CHAPTER 11

ORGANISMS AND POPULATIONS

Question 1:

List the attributes that populations possess but not individuals .

Answer 1:

A population can be defined as a group of individuals of the same species residing in a particular geographical area at a particular time and functioning as a unit. For example, all human beings living at a particular place at a particular time constitute the population of humans.

The main attributes or characteristics of a population residing in a given area are:

- Birth rate (Natality): It is the ratio of live births in an area to the population of an area. It is expressed as the number of individuals added to the population with respect to the members of the population.
- Death rate (Mortality): It is the ratio of deaths in an area to the population of an area. It is expressed as the loss of individuals with respect to the members of the population.
- Sex ratio: It is the number of males or females per thousand individuals.
- Age Distribution: It is the percentage of individuals of different ages in a given population. At any given time, the population is composed of individuals that are present in various age groups. The age distribution pattern is commonly represented through age pyramids.
- Population density: It is defined as the number of individuals of a population present per unit area at a given time.

Question 2:

If a population growing exponentially double in size in 3 years, what is the intrinsic rate of increase (r) of the population?

Answer 2:

A population grows exponentially if sufficient amounts of food resources are available to the individual. Its exponential growth can be calculated by the following integral form of the exponential growth equation:

$$N_t = N_o\, e^{rt}$$

Where,

N_t = Population density after time t

N_O = Population density at time zero

r = Intrinsic rate of natural increase

e = Base of natural logarithms

(2.71828)

From the above equation, we can calculate the intrinsic rate of increase (r) of a population.

Now, as per the question,

Present population density = x

Then,

Population density after two years = $2x$

t = 3 years

Substituting these values in the formula, we get:

$\Rightarrow 2x = x\, e^{3r}$

$\Rightarrow 2 = e^{3r}$

Applying log on both sides:

$\Rightarrow \log 2 = 3r \log e$

$$\Rightarrow \frac{\log 2}{3 \log e} = r$$

$$\Rightarrow \frac{\log 2}{3 \times 0.434} = r$$

$$\Rightarrow \frac{0.301}{3 \times 0.434} = r$$

$$\Rightarrow \frac{0.301}{1.302} = r$$

$$\Rightarrow 0.2311 = r$$

Hence, the intrinsic rate of increase for the above illustrated population is 0.2311.

Question 3

Name important defence mechanisms in plants against herbivory.

Answer 3:

Several plants have evolved various mechanisms both morphological and chemical to protect themselves against herbivory.

Morphological defence mechanisms:

- Cactus leaves (*Opuntia*) are modified into sharp spines (thorns) to deter herbivores from feeding on them.
- Sharp thorns along with leaves are present in *Acacia* to deter herbivores.
- In some plants, the margins of their leaves are spiny or have sharp edges that prevent herbivores from feeding on them.

Chemical defence mechanisms:

- All parts of *Calotropis* weeds contain toxic cardiac glycosides, which can prove to be fatal if ingested by herbivores.
- Chemical substances such as nicotine, caffeine, quinine, and opium are produced in plants as a part of self-defence.

Question 4:

An orchid plant is growing on the branch of mango tree. How do you describe this interaction between the orchid and the mango tree?

Answer 4:

An orchid growing on the branch of a mango tree is an epiphyte. Epiphytes are plants growing on other plants which however, do not derive nutrition from them. Therefore, the relationship between a mango tree and an orchid is an example of commensalisms, where one species gets benefited while the other remains unaffected. In the above interaction, the orchid is benefited as it gets support while the mango tree remains unaffected.

Question 5:

What is the ecological principle behind the biological control method of managing with pest insects?

Answer 5:

The basis of various biological control methods is on the concept of predation. Predation is a biological interaction between the predator and the prey, whereby the predator feeds on the prey. Hence, the predators regulate the population of preys in a habitat, thereby helping in the management of pest insects.

Question 6:
Define population and community.
Answer 6:
Population:
A population can be defined as a group of individuals of the same species residing in a particular geographical area at a particular time and functioning as a unit. For example, all human beings living at a particular place at a particular time constitute the population of humans.
Community:
A community is defined as a group of individuals of different species, living within a certain geographical area. Such individuals can be similar or dissimilar, but cannot reproduce with the members of other species.

Question 7:
Define the following terms and give one example for each:
(a) Commensalism
(b) Parasitism
(c) Camouflage
(d) Mutualism
(e) Interspecific competition
Answer 7:
(a) Commensalism: Commensalism is an interaction between two species in which one species gets benefited while the other remains unaffected. An orchid growing on the branches of a mango tree and barnacles attached to the body of whales are examples of commensalisms.
(b) Parasitism: It is an interaction between two species in which one species (usually smaller) gets positively affected, while the other species (usually larger) is negatively affected. An example of this is liver fluke. Liver fluke is a parasite that lives inside the liver of the host body and derives nutrition from it. Hence, the parasite is benefited as it derives nutrition from the host, while the host is negatively affected as the parasite reduces the host fitness, making its body weak.
(c) Camouflage: It is a strategy adapted by prey species to escape their predators. Organisms are cryptically coloured so that they can easily mingle in their surroundings and escape their predators. Many species of frogs and insects camouflage in their surroundings and escape their predators.
(d) Mutualism: It is an interaction between two species in which both species involved are benefited. For example, lichens show a mutual symbiotic

relationship between fungi and blue green algae, where both are equally benefited from each other.

(e) Interspecific competition: It is an interaction between individuals of different species where both species get negatively affected. For example, the competition between flamingos and resident fishes in South American lakes for common food resources i.e., zooplankton.

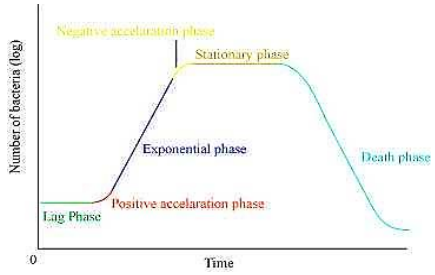
Question 8:

With the help of suitable diagram describe the logistic population growth curve.

Answer 8:

The logistic population growth curve is commonly observed in yeast cells that are grown under laboratory conditions. It includes five phases: the lag phase, positive acceleration phase, exponential phase, negative acceleration phase, and stationary phase.

- *Lag phase:* Initially, the population of the yeast cell is very small. This is because of the limited resource present in the habitat.
- *Positive acceleration phase:* During this phase, the yeast cell adapts to the new environment and starts increasing its population. However, at the beginning of this phase, the growth of the cell is very limited.
- *Exponential phase:* During this phase, the population of the yeast cell increases suddenly due to rapid growth. The population grows exponentially due to the availability of sufficient food resources, constant environment, and the absence of any interspecific competition. As a result, the curve rises steeply upwards.
- *Negative acceleration phase:* During this phase, the environmental resistance increases and the growth rate of the population decreases. This occurs due to an increased competition among the yeast cells for food and shelter.
- *Stationary phase:* During this phase, the population becomes stable. The number of cells produced in a population equals the number of cells that die. Also, the population of the species is said to have reached nature's carrying-capacity in its habitat.



A Verhulst − pearl logistic curve is also known as an S-shaped growth curve.

Question 9:

Select the statement which explains best parasitism.

(a) One organism is benefited.

(b) Both the organisms are benefited.

(c) One organism is benefited, other is not affected.

(d) One organism is benefited, other is affected.

Answer 9:

(d) One organism is benefited, other is affected.

Parasitism is an interaction between two species in which one species (parasite) derives benefit while the other species (host) is harmed. For example, ticks and lice (parasites) present on the human body represent this interaction where in the parasites receive benefit (as they derive nourishment by feeding on the blood of humans). On the other hand, these parasites reduce host fitness and cause harm to the human body.

Question 10:

List any three important characteristics of a population and explain

Answer 10:

A population can be defined as a group of individuals of the same species, residing in a particular geographical area at a particular time and functioning as a unit. For example, all human beings living at a particular place at a particular time constitute the population of humans.

Three important characteristics of a population are:

- Birth rate (Natality): It is the ratio of live births in an area to the population of an area. It is expressed as the number of individuals added to the population with respect to the members of the population.
- Death rate (Mortality): It is the ratio of deaths in an area to the population of an area. It is expressed as the loss of individuals with respect to the members of the population.
- Age Distribution: It is the percentage of individuals of different ages in a given population. At any given time, a population is composed of individuals that are present in various age groups. The age distribution pattern is commonly represented through age pyramids.