:

(i) Why scientific naming is necessary?

(ii) How living organisms are classified into two kingdom classification?

(iii) Why virus is not placed in any kingdom?

(iv) Draw chart showing three kingdom classification.

(v) Why amoeba is not placed in animal kingdom?

(vi) Why cyanobacteria are placed in monera?

6. Write detailed answers of the following questions:

(i) Describe in detail five kingdom classification.

(ii) What is taxonomic hierarchy? Explain aims of classification.

(iii) Describe effect of deforestation on biodiversity.