

CHAPTER-11

ORGANISMS AND POPULATIONS



Revision Notes

Characteristics of a Population

- **Population** : A population is defined as a group of individuals of the same species that live in a particular geographical area at a particular time and functioning as a unit.
- A population has certain attributes that an individual organism does not have. For example, individuals may have births and deaths, but a population has **birth rates** and **death rates**.
- **The birth and death rates** are referred to as per capita births or deaths respectively, which increases and decreases with respect to members of the population.
- **Sex ratio** is another attribute of the population. An individual may be male or female but the population has a **sex ratio**.
- A population at a given time is composed of different individuals of different ages. If the age distribution is plotted for the population, the resulting structure is called age pyramids. The shape of pyramids reflects the shape of the growth status of a population.
- **Population size or population density** (N) is measured in terms of number.
- **Population Growth** : The size of the population is not static. It keeps changing with time, depending upon food availability, predation, and adverse weather condition. The main factors that determine population growth are :
 - (i) Natality (number of births) [B]
 - (ii) Mortality (number of deaths) [D]
 - (iii) Immigration (individuals that come into habitat) [I]
 - (iv) Emigration (individual that leaves the habitat) [E]

If 'N' is population density at time 't', then its density at t + 1 is

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



Key Words

Birth rate (Natality) : It is the ratio of live births in an area to the population of an area.

Death rate (Mortality) : It is the ratio of deaths in an area to the population of an area.

Sex ratio : It is the number of males or females per thousand individuals.

Population density : It is defined as the number of individuals of a population present per unit area at a given time.

Differences between Natality Rate and Mortality Rate :

S. No.	Natality Rate	Mortality Rate
1.	Addition of new individuals due to birth, hatching, germination or division.	Number of individuals in a population decreases with the death of the individuals.
2.	Natality shows the number of offsprings produced per unit time per unit population.	Population density and its size is decreased by death rate.

- **Growth model** : Growth of population takes place according to the availability of food, habitat condition and presence of other biotic and abiotic factors. There are two main types of models :

(i) **Exponential Growth** : This kind of growth occurs when food and space are available in a sufficient amount. The population grows exponentially or geometrically. If the size of a population is N , the birth rate is represented as ' b ' and death rate as ' d ', then increase and decrease in N during a unit period time ' t ' will be

$$dN/dt = (b - d) \times N$$

Let, $(b - d) = r$.

Then, $dN/dt = rN$

The r in this equation is called 'intrinsic rate of natural increase.



Key Fact

Polar bear one of the world's largest living animals is Earth's number one apex predator. Apex predators are the top predators in the food chain.

(ii) **Logistic Growth** : There is a competition between the individuals of a population for food and space. The 'fittest' organism survives and reproduces. This type of growth initially shows a lag phase followed by phases of acceleration and de-acceleration. K indicates the carrying capacity of the

$$dN/dt = rN \left(\frac{K - N}{K} \right)$$

Where, N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity

- **Population interaction** : All animals, plants and microbes in a biological community interact with each other. These interactions may be beneficial, detrimental or neutral to one species or both.

The following types of interactions are seen :

- (a) **Predation** : It is the interaction between two species members in which the members of one species capture, kill and eat up the members of other species.
- (b) **Parasitism** : It is the relationship between two living organisms of different species in which one organism called a parasite obtains its food directly from another living organism called the host.
- (c) **Proto-cooperation** : It is the interaction between two living organisms of different species in which both are mutually benefitted but they can live without each other.
- (d) **Competition** : It is the rivalry between two or more organisms for obtaining the same resources.
- (e) **Mutualism** : It is the interaction between two organisms of different species where both the partners are benefitted but cannot live separately.

IMPORTANT DIAGRAMS :

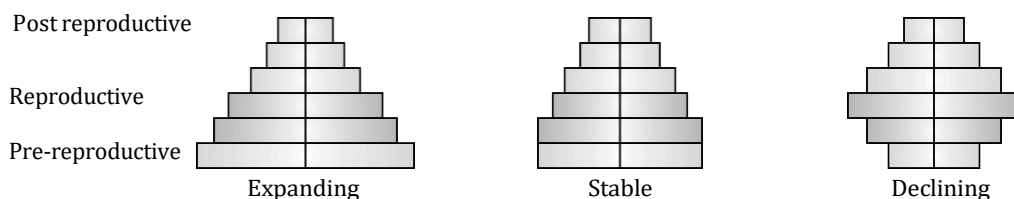


Fig. 11.1 Representation of age pyramids for human population

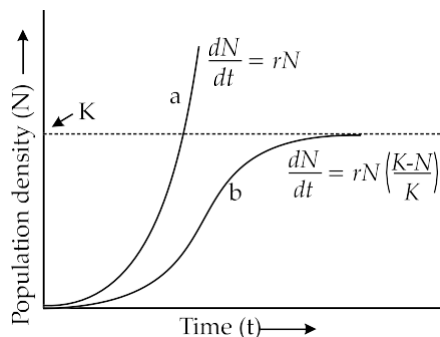


Fig. 11.2 Population Growth Curve :

- (a) When responses are not limiting the growth, plot is exponential.
- (b) When responses are limiting the growth, plot is logistic. It produces sigmoid curve (S-shaped). K is carrying capacity.



Mnemonics

Concept: Population Density at time $t + 1$

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

Mnemonic: Never try Before I Dare to Exit

Example

- Q.**
- (i) List the different attributes that a population has and not an individual organism.
 - (ii) What is population density ? Explain any three different ways the population density can be measured, with the help of an example each.
- Sol. (i)** Following are the attributes that a population has but an individual organism does not have :
- (a) Birth rate : Per capita births.
 - (b) Death rate : Per capita deaths.
 - (c) Sex ratio : Ratio of number of males to females in a population.
- (ii) **Population density** : It means number of

individuals present per unit area. Population density can be measured by determining the population size. The different methods to study population size are as follows :

- (a) **Quadrat method** : It is a method that involves the use of square of particular dimensions to measure the number of organisms e.g., The number of *Parthenium* plants in a given area can be measured using the quadrat method.
- (b) **Direct observation** : It involves the counting of organisms in a given area e.g., In order to determine the number of bacteria growing in a petridish, their colonies are counted.