■ **Defination of Biodiversity - The differences and variations shown by living organisms in size, shape, nutrition, habit and habitat. This variety of life is called biodiversity.**

➢ **Levels of Biodiversity -**

Diversity of living world can observed at various levels, ranging from molecules to ecosystem level.

1) Genetic Diversity -

I. It is the intraspecific diversity.

II. It is the diversity in the numbers and types of genes as well as chromosomes present in different species and also variation in the genes and their alleles in the same species.

III. It includes variation within a population and diversity between populations that are associated with adaptation to local conditions.

IV. Genetic variations lead to individual differences within species. Such variation lead to way to evolution.

V. They also improve the chances of continuation of species in the changing environmental conditions or allow the best adapted to survive.

VI. Existance of subspecies, races are examples of genetic diversity. E.g. 100 varieties of mangoes 50,000 varities of rice or wheat.

VII. Another case of genetic diversity is a medicinal plant Ravwolfia vomitoria which secretes active components reserpine is found in different Himalayan ranges. This plant shows variations in terms of potency and concentration of active chemical from location to location.

VIII. Genetic diversity is essential for healthy breeding population of a species.

2) Species diversity (Community) -

I. It is interspecific diversity.
II. The number of species of plants and animals that are present in a region constitutes its species diversity.
III. Some areas or regions are richer in species than in other regions.
IV. Species diversity deals with variety of species as well as number of individuals of different species observed in area under study. E.g. amphibian species diversity is more in western ghats than in eastern ghats.
V. Natural undisturbed tropical forests have much greater species richness than monoculture plantation of timber plant developed by forest plantation.
VI. India is one amoung 15 nations that are rich in species diversity.

3) Ecological (Ecosystem) diversity -

I. It is related to different types of ecosystems / habitats within a given geographical area.
II. There are a large variety of ecosystems on earth having their own complement of distinctive interlinked species based on the differences in the habitat.
III. It can be described for a specific geographical region.
IV. There may be one or many different types of ecosystems in region.
V. Thus ecosystem diversity is very high in India while it is quite low in Norway.
VI. In India we can find a great variety of ecosystems deserts, rain forests, deciduous forests, estuaries, wetlands, grasslands etc.
VII. The western ghats show great ecosystem diversity while regions like Ladakh and Rann of Kutch do not show variance like we observe in Western ghats.

The diversity of life at all the three levels is now rapidly being modified by modern mar.

- **Patterns of Biodiversity** - There are two patterns viz. Latitudinal and Altitudinal gradient and species area relationship.
  - **Latitudinal and altitudinal gradients -** Biodiversity, barring Arid / Semiarid and aquatic habitat show latitudinal and altitudinal gradient.

    a) Latitudinal -

    1) The distribution of diversity is not uniform around the Globe. Species richness exhibits latitudinal gradient for many plants and animals.
    2) It has been observed that species richness is high at lower latitudes and there is a steady decline towards the poles.
    3) Factors like overall stability of tropical regions for millions of years, lesser climate changes throughout the year and availability of plenty of sunlight that favoured speciation.
    4) Tropical areas have less experienced drastic disturbances like periodic glaciations observed at poles. Such a stability over millions of years might have favoured speciation.
    5) The Availability of more intense sunlight, warmer temperature and higher annual rainfall in tropics as factors responsible for bountifulness of these regions.
    6) In more or less constant climate conditions and abundance of resources, some animals enjoy food preferences. For e.g. Fruits being available throughout the year in rain forest, variety of frugivorous organisms is more as compared to the temperate regions.
    7) Species richness or diversity for plants and animals decreases as we move away from equator to the poles. It is maximum in tropical rain forests. e.g. Amazon rain forest (40,000 plants, 1,300 birds, 427 mammals, 3000 species)

  - **Altitudinal**

    1) It speaks for the height from mean sea level (MSL) Upwards.
    2) Species diversity is more at lower altitudes than at higher altitudes. It is because at higher altitudes, change in the climate conditions and drastic seasonal variations, lead to the decrease in the species diversity.

b) Species - Area Relationship -

1) Scientist have tried to establish relationship between species diversity and the size of the habitat.
2) It is considered that number of species present is directly proportional to area.
3) It is understood that larger areas may have more resources that can be distributed amongst the inhabitant species, whether it is true.
4) German naturalist Alexander Von Humboldt observed that species richness does increase with the increase in area but up to a limit.

◆ Importance of species diversity to the ecosystem -

Productivity Stability Hypothesis -

A community is said to be stable, if average biomass production remains fairly constant over a period of time. It should be strong enough to withstand disturbances and recover quickly. It also must be resistant to invasive species. David Tillman carried out various field experiments and proved that species richness does help the stability of an ecological community. Rich diversity leads to lesser variation in biomass production over a period of time. This is called **Productivity Stability Hypothesis.**

Productivity Stability Hypothesis -

Paul Ehrlich, an ecologist from Stanford gave an analogy to explain significance of diversity. It is called Rivet Popper Hypothesis. He compared Aeroplane to ecosystem and the species as rivets that keep all parts of aeroplane together. Ofcourse, there are thousands of rivets needed to hold all parts of the aeroplane together. If each passenger dicides to pop even one rivet or in other words, if one species gets extinct, initially not much of the turvulence will be experienced but slowly, as number of popped rivets will increase, there will be a serious threat to the safety of the aeroplane.

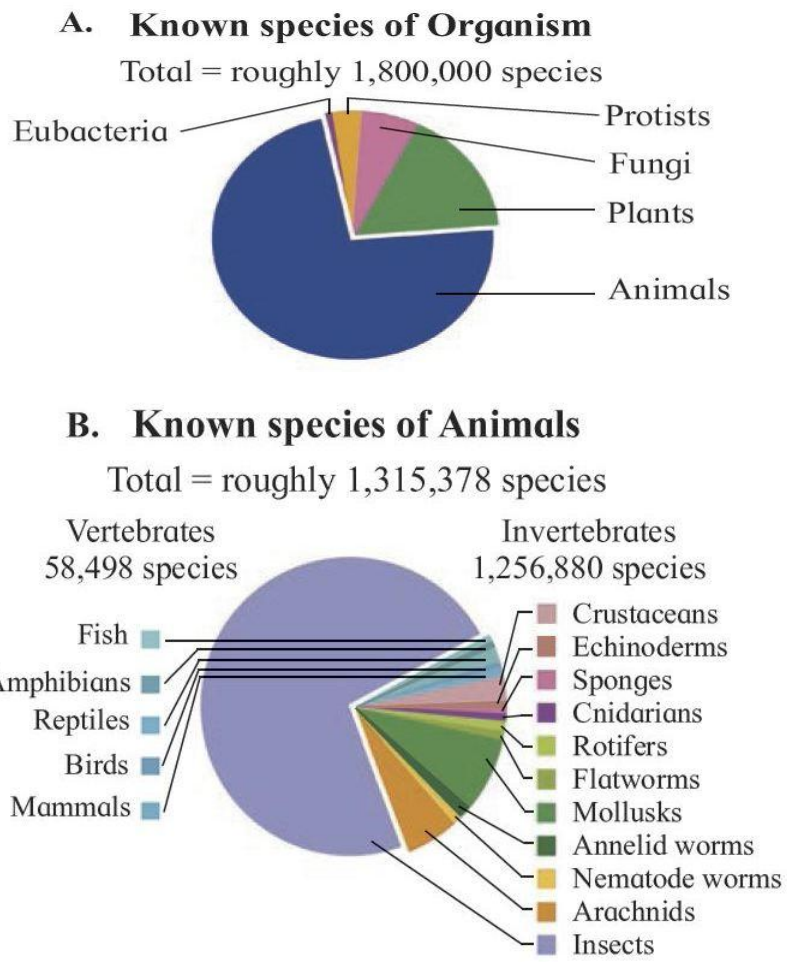
Suppose rivets at key positions such as the one that bind the wings to the body of the aeroplane are removed, situation will become serious. Thus, we can say that relationship between diversity and well being of ecosystem

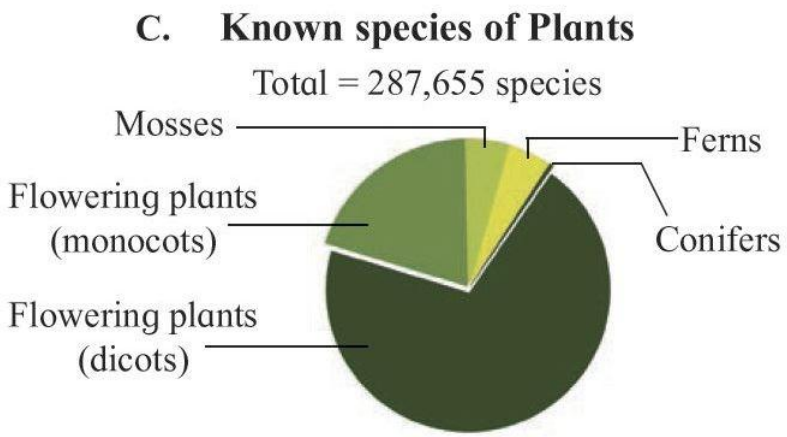
is not linear. But it is certain that loss of species may not pose threat to the ecosystem initially Loss of key species will certainly cause threat in very short span of time. It will affecdt food chains, food web, energy flow, natural cycles etc. In short it will affect the balance of ecosystem.

Biodiversity Current Scenario -

It is difficult to come to know about the exact number of species that are present on earth today Though over 1.5 million species have been documented as per IUCN data (2004) so far, we are yet to study lot more than these.

Tropical rain forests the major diversity hubs, are yet to be explored completely. Some exorbitant numbers like existence of 20 to 50 million varieties have been made But Robert May has given convincing estimate of about 7 million species round the globe.





Dia - Graphical representation of known animal and plant groups

In the diagrams, we do not find any data of prokaryotes. Several moneran species are not cultivable under laboratory conditions. Also conventional taxonomic method are not suitable for identification of prokaryotic species.

India boats a share of 8.1 % of total biodiversity wealth of the earth. One of the 12 megadiversity countries of the globe. India has 2.4 % of total land area of the world. We have identified around 45,000 plant species and nearly double the number of animal varieties from our natural wealth. If we consider May's estimate of global biodiversity. We have recorded only 22 % of our natural wealth. This situation underlines the need of taxonomists to study the biodiversity. But major concern is the possibility of loss of these varieties before we identify them because of activities like reclamation and deforestation.

❖ Loss of Biodiversity -

1) The loss of biodiversity is extinction of species.
   There are 3 types of extinction viz. **Natural extinction**, **Mass extinction** and **Manmade extinction** (anthropogenic).
2) Natural extinction include forest fires, earthquakes, volcanic eruptions etc.
3) Man made extinction includes habitat distruction hunting, settlement, overexploitation and reclamation.
4) Loss of biodiversity leads to the overall imbalance in the ecosystem.
5) Loss of biodiversity in any area can lead to the decline in plant production, lower resilience to environmental disturbance like flood.
6) There are five mass extinctions during various stages of history of earth (ice age).

❖ Cause of Biodiversity losses -

There are four major causes popularly known as The 'Evil Quartet'

1) Habitat loss and fragmentation - It is the prime cause of distruction. Reduction in vast natural habitats and local degradation by pollution, create crisis situation for the living beings. Loss of local habitat due to human activities, creates threats to migratory birds as well as thouse animals that need larger territories. Tropical rain forests are being last at an alarming rate. Tropical rain forest cover has reduced from 14% to 6 % over the years

2) Over exploitation - The difference between human beings and other animals is that, humans have the tendency to accumulate beyond their needs. This has resulted in the overexploitation of resources which in turn causes threats to various organisms. Dodo bird, Stellar sea cow and passenger pigeon are few examples of extinction due to overexploitation.

3) **Alien species invasion** - When a new species gets introduced in to any ecosystem accidentally or intentionally, there are chances that it proves harmful for existing species. It can also to extinction of local species. In such a case it is called as **invasive species** e.g. The carrot grass (Parthenium), Lantana and Water hyacinth (Eichhornia). Introduction of predator fish Nile perch in Lake Victoria proved deleterious for 200 local species in Ciclid fish. In India introduction of African catfish Clarias gariepinus for aquaculture purpose has proved harmful to endemic catfish varieties. One of the major reasons of such a harmful effect of alien species is lack of local predator.

4) **Co - extinctions** - Many Times organisms are associated with each other in obligatory way. In such cases extinction of one variety leads to loss of associate variety from the ecosystem. e.g. Extinction of host fish causes extinction of unique parasites. Coevolved plant pollinator, also have such a threat. When any species is totally eliminated from earth, it is called **extinct**. e.g. Dinosaurs, When the number of members of a species starts dwindling, it is said to be **endangered**. The International Union for conservation of Nature and Natural Resources (IUCN), maintains a Red Data Book also known as Red List. Where conservation status of plant and animal species is recorded.

❖ **Conservation of Biodiversity -**

Conservation of biodiversity means protection, upliftment and scientific management of biodiversity to maintain its optimum level and to derive sustainable benefits for present and future stratefies.

Why to Conserve Diversity -

The resons for conservation of biodiversity can be classified in to three categories.

a) **Narrowly utilitarian reasons -**

Humans are reaping material from biodiversity. It may be deriving resources for basic needs such as food, clothes, shelter ot industrial products like resins, tannins, perfume base etc. For asthetic use as in ornaments or artefacts.

Medicinal use of plants and animals is another major factor. It shares 25 % of global medicine market. Around 25000 species are put to use by tribals worldwide as traditional medicines.

b) **Broadly utilitarian reasons -**

Natural giving us oxygen in free Animals play a crucial role in pollination and seed dispersal.

Amazon forest is estimated to produce 20 % of total oxygen of earths atmosphere. We need to consider recreational use of diversity too the devasting fires in Amazon rainforest in Augest 2019. These are mainly caused in Brazil and are more manmade than natural. The slush and burn policy of locals to reclaim forestland has caused a towering 906000 hectares of forest devastation only in year 2019.

c) **Ethical reasons -**

We have no right to destroy the diversity simply because we share the earth with them. All living being have equal right to survive irrespective of their known or prospective economic use.

❖ **Conservation of Biodiversity -**

There are two main types of conservation strategies.

a) **In-situ conservation -**

Protection of organisms automatically takes place if its natural habitat is protected. e.g. Kanha forest as tiger reserve. This is called **in-situ conservation**.

1. It is nothing but conservation 'at home'.
2. Around 34 Biodiversity hotspots have been identified by the conservationist.
3. Hot spots are the regions with high species richness as well as density.
4. These areas need to be protected strategically by setting legislative measures apart from awareness and conservation.
5. In-situ conservation also includes introduction of varieties traditionally used in to farming and horticulture. e.g. In Maharashtra, Pawra tribals in Satpuda have protedted varieties of corn with different coloured kernels.
6. India has 3 world's Biodiversity hot spots Western Ghats, Indo Burma and Eastern Himalayas.
7. It has been estimated that protection of these diversity rich hotspots could reduce extinction rate by almost 30 %.
8. India at present has 14 biosphere reserves, 90 national parks and 448 wildlife sactuaries. In Maharashtra, there are 5 national parks and 11 sactuaries.
9. Indian culture and traditions are always connected with nature and rituals are laid down to protect biodiversity. In many cultures, stretches of forests were set aside and protected in the name fo Almighty, which are called sacred groves.

10. Such sacred groves are found in Khasi and Jaintia hills in Meghalaya, Western ghat regions of Maharashtra and Karnataka. Aravali hills of Rajasthan and Bastar and Chanda and Sarguja areas of Madhya Pradesh.
11. Sacred groves serve the only chance of survival for some endangered varieties of animal and plant species. Tribals do not allow to cut even single branch of tree from sacred grove.

b) **Ex-situ Conservation** -

When a species is critically endangered, special measures have been taken to protect it. It might be protected in captivity, as one of the measures of protection. This is called **Ex-situ conservation.**

1. The living beings are protected away from their natural habitats in special settings.
2. Wild life safari parks, 200 logical parks and botanical gardens serves this purpose.
3. Animals which have decreased in number are allowed to breed in captivity in order to protect them. e.g. crocodile bank of Chennai.
4. Seed banks are established to conserve wild varieties of food grains and vegetables.
5. Now a days, modern techniques like tissue culture, in vitro fertilization of eggs and cryopreservation. (preservation at low temp 196° C) of gametes are used to protect endangered species.

- **Biodiversity diversity Act 2002 -**
  1. In order to provide sustainable managements and conservation of country's natural resources, government passed Biological Diversity Act (BD act) in the year 2002.
  2. The law broadly defines biodiversity as plant, animals and microorganisms and their parts, their genetic materials and by-products. It excludes value added products and human genetic material.
  3. A three tier system has been established with National Biodiversity Authority (NBA) at the national level, the State Biodiversity Boards (SBBs) at state level and Biodiversity Management Committees (BMCs) at the local level for the approval of utilization of any biological resourse for commercial or research purpose. It is mandatory for foreigners, NRIs as well as Indian citizens and institutions to seek permission from NBA before exploiting local resource. NBA has powers of civil court. Not seeking approval of NBA, can incur jail and fine up to 10 Lakh rupees.