Population Ecology

Population: A population is a group of individuals of a same species present in a particular geographical area and functioning as a unit of the biotic community.

Ex: All individuals of deer in a forest,

all individuals of rabbits in a forest

Population Characteristics

1. Density
2. Birth Rate or Natality
3. Death Rate or Mortality
4. Dispersion
5. Growth rate or Growth form
6. Dispersal
7. Age distribution

1. Density: The number of individuals of a population per unit area

2. Natality:

- Natality is the ability of individuals of a Population to produce new individuals.
- There are two types of natality;
  - 1. **Absolute natality** is the birth rate in a population where maximum reproduction occurs under ideal environmental conditions. It is constant for a given population.
  - 2. **Ecological or realized natality** is the population increase under a given set of environmental conditions. This varies from population to population as size, density, age distribution, the resources, biotic community, and abiotic factors change between the populations.
- Natality is generally expressed as a rate defined by number of births per unit time.

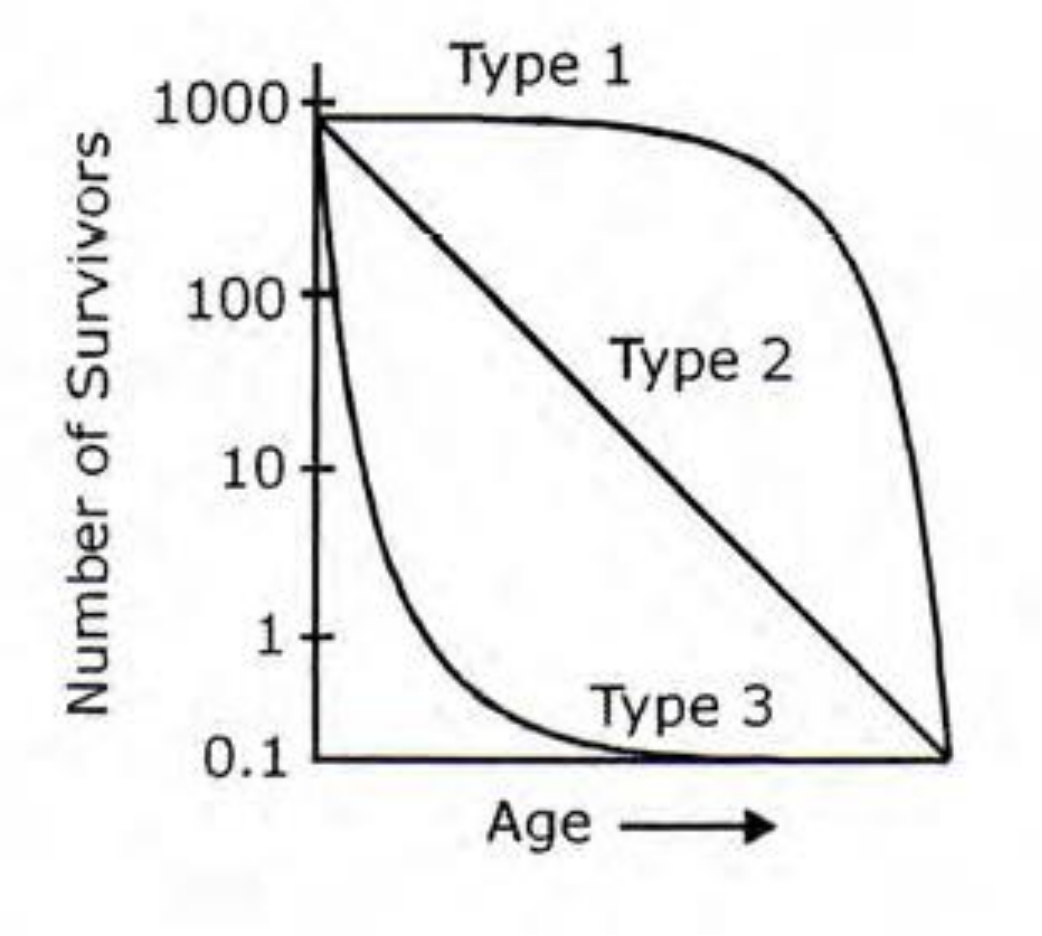
3. Mortality:

- Mortality is the rate of death of individuals of a populations.
- There are two types of Mortality;
  - 1. **Absolute Mortality** is the death rate in a population where minimum death occurs under ideal environmental conditions. It is constant for a given population.
  - 2. **Ecological or realized Mortality** is the population decrease or death rate under a given set of environmental conditions. This varies from population to population as size, density, age distribution, the resources, biotic community, and abiotic factors change between the populations.
- Mortality is generally expressed as a rate defined by number of births per unit time.
- **Survivorship curve**: The graph shows the survivors and death of individuals in a population. It shows the number of individuals to a particular age. There are 3 types of curves are observed.

Type 1: Highly concave curve, where individuals' death is minimal until they reach the end of their life span. Ex: Elephants, Tigers

Type 2: Highly convex curve, where individuals' death is maximum at the beginning of their life span. Ex: Fish, Crocodile

Type 3: Steady curve, where individuals' death is uniform throughout their life span. Ex: Humans, Deer.



4. Dispersion:

- Dispersion is the spatial or temporal distribution pattern of individuals in a population.
- Population may be distributed in three broad patterns;

1. **Regular Dispersion:** All the individuals of a population are distributed with more or less equal distances. This type of distribution is rare in nature but can be seen in managed systems like **croplands**.

2. **Random Dispersion:** The position of one individual is unrelated to the another. This type of dispersion occurs where environment is very uniform and there is no tendency to aggregate. This is also relatively rare in nature.

3. **Clumped Dispersion:** Individuals of a population occurs as a aggregates or groups as the resources occurs. This type of dispersion is showed by the most of the populations.

5. Growth rate or Growth form:

- Population is a dynamic entity and they have a characteristic patterns of increase called population growth forms.
- There are majorly two growth patterns are observed; 1. J-shaped and 2. S-shaped or sigmoid growth form.

1. J-shaped growth form:

- The population density increases in exponential or geometric pattern, like 2, 4, 8, 16, 32… so on, until the population runs out of resources or there appears a some other limitation.
- Growth comes to a abrupt halt or end and density decreases rapidly until conditions for another rapid growth episode are restored.

2. S-shaped growth form:

- In this pattern, The population will have self-limiting negative feedback and **reduces the rate of growth more and more as density increases**.

- At the end, when the population reaches the **carrying capacity (K)** acquires a steady state in which the rate of natality is equal to the rate of mortality.

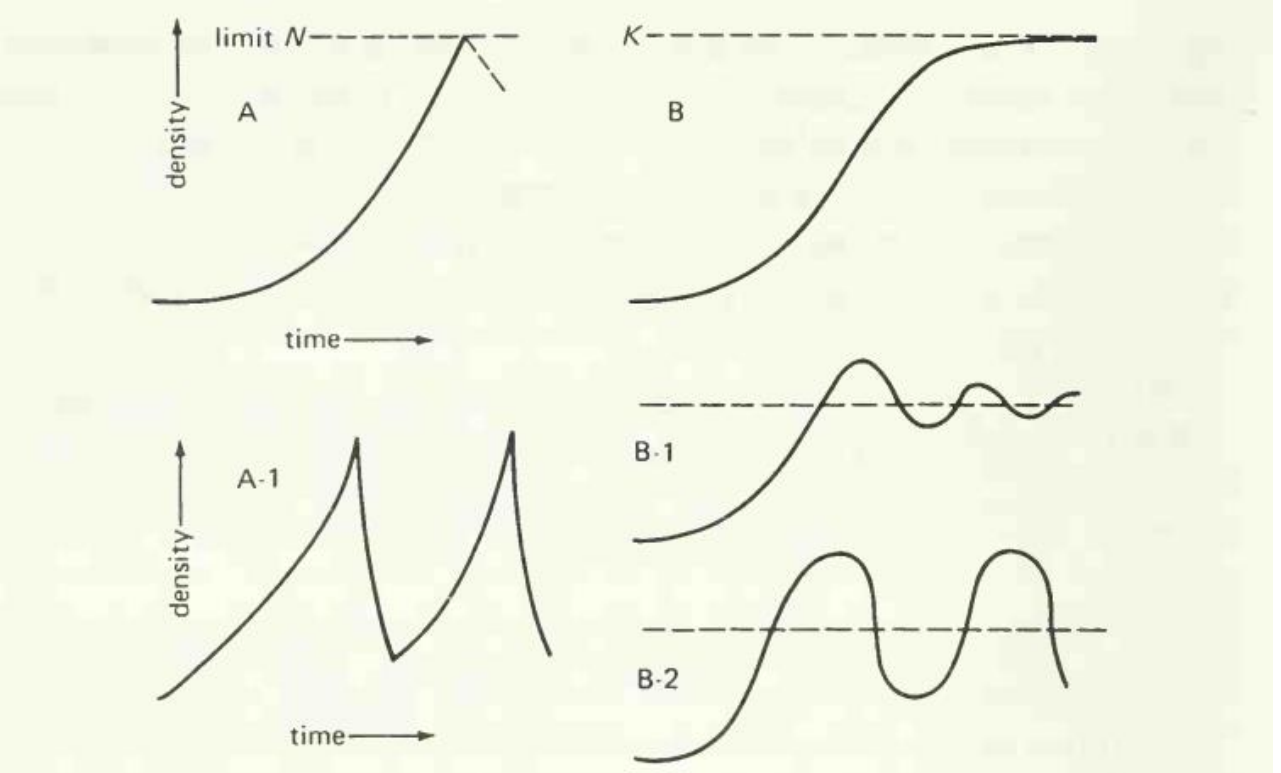


Fig. 5-1 Two types of population growth form the J-shaped (exponential) (A), and the S-shaped (sigmoid) (B), and some variants. A-1 illustrates severe oscillations that would result from "boom and bust" cycles of exponential growth. B-1 and B-2 show dampened and undampened oscillations that occur when sigmoid growth overshoots the carrying capacity, *K*.

6. Dispersal:

- Population is a dynamic entity and in nature since individuals are always leaving or enering the populations.
- But such changes normally do not affect the size of a population as there will be movement of in and out of the population with a same probability.
- There are majorly three patterns of dispersal of a population are observed;

1. **Emigration:** Outward movement of individuals.
2. **Immigration:** Inward movement of individuals.
3. **Migration:** Regular departure and return of individuals.

7. Age distribution:

- It is observed that the indiviauals in a population will be of different age groups and relative number of these groups significantly influence the characteristics of a population, such as natality and mortality.
- There are three age groups are observed in a population;
    1. Pre-reproductive
    2. Reproductive
    3. Post-reproductive
- The proportion of individuals in each age group is called **Age Structure.**
- The age structure of a population can be arranged in the form of pyramids called **“Age Pyramids.”**
- There are three types of hypothetical age pyramids can be suspected;

❖ There are three types of hypothetical age pyramids that can be suspected;

1. **Expanding population**: Birth rate is high and death rate is low (Pyramid shaped).
2. **Stable population**: Pre-reproductive age groups are equal sized (Bell-shaped).
3. **Diminishing population**: Pre-reproductive age group is smaller compared to reproductive and post-reproductive age groups (Urn-shaped). .

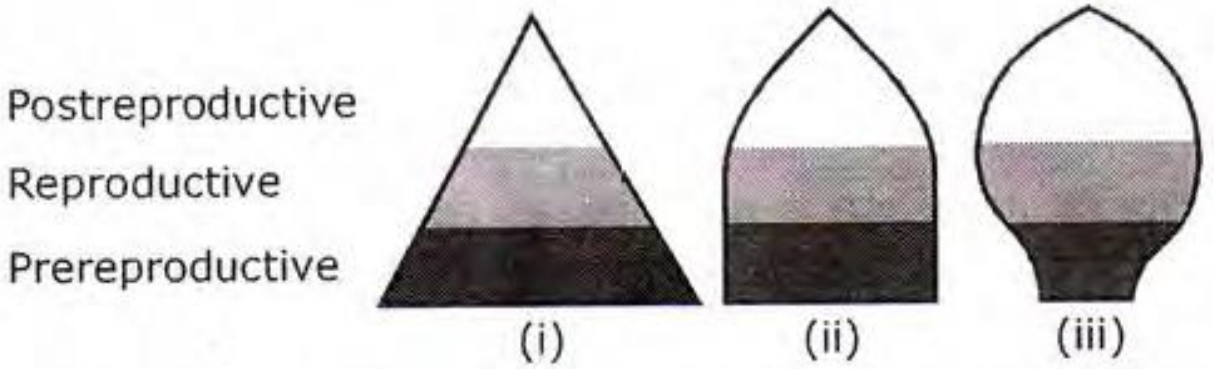


Figure 7.20 : Age structure of different types of populations : (i) expanding population (indicating a high percentage of young individuals in a population) (ii) stable population (indicating moderate proportion of young to old individuals) (iii) diminishing population (indicating a low number of young individuals)