

PUC Ist year - Semester – II

Unit VI. Ecology and Environment

Module No: 31. Population Ecology

A population is generally a group of individuals of a particular species occupying a particular area at a specific time. A population is self regulating system. Population Ecology is the study of individuals of the same species where the processes as aggregation, inter dependencies between individuals etc. and the various factors governing such processes are emphasized. The size of specific populations and their various characteristics are determined by their interactions with their physico-chemical environment and with other populations.

The various characteristics of a population are as follows:

- 1. Population Density:** Population density can be defined as the number of individuals per unit area or per unit volume.

For example 300 trees per hectare of land. Population density can easily be found out by using density formula as follows:

$$D = \frac{n/a}{t}$$

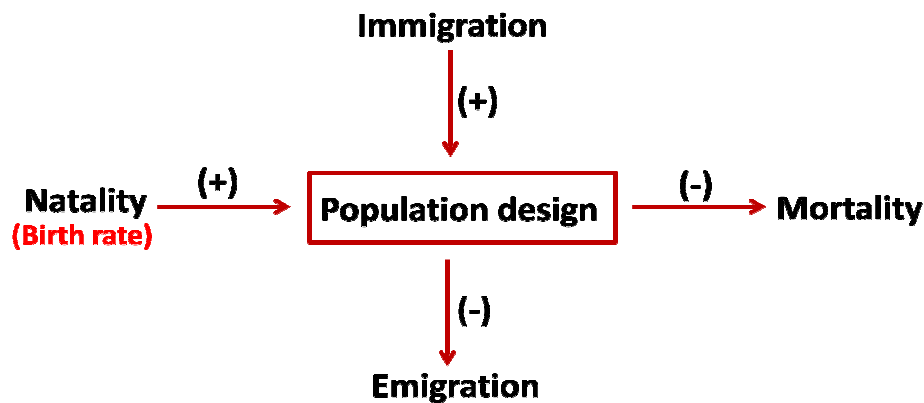
Where 'D' stands for Density

'n' stands for number of individuals

'a' stands for area and

't' stands for time unit

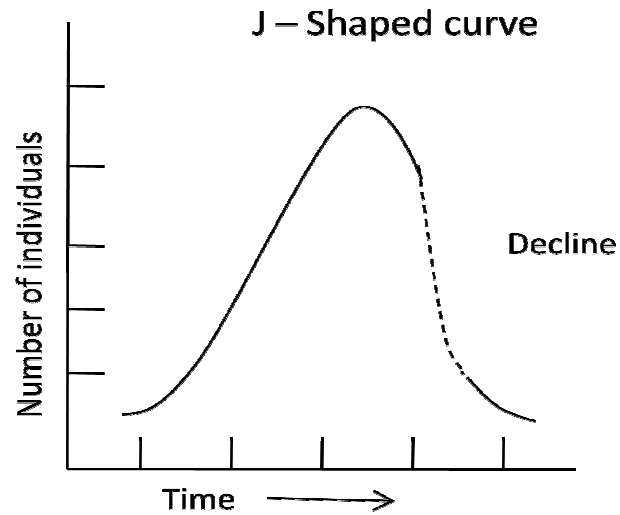
The density of population is influenced by reproductive rate, birth rate, death rate of population, emigration, immigration, migration and on certain environmental factors. The density may change with season, weather conditions, food supply etc.



2. Population Growth: The increase in the size of population is called population growth. Population growth refers to the total number of increase in the organisms occupying a certain area. The growth of a population in an area is affected by births, deaths and movement of organisms into and away from the population.

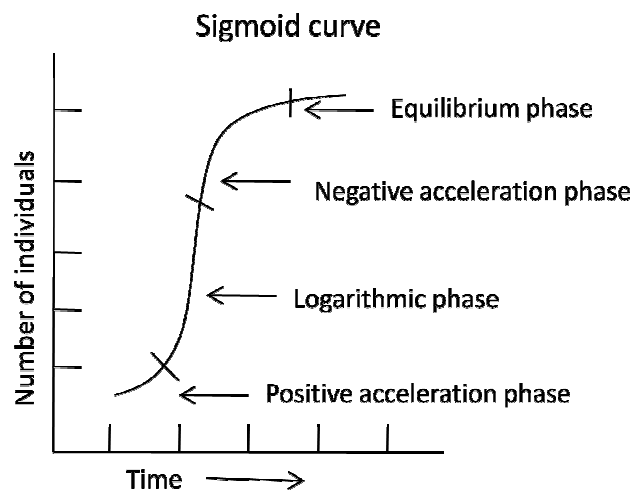
3. Growth Curves: When the increase in the number of animals is plotted against time factor, a curve is obtained called the Growth curve. The pattern of growth is different for different populations. Mainly, two types of growth curves are obtained, they are (1) J – shaped growth curve and (2) S – shaped growth curve or Sigmoid growth curve.

J – Shaped growth curve:



This is obtained when the density of the organisms increases rapidly in compound interest fashion and then stops abruptly as environmental resistance or other limits become effective more or less suddenly. This type of growth pattern gives a 'J' shaped curve. Certain insects like Thrips in roses, Algal bloom, locust etc show J – shaped curve.

S – Shaped Growth curve:



The growth of population always follows this type of curve. In the sigmoid form of growth pattern, the population after occupying a favorable

area increases slowly at first (Positive acceleration phase), then more rapidly (the logarithmic phase), and then the rate first declines quickly (Negative acceleration phase) and then gradually to zero as the environmental resistance increases (equilibrium phase). The upper level beyond which no major increase can occur. Since the number cannot increase further it is apparent that the environment can support only this number and the limitation of the environment is referred to as its carrying capacity. At the equilibrium phase the birth rate (Natality) is balanced by the death rate (Mortality). This type of growth pattern is seen more frequently as in yeast cells grown in laboratory and in human population.

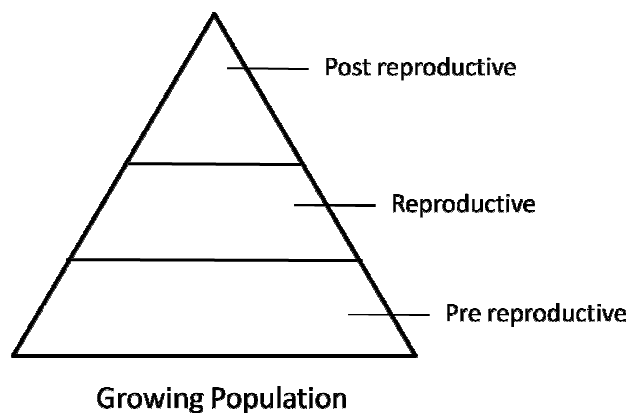
4. **Carrying Capacity:** The carrying capacity may be defined as the maximum number of individuals of species that can be supported in a habitat at a given time. Once a population reaches at the carrying capacity, it fluctuates around it. Every organism requires a definite space or definite area and can support a definite number of organisms.
5. **Biotic Potential:** Biotic potential or reproductive potential of a population is the potential ability of inherent power of a population to increase in number when the age distribution in the population is stable and all the environmental conditions are optimum. The biotic potential is far more from what is actually observed performance of a population. The environmental factors such as Climate, population density, competition, enemies, disease, mortality rate, natality rate, scarcity of food etc. provide environmental resistance and check the reproductive potential and increase in the size of population.
6. **Factors affecting Population Growth:** No animal population increases indefinitely. Its number is influenced by some factors outside the population it self or by some factors acting with the population, the former

are termed as density independent factors and the latter density dependent factors.

The limiting effects of space, weather, and food are considered to be the density – Independent factors. The density – dependent factors that have a stabilizing effect on population size are competition, reproductivity, predation, emigration, disease, territoriality, social dominance and hierarchy, home range, endocrine balance and cycles.

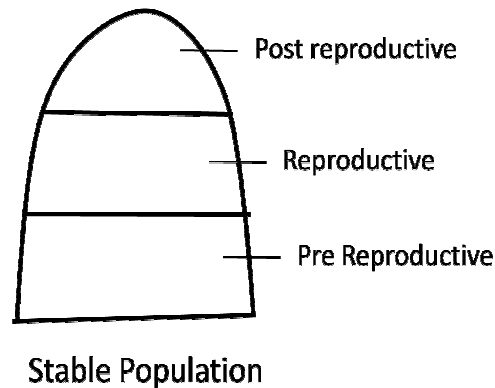
- 7. Pyramids of Age:** In a population, three ecological ages or age groups have recognized namely (1) Pre reproductive (2) Reproductive and (3) Post reproductive.

Age distribution in a population may be represented by arranging the data in the form of age pyramids. A growing population has a very large percentage of young individuals and has relatively few old ones. This is because the birth rate is high since the multiplication is very rapid many more young individuals are there in place of few who die and thus a pyramid shaped age structure is developed as in the case of bacteria, yeast, paramecium, housefly etc.

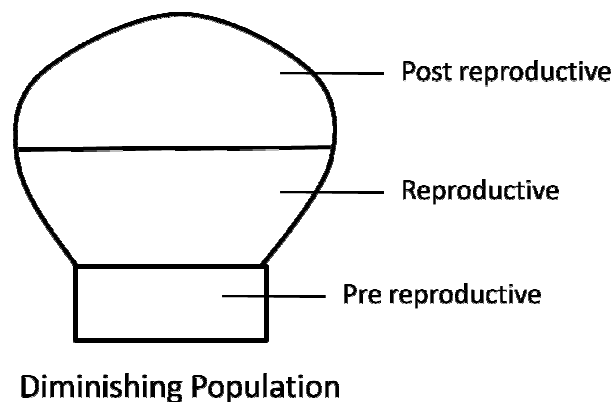


In a stable population, the proportion of pre reproductive and reproductive individuals is approximately equal while the post reproductive

individuals are relatively less in number. The age structure of such a population is represented by a bell shaped structure.



In a diminishing population the birth rate is very low so that the individuals in the pre reproductive group are relatively less than those of the reproductive or post reproductive group. Such age structure can be represented by an Urn shaped structure.



Glossary:

Immigration: is the number of individuals of the same species that have come into the habitat from else where 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.

Check Points:

- A population is self regulating system.

$$D = \frac{n/a}{t}$$

- Density of the population is determined by
- Increase in the size of population is called population growth.
- Two types of growth curves can be obtained. They are J-shaped curve and S-shaped curve.
- Most of the population follow S-shaped curve.
- The ability to reproduce at a certain rate is called biotic potential.
- Density dependent and Density independent factors affect growth of population.
- Pre reproductive, Reproductive and post reproductive age groups are present in a population.

Short answer questions:

1. Describe population density
2. What is Biotic potential
3. Explain population growth curves
4. Describe age pyramids
5. What are the factors that affect population growth?

Long answer questions:

1. Describe the various characteristics of a population, and what factors affect population growth.

MCQ:

1. The increase in the size of population is called

A. Population Density
B. Population Growth
C. Biotic Potential

D. Carrying capacity
2. The birthrate is otherwise called

A. Mortality
B. Natality
C. Biotic potential
D. Reproductive potential

3. The maximum number of individuals of species that can be supported in a habitat at a given time is called
- A. Population Density B. Population Growth **C. Carrying capacity** D. Biotic potential
4. The density - dependent factors affecting population growth includes
- A. Competition B. Predation and diseases C. Emigration **D. All**
5. Ecological age groups found in a population
- A. Pre reproductive B. Reproductive C. Post reproductive **D. All**
6. In a growing population
- A. Large percentage of young individuals are present
- B. Birth rate is very high
- C. Few old individuals are present
- D. All**
7. Pyramid shaped age structure can be seen in
- A. Growing population**
- B. Stable population
- C. Diminishing population
- D. None of the above
8. The proportion of Pre-reproductive and reproductive individuals is approximately equal in
- A. Growing population
- B. Stable population**
- C. Diminishing population
- D. All
9. Urn shaped age structure can be seen in
- A. Growing population
- B. Stable population

C. Diminishing population

D. None of the above

10. The number of individuals per unit area or per unit volume is called

A. Population Density

B. Population Growth

C. Growth rate

D. Carrying capacity