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ATTRIBUTES OF POPULATION

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Population Attributes:

A population has certain attributes that an individual organism does not have.

Some of them are given below:

(i) Population Size or Density:

It is the number of individuals of a species per unit area or volume.

$$\text{Population Density (PD)} = \frac{\text{Number of individuals in a region (N)}}{\text{Number of unit area in the region (S)}} \quad \text{PD} = \frac{N}{S}$$

(ii) Birth Rate (Natality):

It is the rate of production (birth rate) of new individuals per unit of population per unit time. For example, if in a pond, there are 20 lotus plants last year and through reproduction, 8 new plants are added, taking the current population to 28. Then, birth rate = 8/20 = 0.4 offspring per lotus per year.

(iii) Death Rate (Mortality):

It is the rate of loss of individuals (death rate) per unit time due to death or due to the different environmental changes, competition, predation, etc. For example, if individuals in a laboratory population of 40 fruit flies 4 died during a specified time interval. Then, the death rate = 4/40 = 0.1 individuals per fruit fly per week.

(iv) Sex Ratio:

An individual is either a male or a female but a population has a sex ratio such as 60% of the population are females and 40% are males. Thus, ecologists measure the number of males and females within a population to construct a sex ratio, which can help researchers predict population growth or decline. Much like population size, sex ratio is a simple concept with major implications for population dynamics. For example, stable populations may maintain a 1:1 sex ratio and therefore keep their growth rate constant, whereas declining populations may develop a 3:1 sex ratio favoring females, resulting in an increased growth rate.

Age Pyramid:

Population at any given time is composed of individuals of different ages. When the age distribution (per cent individuals of a given age or age group) is plotted for the population, this is called age pyramid.

The age pyramids of human population generally shows the age distribution of males and females in a combined diagram.

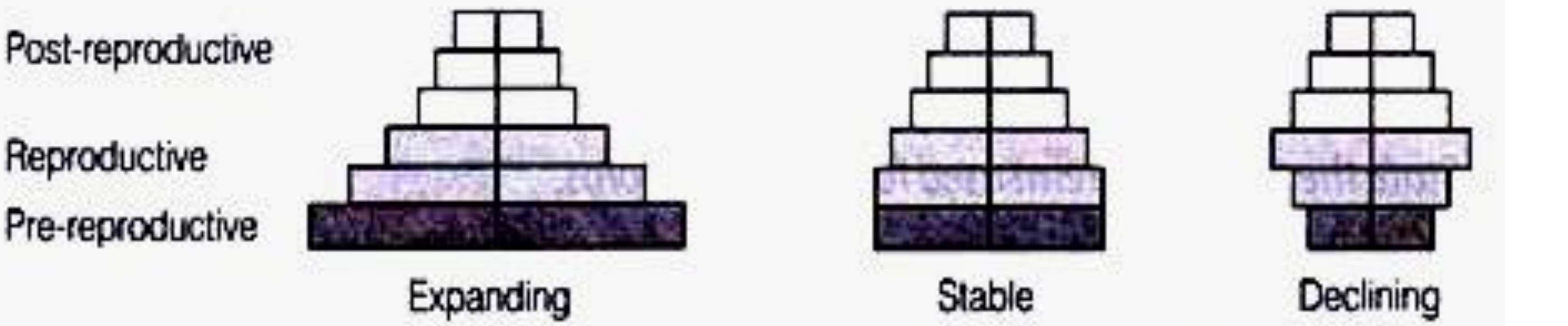
The growth status of the population is reflected by the shape of the pyramids.

That whether it is:

(i) Growing Expanding

(ii) Stable

(iii) Declining.



Representation of age pyramids for human population

Population Growth:

The size of a population for any species is not a static parameter, it keeps changing with time.

It depends on the following factors:

(i) Food availability

(ii) Predation pressure

(iii) Weather

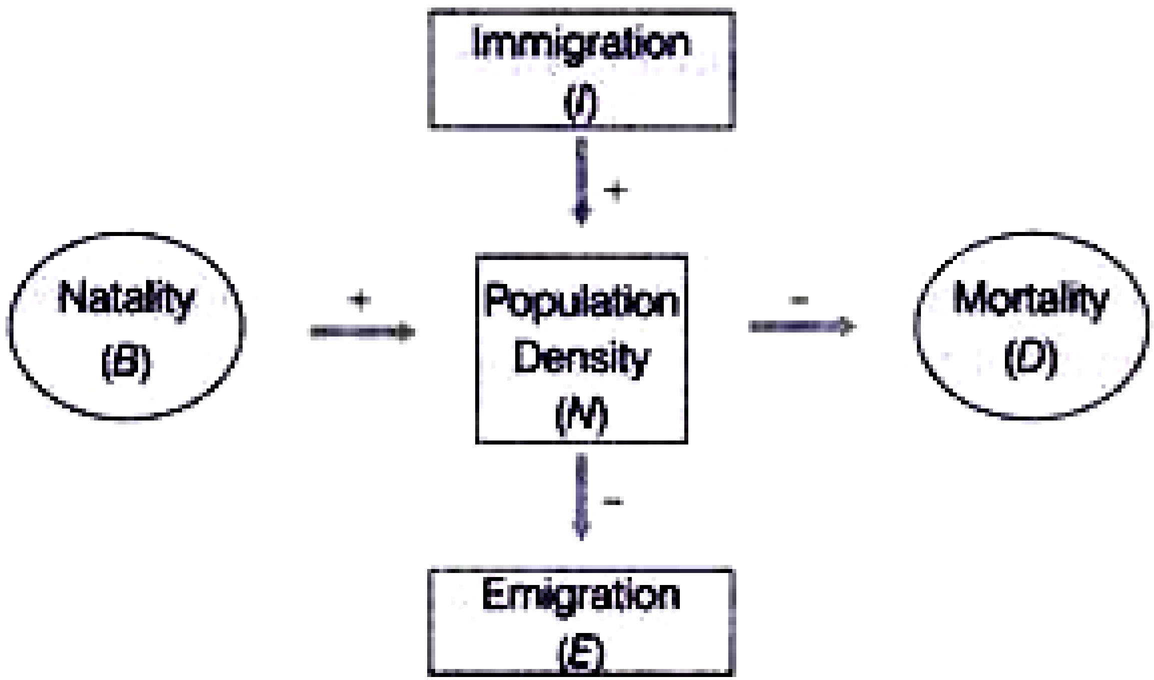
The density of a population in a given habitat during a given period, fluctuates due to the four basic processes:

(a) Natality refers to the number of births during a given period in the population that are added to initial density.

(b) Mortality is the number of deaths in the population during a given period.

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

(d) Emigration is the number of individuals of population who left the habitat and moved elsewhere during a given period of time.



Factors influencing population density

Out of these four, natality and immigration contribute an increase in population density while mortality and emigration contribute to the decrease in population density.

So, if N is the population density at time t, then its density at time t +1 is

$N_{t+1} = N_t + [(B + I) – (D + E)]$

Where, N = Population density

t = Time,

B = Birth rate,

I = Immigration,

D = Death rate,

E = Emigration

From the above equations, we can see that population density will increase if, (B + I) is more than (D + E).

Growth Models:

Studying about the behaviour and pattern of different animals can help us to learn a lesson on how to control the human population growth.

There are following two models of population growth:

Exponential Growth:

Availability of resources (food and space) is essential for the growth of population. The unlimited availability results in population exponential. The increase or decrease in population density (N) at a unit time period (t) is calculated as (dN/dt)

Let dN/dt = (b – d) X N

Let (b-d) = r, then, dN/dt = rN

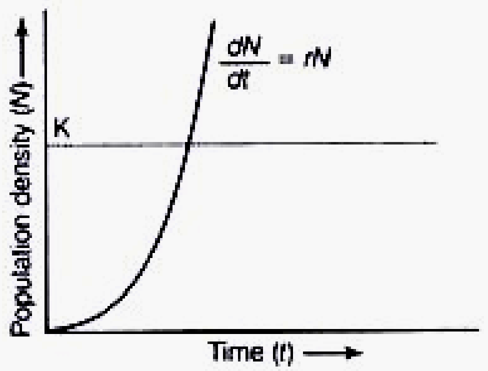
Where, N is population size, b is birth per capita

d is death per capita, t is time period

and r is intrinsic rate of natural increase.

r, is an important parameter that assess the effects of biotic and abiotic factors on population growth. It is different for different organisms.

It is 0.015 for Norway rat and 0.12 for flour beetle. The above equation results in J-shaped curve as shown in graph.



Population growth curve showing exponential growth

Integral form of exponential growth is $N_t = N_0 ert$

Where,

N_t = Population density after time t,

N_0 = Population density at time zero (beginning),

r = Intrinsic rate of natural increase,

e = Base of natural logarithms (2.71828).

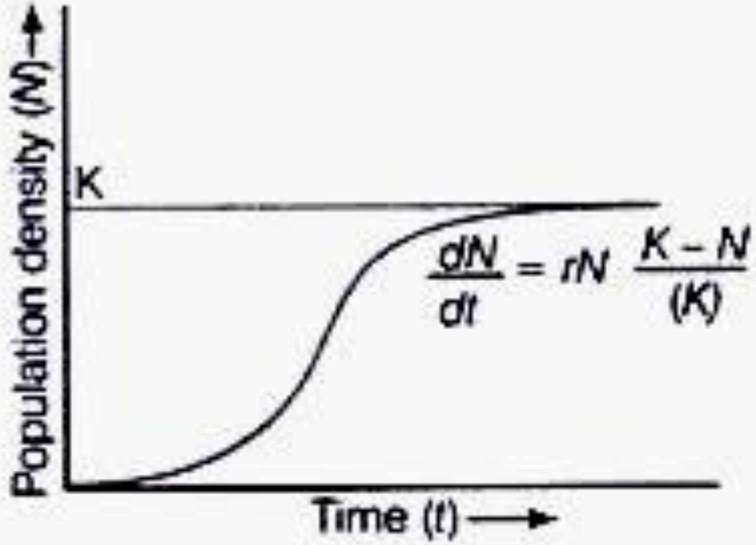
Any species growing exponentially under unlimited resource conditions, without any checks can reach enormous population densities in a short time.

Logistic Growth:

Practically, no population of any species in nature has unlimited resources at its disposal. This leads to competition among the individuals and the survival of the fittest. Therefore, a given habitat has enough resources to support a maximum possible number, beyond which no further growth is possible.

This is called the **carrying capacity (K)** for that species in that habitat. When N is plotted in relation to time t, the logistic growth show sigmoid curve and is also called **Verhulst-Pearl Logistic Growth** and is calculated as

$dN/dt = rN\ (K - N/K)$



Population growth curve showing logistic growth

Where, N is population density at time t K is carrying capacity and r is intrinsic rate of natural increase.

This model is more realistic in nature because no population growth can sustain exponential growth indefinitely as there will be completion for the basic needs.

Human population growth curve will become S-shaped, if efforts are being made throughout the world to reduce the rate of population growth and make it stationary.

Note: Human population growth curve is not J-shaped.

Life History Variations:

Darwinian fitness (high 'r' value) states that the population evolve to maximise their reproductive fitness in the habitat where they live. Under particular set of selection pressures, organisms evolve towards the most efficient reproductive strategy.

The rate of breeding varies from species to species:

a. Some species breed only once in their life time (Pacific salmon fish and bamboo), while some breed many times in their life time (birds and mammals).

b. Some produce large number of small sized offsprings (oysters), whereas other produce small number of large sized offsprings (birds and mammals).

c. Life history traits of organisms have evolved in relation to the constraints imposed by the biotic and abiotic components of habitats in which they live.

THANK YOU