ATOMIC ENERGY CENTRAL SCHOOL, INDORE

CLASS XII

BIOLOGY

MODULE 2/3

CHAPTER 13

ORGANISMS AND POPULATIONS

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PGT(SS) - BIOLOGY

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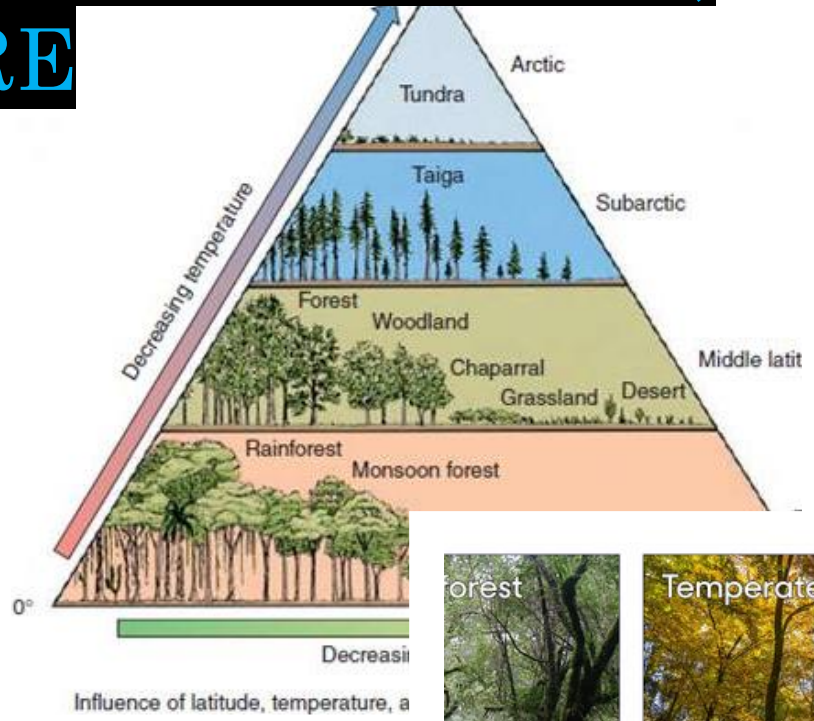
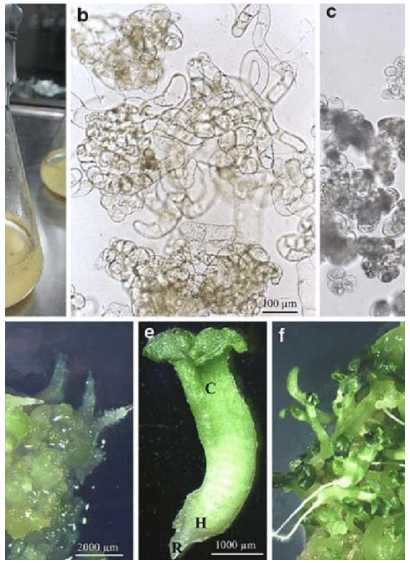
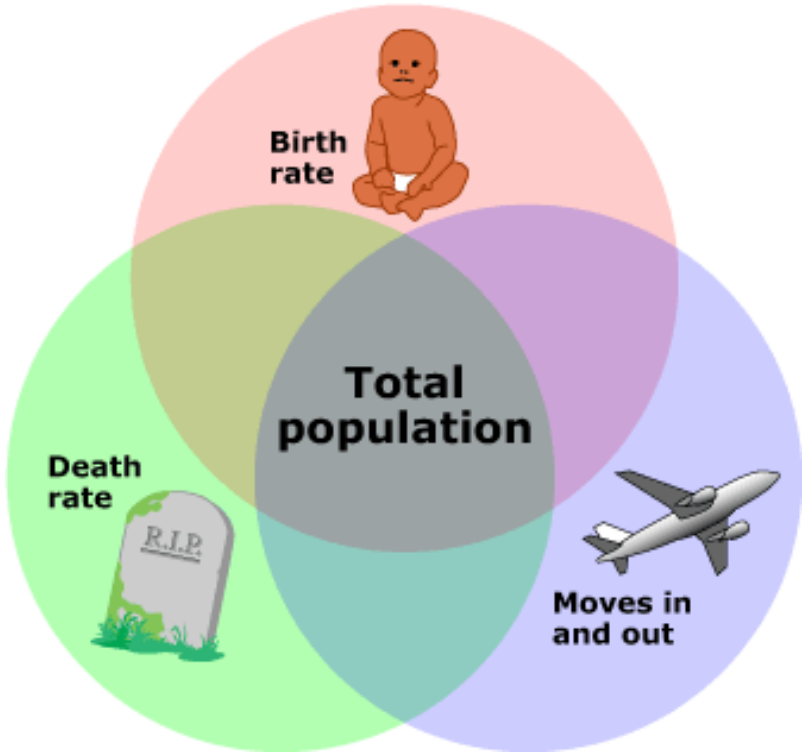


Influence of latitude, temperature, a

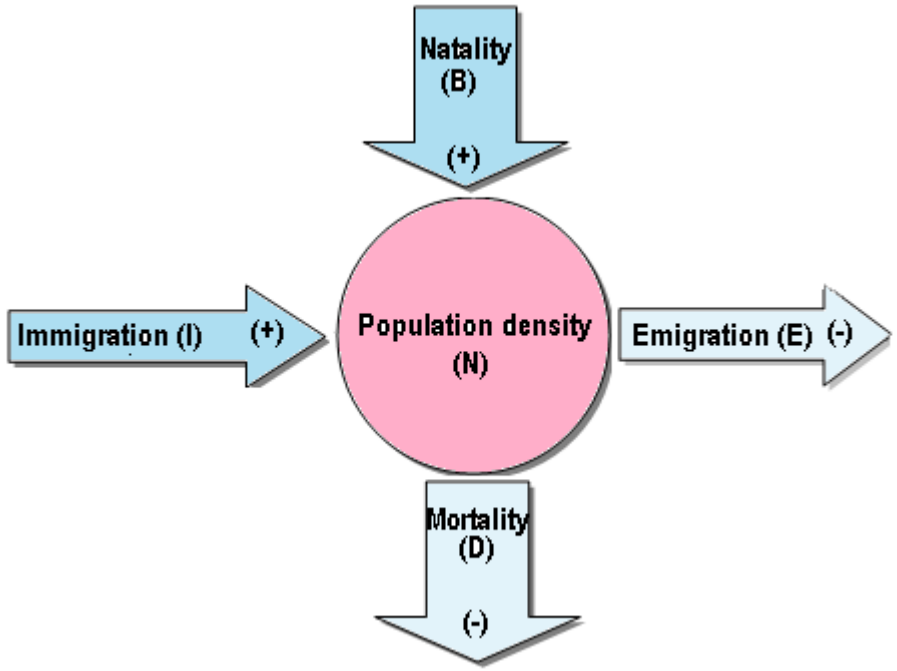


13.2.1 Population Attributes



- **Some significant attributes that populations possess are –**
  - **Birth rate / natality, population density, death rate/ mortality, sex ratio, age distribution.**
  - **Birth rate or natality** refers to the average number of young ones produced by birth, hatching or germination per unit time (usually per year). In the case of humans, it is commonly expressed as the number of births per 1000 individuals in the population per year.
  - The maximum birth rate that a species can achieve under ideal environmental conditions called **potential natality.** However, the actual birth rate under the existing conditions is much less. It is termed as **realized natality.**

13.2.1 Population Attributes

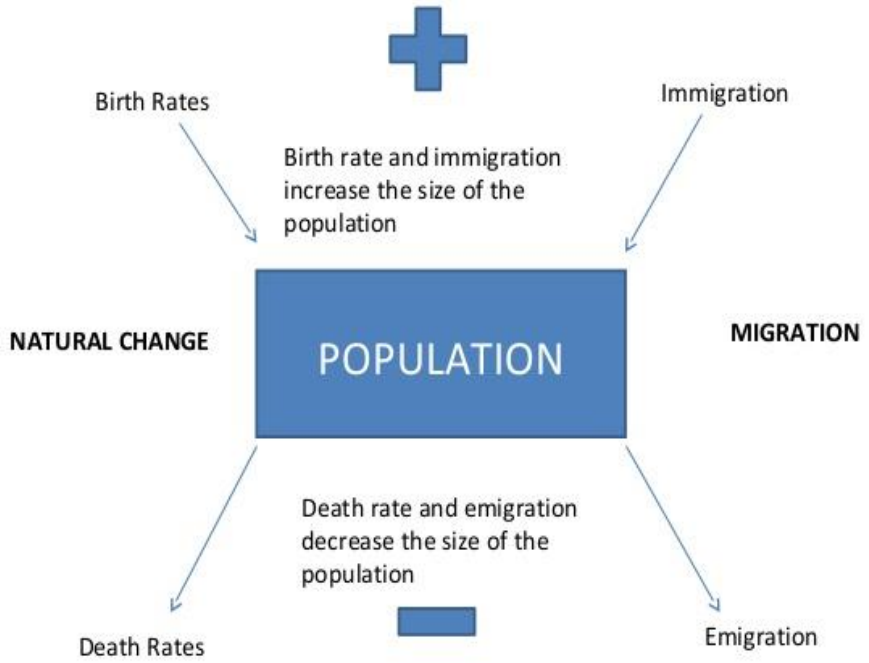


- **Some significant attributes that populations possess are –**

Death rate or mortality is the average number of individuals that die per unit time (usually per year). In humans, it is commonly expressed as the number of deaths per 1000 persons in a population per year. Lowest death rate for a given species in most favourable conditions is called **potential mortality**, while the actual death rate being observed in existing conditions is called **realized mortality.**

The death rate of a population can be easily represented by **survivorship curve**. In this curve, time is plotted against the number of survivors.

13.2.2. Population Growth



Population density, is the number of individuals present per unit area or volume at a given time. For instance, the number of animals per square kilometre, number of trees per area in a forest, or number of planktonic organisms per cubic meter of water.

The population density is determined by four basic processes- **natality, mortality, immigration and emigration.**

The percentage ratio of natality over mortality is known as **vital index** i.e., natality / mortality × 100. It determines the growth of a population.

Immigration is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration.

Emigration is the number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.

13.2.2. Population Growth

Age distribution : Various age groups in a population determine its reproductive status. The three ages referred to as ecological ages in a population are – **pre-reproductive**, **reproductive** and **post-reproductive**. Population with more young members grow rapidly, while the declining populations have a large proportion of older individuals.

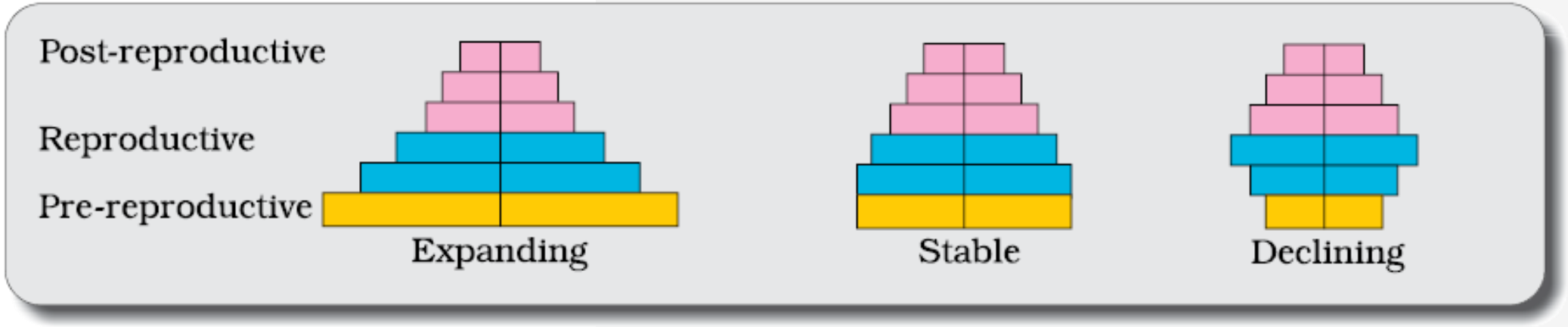
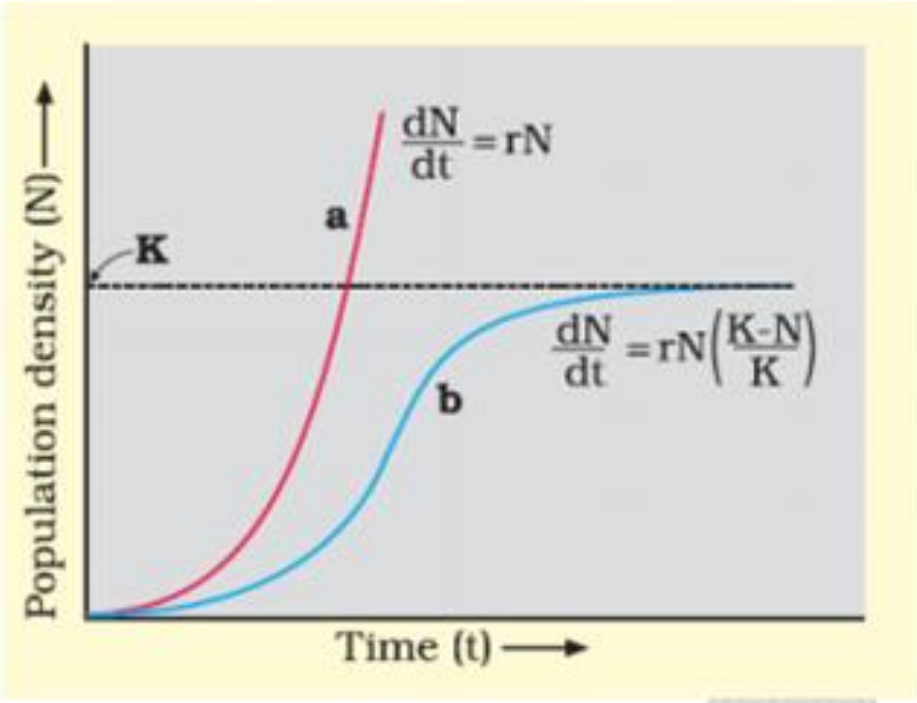


Figure 13.4 Representation of age pyramids for human population. (NCEERT)

13.2.2. Population Growth

Figure 13.5 Population growth curve a when responses are not limiting the growth, plot is exponential, b when responses are limiting the growth, plot is logistic, K is carrying capacity



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There are three kinds of survivorship curves–

Diagonal curve : If the death rate of different age groups of organisms are equal, then the curve is represented or plotted as a straight line.

e.g., Hydra, mice and many adult birds.

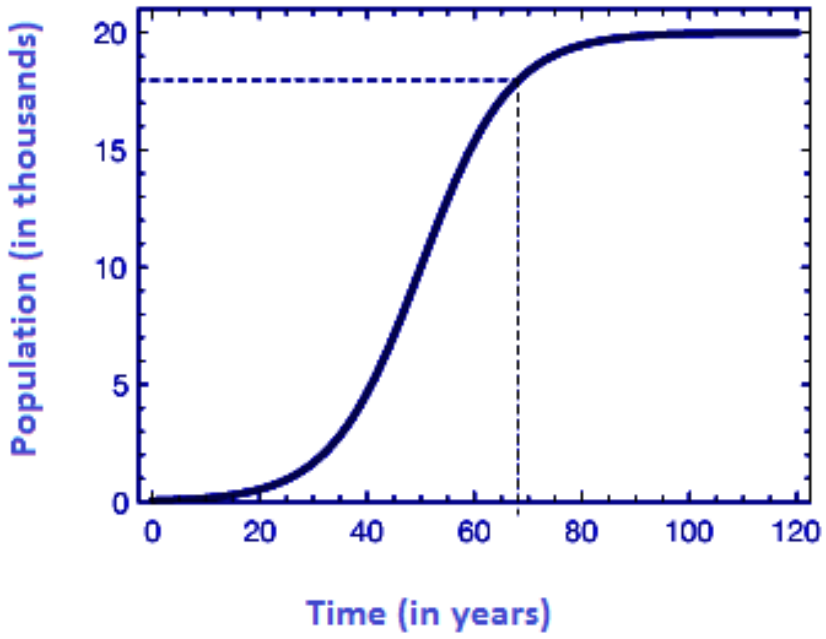
Convex curve : When organisms have completed their potential life span and died in old age then the curve is convex, the curves goes horizontal till potential life span and then declines rapidly. e.g., Man, rabbit and many mammals.

Concave curve : This kind of curve is mostly found in such organisms who die before their potential life span. e.g., Fish, Oysters and Invertebrates.

Sex ratio is the ratio of males to females in a population.

13.2.2. Population Growth

(A) Sigmoid or S-shaped growth curve



It is formed of five phases :

Lag phase: In this phase, individuals adapt themselves to the new environment, so there is no or very little increase in population.

Positive acceleration phase: It is the period of slow increase in population in the beginning.

Logarithmic or exponential phase : It is the period of rapid rise in population due to the availability of food and the requirements of life in plenty and no competition.

Negative acceleration phase : In this again, there is a slow rise in population as the environmental resistance increases.

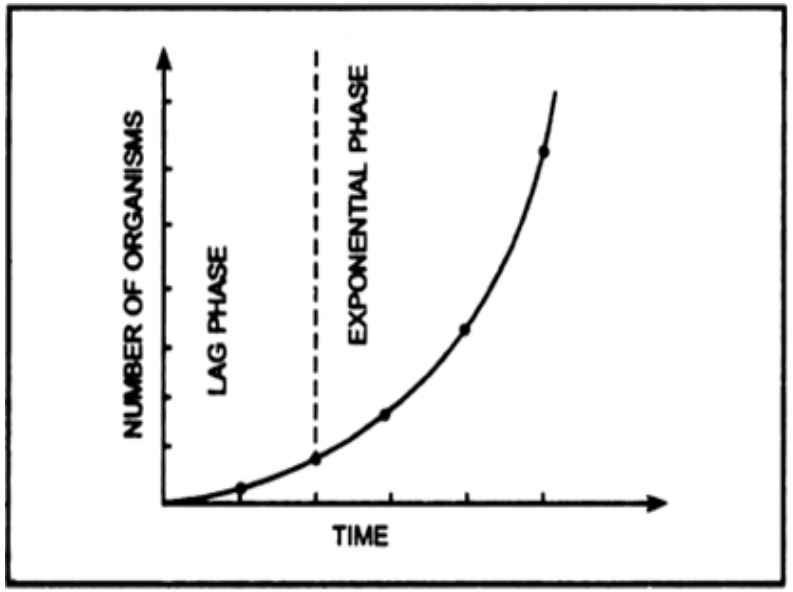
Stationary (Plateau) phase : Finally, growth rate becomes stable because mortality and natality rates become equal to each other. So, **there is zero growth rate**. A stable population is said to be in equilibrium, or at saturation level.

This limit in population is a constant (K) and is imposed by the carrying capacity of the environment.

13.2.2. Population Growth

(B) J-shaped Growth curve

This type of population growth is also called Verhulst Pearl Logistic growth.



- **It has only two phases :-**
- **Lag phase :** It is period of adaptation of animals to new environment so and thus, is characterized by slow or no growth in population.
- **Logarithmic or Exponential phase :** It is characterized by rapid growth in a population which continues till enough food is available.
- The sudden increase in mortality is called **population crash**. Lemming of tundra, some insect, algal blooms and annual plants also show J-shaped curves.
- The population growth curve is S-shaped in most of the organisms.
- Human population also shows S-shaped curve.

13.2.2. Population Growth

Equation for exponential growth can be

$$\frac{dN}{dt} = (b-d) \times N$$

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

$$\frac{dN}{dt} = rN \text{ or } N_t = N_0 e^{rt}$$

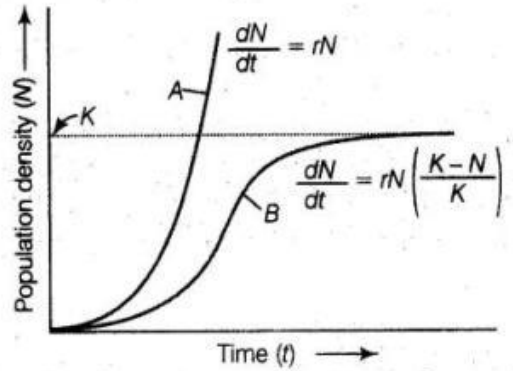
Where, N = Population size, N_t = Population density after time t

N_0 = Population density at time zero,

r = Intrinsic rate of natural increase

e = Base of natural logarithms (2.71828), b = Birth rate and

d = Death rate



Population growth curve *A* when responses are not limiting the growth, plot is exponential, *B* when responses are limiting the growth,plot is logistic, *K* is carrying capacity

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Change in population size during time interval

= (Birth + **Immigration** during time interval) – (Death + **Emigration** during time interval)

The above expression in words may be represented in a simple way by a mathematical model.

Suppose, N = population size and t = time. The Greek letter delta, (Δ), indicates change. We can now represent change in population as ΔN, and time interval as Δt.

The verbal equation can be written as

ΔN/ Δt = (B + I) – (D + E) in which, B = absolute number of births in the population during the time interval, D = the absolute number of deaths during that interval;

I = immigrants and E = emigrants.

I and E , being insignificant, may be ignored. Then the equation simplifies to

ΔN/ Δt =B – D.

THANK YOU

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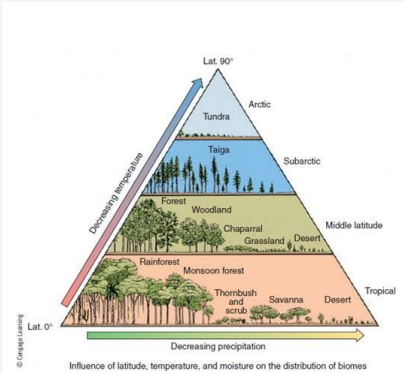

Influence of latitude, temperature, and moisture on the distribution of biomes