POPULATION ECOLOGY

The term population has its origin in the Latin word *populus*, meaning people. In ecology, a **population** may be defined as a group of organisms of the same species occupying a particular space. Thus, we may speak of the deer population of Corbett National Park, the deer population of Kaziranga Wild Life Sanctuary, the human population of Delhi, or the human population of India. The ultimate constituents of the population are **individual organisms** that can potentially interbreed. The populations may be subdivided into **demes** or local populations, which are groups of interbreeding organisms, the smallest collective unit of a plant or animal population. Individuals in demes, thus, share a common gene pool. The boundaries of a population both in space and in time are vague and in practice are usually fixed arbitrarily by the investigator.

Some ecologists recognized following two types of populations: 1. **Monospecific population** is the population of individuals of only one species; and 2. **Mixed** or **polyspecific population** is the population of individuals of more than one species. Often ecologists use the term **community** for polyspecific population.

The population has various **group characteristics**, which are statistical measures that cannot be applied to individuals. These group characteristics are of three general types. The basic characteristic of a population is its **size** or **density** which is affected by four primary population parameters such as **natality** (births), **mortality** (deaths), **immigration** and **emigration** (Fig. 6.1). In addition to these at- tributes, one can derive secondary characteristics of a population, such as its **age distribution**, **genetic composition**, and **pattern of distribution** (distribution of individuals in space). These population parameters result from a summation of individual characteristics. Thus, group attributes of population are different from those of an individual, for instance an individual cannot have a density, it cannot have a rate of birth or death, although it occupies a place, is born and dies. The group attributes of a population with respect to rates of birth, death, reproduction, etc., form the science of **demography**. However, when they are studied from a ecological point of view, this forms a **population ecology** or **democology**. In other words, population ecology is the study of individuals of the same species where the processes such as aggregation, interdependence between individuals, etc., and the various factors governing such processes are emphasized.

The ecological study of populations include the following three main aspects:

1. Population characteristics;
2. Population dynamics;
3. Regulation of population.

POPULATION CHARACTERISTICS

Ecologists use various terms when understanding and discussing populations of organisms. A population is all of one kind of species residing in a particular location. *Population size* represents the total number of individuals in a habitat. *Population density* refers to how many individuals reside in a particular area.

Population Size is represented by the letter N, and it equals the total number of individuals in a population. The larger a population is, the greater its generic variation and therefore its potential for long-term survival. Increased population size can, however, lead to other issues, such as overuse of resources leading to a population crash.

Population Density refers to the number of individuals in a particular area. A low-density area would have more organisms spread out. High-density areas would have more individuals living closer together, leading to greater resource competition.
Population Dispersion: Yields helpful information about how species interact with each other. Researchers can learn more about populations by studying they way they are distributed or dispersed.
Population distribution describes how individuals of a species are spread out, whether they live in close proximity to each other or far apart, or clustered into groups.

- *Uniform dispersion* refers to organisms that live in a specific territory. One example would be penguins. Penguins live in territories, and within those territories the birds space themselves out relatively uniformly.
- *Random dispersion* refers to the spread of individuals such as wind-dispersed seeds, which fall randomly after traveling.

Clustered or clumped dispersion refers to a straight drop of seeds to the ground, rather than being carried, or to groups of animals living together, such as herds or schools. Schools of fish exhibit this manner of dispersion.

POPULATION DYNAMICS

Populations have characteristic pattern of increase which are called **population growth forms**. Such growth forms represent the interaction of biotic potential and environmental resistance. The study of population dynamics is done by three approaches (1) mathematical models, (2) laboratory studies and (3) field studies.
The growth is the most fundamental dynamic feature that a species population displays. Populations characteristically increase in size in a sigmoid, S-shaped or logistic fashion. When a few organisms are introduced into an unoccupied area, the growth of the population is at first slow (**positive acceleration phase**), then becomes very rapid (**logarithmic phase**) and finally slows down as the environmental resistance increases (**the negative acceleration phase**) until an equilibrium level is reached around which the population size fluctuates more or less irregularly according to the constancy or variability of given environment. The level beyond which no major increase can occur represents the saturation level or **carrying capacity**. The carrying capacity or equilibrium density is represented by the letter **K**. It is often useful to define the maximum rate of growth of the population. This parameter, generally termed the **intrinsic rate of natural increase**, is symbolized **r0** and represents the growth rate of a population that is infinitely small. Accordingly such type of population growth can be described by following **logistic equation** : $dN/dt = r0\ N\ (K - N)\ /K$
Where, $r0$ = innate capacity of population to increase (birth rate without resource limitation), N= population size and K = highest population density that can be maintained in real environment, *i.e.,* at carrying capacity.
There are two main types of population growth forms. (1) J-shaped and (2) S- shaped or sigmoid forms (Fig. 6.8). The growth forms are due to the nature of species and prevailing environmental conditions. In **J-shaped curve** there is a rapid increase in density with the passage of time (called **exponential growth**). The density values when plotted against time give a J-shaped growth curve and at the peak the population growth ceases abruptly due to environmental resistance. For example, the population growth curve in human populations and growth of yeast, *Drosophila* and rabbit under laboratory conditions show an initial slow rate and then it accelerates and finally slows giving the growth curve which is **sigmoid** or **S-shape**. The peak constant level

represented by *K* or upper level (called **asymptote**) of the sigmoid curve is called the **maximum carrying capacity**. It marks the limit to which the environment can support the population.

POPULATION ECOLOGY AND EVOLUTION

Population parameters have been used by population ecologists to draw conclusions about evolution of species:

r - selection and k - selection. In this regard an important synthesis was done by **MacArthur** and **Wilson** (1967) who declared that populations are outcome or *r*- or *k*-selection. The **r-selected** populations have a high intrinsic rate of growth (*r*) and tend to "boom" when environmental conditions are favourable and "best" when these conditions deteriorate. In consequence, they show great fluctuations in density, and incidentally have the potential for large genetic change through the founder effect. The **k-selected populations** have relatively constant density at or near the carrying capacity (*K*) of the environment.