19. Organisms and Environment - II

Population

- It is a group of organisms inhabiting a given area.
- Attributes of population are –
    - Birth rate
    - Death rate
    - Sex ratio
    - Age distribution
- **Age pyramid:** It shows the age distribution pattern for a population.
- Age pyramid for human population shows –
    - **Expanding population:** Has a broader base, representing more number of individuals in pre-reproductive (young individuals) age group
    - **Stable population:** Has almost equal number of individuals in the pre-reproductive and reproductive age groups, converging at the post-reproductive age group
    - **Declining population:** Has lesser number of individuals in the pre-reproductive group and greater number of individuals in the reproductive age group

Demography

- The Statistical study of human population considering the following factors:
    - Distribution of population
    - Size and Density of population
    - Birth rate
    - Death rate
    - Growth rate of population

- **Population density fluctuates due to –**
    - Natality (B)
    - Mortality (D)
    - Immigration (I)
    - Emigration (E)

So,

$$N_{t+1} = N_t + [(B + I) - (D + E)]$$

Where, N_t is the population density at time t and N_{t+1} is the population density at time t+1

- **Population growth curve**
  - When resources are unlimited, the growth curve is known as exponential growth curve.
  - **Exponential growth equation:**
  - $Nt = N0\ ert \Rightarrow \frac{dN}{dt} = rN$

Where,

N_t = Population density after time t

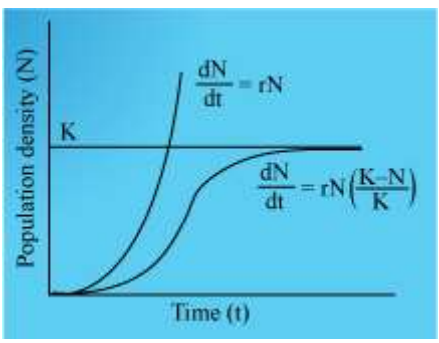
N_0= Population density at time 0

r = Intrinsic rate of natural increase

e = Base of natural logarithm

  - When resources become limiting, the growth curve is said to be logistic growth curve.
    - **Verhulst–Pearl logistic growth equation:** $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$

Where,
N = Population density at time t
r = Intrinsic rate of natural increase
K = Carrying capacity



Population interaction

- There are six types of population interaction –

1. **Mutualism**: It is a symbiotic association between two species where both of them are benefited. Example, fungi and roots of higher plants
2. **Competition:** It is a type of interaction where both the species are negatively affected. Example, Abingdon tortoise getting extinct due to the introduction of goat

  - **Gause's competitive exclusion principle** states that two or more closely related species having identical patterns of resource use cannot coexist in a stable environment;

one which will be better adapted will out-compete or otherwise eliminate the inferior one.

1. **Predation and Parasitism:** It is the population interaction where one species is positively affected while the other species is negatively affected. Example, *Pisaster* hunting on sea urchin is an example of predation while *Cuscuta* deriving nutrition from its host represents parasitism. Parasitism is of two types –

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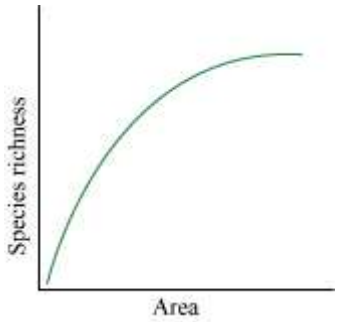
        - Endoprasitism: Example, tapeworms and roundworms in the human body
        - Ectoparasitism: Example, lice on the human skin and ticks on dogs

1. **Commensalism:** It is the population interaction where one species gets positively affected while the other remains unaffected. Example, clown fish living in the poisonous tentacles of sea anemone
2. **Ammensalism:** It is the population interaction where one species gets negatively affected while the other remains unaffected.

- **Biodiversity:** It is the variety of living forms present in various ecosystems.
- There are three important components of biodiversity –
    - **Genetic diversity:** It is the diversity at the gene level.
    - **Species diversity:** It is the diversity at the species level.
    - **Ecological diversity:** It is the diversity at the ecosystem level.
- Total number of plant and animal species on earth is about seven million.
- **Among invertebrates**, insects are more diverse than molluscs and other invertebrates.
- **Among vertebrates**, fishes are more diverse, followed by birds, reptiles and then amphibians.
- **Among plants**, the maximum species-richness is found in angiosperms, followed by fungi, algae, mosses and then ferns.
- **Patterns of biodiversity**
    - **Latitudinal gradients:** The tropical regions show greater level of species- richness than the temperate regions. It is because the tropical regions have less seasonal variation, and have a more or less constant environment. Also, the temperate regions were subjected to glaciations while the tropical region remained undisturbed, which led to an increase in species-diversity in the tropical region.
    - **Species–area relationship:** The relationship between species-richness and area is represented by a rectangular hyperbola. The equation is

$\text{Log } S = \log C + Z \log A$
Where,
S = Species-richness
A = Area
Z = Regression coefficient
C = Y-intercept



Graph representing species–area relationship

- In small areas, the values of regression coefficient are similar, regardless of taxonomic group.
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- **Loss of biodiversity:** It has been observed that the biodiversity around the world is declining at a very fast rate.
  The reasons behind loss of biodiversity are –
  - Habitat loss and fragmentation
  - Over-exploitation of resources
  - Alien species invasion
  - Co-extinction of species

- **Biodiversity conservation**
- **Need for conservation of biodiversity: It is grouped into three categories –**
  - **Narrow utilitarian argument** for biodiversity conservation focuses more on economic benefit, in the form of food, fibre, tannin, etc., provided by diverse plants and animals.
  - **Broad utilitarian argument** for biodiversity conservation focuses on ecosystem services such as pollination, soil formation, photosynthesis, etc., provided by nature.
  - **Ethical argument** regarding conservation of biodiversity focuses on ethical issues.

- **Methods for conserving biodiversity:**
  - **In-situ conservation:** The conservation of endangered plants and animals in their natural habitat is in-situ conservation. Example: sacred groves, biosphere reserves.
  - **Ex-situ conservation:** The conservation of endangered plants and animals outside their natural habitat in artificial conditions. Example: zoological parks, safari, tissue culture propagation, cryopreservation of gametes, etc.