

Topic 1

1. A population has some attributes which are not shown by its individual members. An individual born and dies, whereas the population has a birth rate (natality) and a death rate (mortality). Each population has certain characteristics, such as age distribution, genetic composition, growth models. An individual is either male or female but a population has a sex ratio.

2. The intrinsic rate of natural increase (r) can be calculated by the following exponential growth equation:

$$N_t = N_0 e^{rt} \quad \dots(i)$$

$$\left. \begin{array}{l} \text{Where, } N_t = 2x \\ N_0 = x \\ t = 3 \end{array} \right\} \text{given}$$

\therefore From equation (i)

$$\ln N_t = \ln N_0 + \ln e^{rt} \quad (\text{taking natural log})$$

$$= \ln N_0 + rt \ln e$$

$$= \ln N_0 + rt \quad (\ln e = 1)$$

$$\text{or } r = \frac{\ln N_t - \ln N_0}{t}$$

$$\text{or } r = \frac{\ln N_t / N_0}{t}, \text{ or } rt = 2.303 \log \frac{2x}{x}$$

$$\left(\because \ln \frac{2x}{x} = 2.303 \log_{10} \frac{2x}{x} \right)$$

$$\text{or } r = \frac{2.303 \times .301}{3} = \frac{0.6931}{3} = 0.231$$

or 23.1%

3. Population is the group of individuals of a same species, capable of interbreeding among themselves found in a geographical area. *E.g.*, all the frogs identified as *Rana tigrina* living in a given pond constitute a population. Similarly, all water hyacinth plants (*Eichhornia*) growing in that pond form another population. Organisms of the same kind may form several populations inhabiting different geographical areas. Group of populations belonging to several different species that live together in the same area or habitat and interact through competition, predation, mutualism, etc., comprises a biotic community. Communities are named after one of

their dominant species (*e.g.*, a pine community) or the major physical characteristics of the area (*e.g.*, a freshwater pond community). A biotic community has three subunits; animal community, plant community and microbial community.

4. Logistic population growth curve or S-shaped or sigmoid growth curve is shown by the populations of most organisms. It has following phases : lag phase, log phase, exponential phase and stationary phase. In lag phase there is little or no increase in population. In log phase increase in population starts and occurs at a slow rate in the beginning. During exponential phase, increase in population becomes rapid and soon attains its full potential rate. This is due to the constant environment, availability of food and other requirements of life in plenty, absence of predation and interspecific competition and no serious intraspecific competition so that the curve rises steeply upward. The growth rate finally slows down as environmental resistance increases.

Finally, the population becomes stable during the stationary phase because now the number of new cells produced almost equals to the number of cells that die. Every population tends to reach a number at which it becomes stabilised with the resources of its environment. 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.

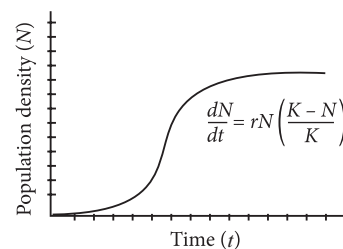
The sigmoid growth form is represented by the following equation :

$$\frac{dN}{dt} = rN \left(\frac{K-N}{K} \right) = rN \left(1 - \frac{N}{K} \right)$$

where $\frac{dN}{dt}$ = rate of change in population size

r = intrinsic rate of natural increase

N = population density at time t ; K = carrying capacity.



5. The three important characteristics of a population are:
- Birth and death rate
 - Age structure
 - Sex ratio

(i) The birth rate (natality) of a population refers to the average number of young ones produced per unit time (usually per year). In the case of humans, it is commonly expressed as the number of births per 1,000 individuals in the population per year.

The death rate (mortality) of a population 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 1,000 persons in a population per year.

(ii) The age structure of a population is the percentage of individuals of different ages such as young, adult and old. Age structure is shown by organisms in which individuals of more than one generation coexist. The ratio of various age groups in a population determines the current reproductive status of the population. It also indicates what may be expected in the future. Population is divided into three age groups; pre-reproductive, reproductive and post-reproductive.

(iii) The sex ratio of a population refers to the number of females per thousand male individuals. There were 933 females per 1,000 males in our country in 2001 census. The number of females in a population is very important as it is often directly related to the number of births. The number of males may be less significant because in many species a single male can mate with several females.

Topic 2

1. An orchid growing as an epiphyte on a branch of mango tree is an example of commensalism. Commensalism is the relationship between individuals of two species of which one is benefited and the other is almost unaffected, *i.e.*, neither benefited nor harmed. A commensal may get shelter (protection), or ride, or support instead of or in addition to food. Epiphytes are space parasites, they use trees only for attachment and manufacture their own food by photosynthesis. In *Vanda*, an epiphytic orchid, a special kind of aerial roots (hanging roots) hang freely in the air and absorb moisture with the help of their special absorptive tissue called velamen.

2. Biological control of pests is largely based on predator - prey relation. Baculoviruses (mostly of genus *Nucleopolyhedrovirus*) are useful in controlling many insects and other arthropods. Aphids and other pests are kept under check by beetles (*e.g.*, *Coccinella* or lady bird beetle). Fish *Gambusia* is introduced in ponds to check growth of mosquito

larvae. Biological control methods adopted in agricultural pest control are based on prey regulating ability of the predator.

3. (a) Commensalism is the interaction between two living individuals of different species in which one is benefited while the other is neither harmed nor benefited except to a negligible extent. Example, the pilot fish always accompanies shark without getting attached to its body. It feeds on falling pieces of food when the shark is eating the prey.

(b) Parasitism is an interaction between two living organisms of different species in which one organism called parasite obtains its food directly from another living organism called host. The parasite spends a part or whole of its life on or in the body of the host. Thus it is an interaction between two individuals wherein the parasite gets the benefit at the expense of the host. *E.g.*, *Ascaris*

(c) Camouflage (Cryptic appearance) is the ability to blend with the surrounding or background. It is the most common type of adaptation by animals to remain unnoticed for protection or aggression. Camouflage is protective to animals which are preyed upon by others. It is advantageous in predation for predators like praying mantis (*Mantis religiosa*) which are green coloured, resembling a thin stem and remain unnoticed till the prey comes within their striking range.

(d) Mutualism is an interaction between two species in which both species get benefited. (The term symbiosis is often used synonymously with mutualism.) A well-known example of mutualism is the association between termites and the specialised protozoans that inhabit their guts. The protozoans, unlike the termites, are able to digest the cellulose of the wood that the termites eat and release sugars that the termites absorb. The termites benefit by being able to use wood as a foodstuff, while the protozoans are supplied with food and a suitable environment.

(e) In interspecific competition two or more populations usually belonging to the same trophic level or feeding habit compete with one another for the available natural resources. For example, in a forest area trees, shrubs, herbs and vines compete with one another for sunlight, nutrients, water, pollinators and dispersal agents.

4. (d) : Parasitism is an association of two organisms of different sizes and species in which one is benefited and the other is harmed. The organism which is benefited is called parasite, and the organism that suffers is termed host. The parasite is weaker and smaller than host and gets nourishment and often shelter also from the host. The host can live without the parasite, but the parasite cannot survive without the host.

