Population Growth and Dynamics

Population Growth and Dynamics

Population Growth

A population can be defined as the group of organisms of the same species which is occupying a particular area or space. The population of an area has six characteristics namely population size and density, dispersion, age structure, natality, mortality, and fluctuations. The increase in the number of species in a particular fashion can be termed population growth form. The growth in population shows the interaction of the biotic potential and environmental resistance that the species may show. The growth of the population can be divided into two types, exponential growth, and logistic growth. Population growth is an ever-changing entity, it may increase or decrease and may even remain constant. This change in the population over a period of time gives us the growth rate as shown in the equation below.

$$\frac{dN}{dT} = rN$$

Where, N – number of organisms, T – time, and r - per capita rate of increase

1. Exponential growth

Exponential growth is seen in a population when *r*, which is the per capita rate of increase, is always positive and constant. In exponential growth, the *r* is represented as r_{max}, which is the per capita rate of increase, is maximum under ideal conditions that is an unlimited source of resources and no competition. The graph seen is "J" shaped. The maximum growth rate for a species is called its biotic potential.

$$\frac{dN}{dT} = r_{max}N$$

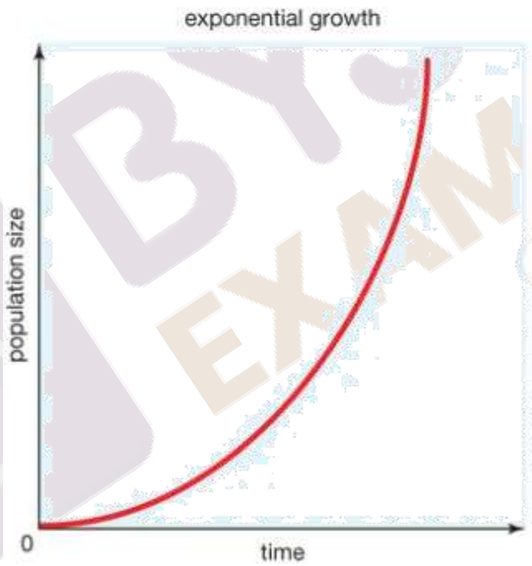

Figure 1. Graph of a population showing exponential growth, J-shaped curve

2. Logistic growth

When a population initially grows exponentially as there are fewer individuals and more resources available in hand. But as the growth continues the number of individual increase and the resource availability decreases this leads to stagnation in the growth and an S-shaped curve is formed. The population has reached the carrying capacity (K), which is the number of individuals an environment can support. Logistic growth is when the per capita growth decreases as the population reaches maximum due to limitations imposed by resources i.e. the carrying capacity of the environment.

$$\frac{dN}{dT} = r_{max}\frac{(K-N)}{K}N$$

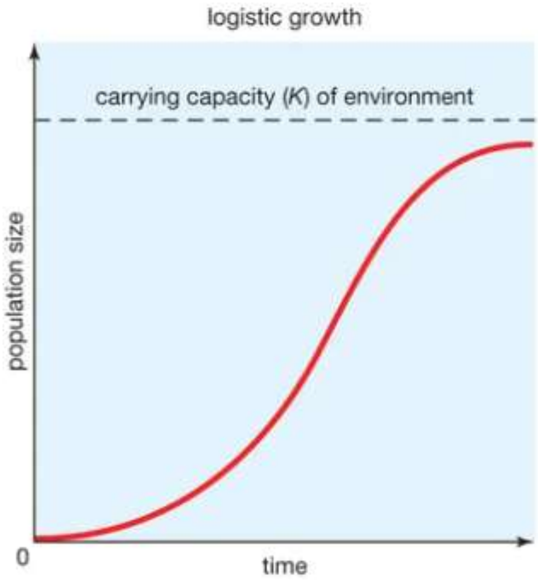

Figure 2. Graph of a logistic growth of population, S-shaped curve

Population regulation

1. Density-dependent factors – When the effect on the population growth is a function of density of the population, it is called density-dependent factors. Also known as the regulating factors that include competition, predator-prey interaction, disease, etc.
2. Density-independent factors – When the effect on the population growth is irrespective of the size of the population, it is known as density-independent factors. Also known as the limiting factors that include sudden changes in temperature, storms, fires, etc. These factors do not take into consideration the size of the population.

R -strategists

The R-strategist are the ones that live near the *r* that is the line of exponential growth. These organisms grow under unstable conditions, so the priority to keep the population surviving is to keep multiplying it. The characteristic of R-strategists is they breed more than once in their lives and produce multiple off-springs at one birth to increase the chance of survival, these have a very high infant mortality rate. The size of the individuals is usually small and they have minimum parental care.

K -strategists

The K-strategists are the ones that live near the carrying capacity (*k*) of the population growth curve. These organisms survive under stable conditions. They have very limited resources; the population has reached a stable size and excess growth in the population will lead to the death of the entire population as there will be no resources to support them. The characteristics seen in K-strategists include occasional breeding, longer gestational period, giving birth to one or two off-springs at a time, the off-springs take a very long period of time to grow and require parental supervision.

Concept of Metapopulation

Metapopulation term was coined by Richard Levins, in 1970, to define the population of populations. This can be described as the local population in a large area where there is migration between individuals of the population. A metapopulation is formed due to extinction and recolonization amongst species. Metapopulations are composed of discrete subpopulations. The structure of the metapopulation can be described as the network of patches that is occupied by a metapopulation, these patches are spread over an area and there is migration between the patches.

Types of metapopulation

1. Classical metapopulation model - This model is also known as the Levins metapopulation model. It is a large network of populations that has the same dynamics, the interaction between the individual in a patch is very high compared to inter-patch interaction. The change of extinction and recolonization is also high.
2. Patchy metapopulation model - Populations present in patches and the patches are interconnected through individual migration. A patch may go extinct but others can recolonize the empty patch.

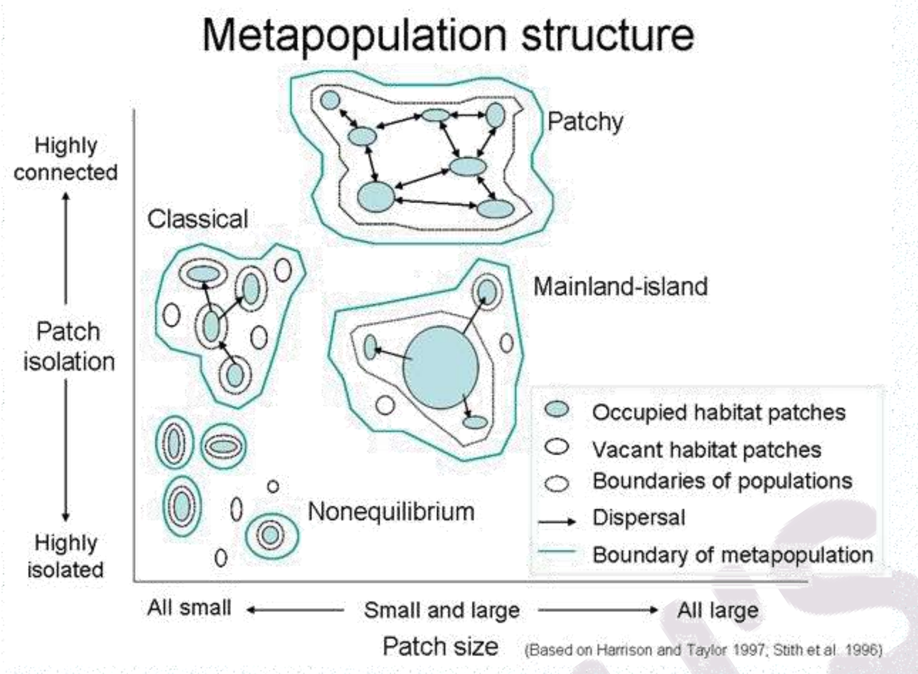

Figure 3. Structure of metapopulations

3. Non-equilibrium model - These are independent patches and do not have any migration. Here divergent evolution takes place. The vacant patches are never recolonized and this is not considered a working metapopulation.
4. Mainland-island population model - Large population consisting of the island population. The large population is the source and the island population is the sink.