CHAPTER 13

Organisms and Environment

Ecology is a field of biology that focuses on exploring the interrelationships between organisms, as well as between organisms and their abiotic environment. **Ernst Haeckel**, a renowned scientist, coined the term "**ecology**."

Organizational Levels of Ecology

Ecology is concerned with four levels of organization: organisms, populations, communities, and biomes.

- **Organisms** are the basic unit of ecology at the individual level.
- **Populations** are the total number of organisms with similar features and the potential to interbreed and produce fertile offspring.
- **Communities** are groups of different species that coexist in a specific geographic area.
- **Biomes** are large areas with a specific vegetation type and associated fauna in a particular climate zone, such as a tropical rainforest or deciduous forest.
- **Habitat** is the specific environmental conditions in which an organism lives and represents a particular set of conditions suitable for its successful growth.
- **Ecological niche** describes the resources utilized by an organism, the place it occupies, and the functional role it plays in the ecosystem.

Environment

The environment refers to the combination of all external factors, both *living* and *nonliving*.

Abiotic factors

The environment plays a crucial role in determining the survival and reproductive success of organisms. One of the key components of the environment is the **abiotic factors**, which are non-living factors that impact the biological processes of living organisms. Some of the major *abiotic factors* are temperature, water, light, and soil.

Temperature is one of the **most important** abiotic factors that impact organisms. Organisms that can tolerate and thrive in a wide range of temperatures are called **eurythermal**, while those that are limited to a narrow temperature range are called **stenothermal**. For example, polar bears are stenothermal, as they can only survive in the extreme cold temperatures of the Arctic. In contrast, most mammals and birds are eurythermal, meaning they can tolerate a wide range of temperatures.

Water availability is another crucial abiotic factor that influences the productivity and distribution of plants. Aquatic organisms are dependent on water for survival and their survival is impacted by factors such as pH, chemical composition, and temperature of water. Organisms that can tolerate a wide range of salinity are called **euryhaline**, while those restricted to a narrow range of salinity are called **stenohaline**.

Light is also an important abiotic factor, as it is the source of energy used by plants for photosynthesis, which releases oxygen. The availability of light on land is closely linked to the temperature of the sun, and both factors play a critical role in shaping the distribution and survival of organisms.

Finally, **soil** is another crucial abiotic factor, as it provides the physical support, nutrients, and water necessary for plant growth. The nature and properties of soil are affected by climate, weathering processes, soil transportation, and development. The water holding capacity and percolation of soil are determined by characteristics such as soil composition, particle size, and aggregation.

Overall, the abiotic factors of the environment play a critical role in shaping the distribution and survival of organisms. Understanding how these factors impact biological processes is essential for managing and conserving ecosystems.

Responses to abiotic factors

Endotherms maintain a stable internal environment despite changes in the external environment, while **ectotherms** rely on the environment to regulate their body temperature and other physiological PR ecosystem)

- **Adaptation**: Organisms may undergo structural, functional or behavioural changes in response to abiotic stressors. For example, desert plants have adapted to the arid conditions by developing long roots to tap into underground water sources and reducing the surface area of their leaves to minimize water loss through transpiration.
- **Migration**: Some organisms may move to more favourable environments in response to unfavourable abiotic conditions. For example, birds migrate to warmer regions during the winter to avoid the cold.
- **Suspend**: Organisms may enter a state of dormancy during unfavourable conditions, such as drought or extreme cold, to conserve energy and survive until more favourable conditions return. For example, some animals ***hibernate*** during the winter to conserve energy and reduce their metabolic rate.

Overall, organisms have evolved various strategies to cope with abiotic stressors, and their ability to do so plays a crucial role in their survival and success in different environments.

Adaptation

Adaptation is a crucial concept in biology that refers to any characteristic or attribute of an organism that enhances its ability to survive and reproduce in its specific environment. It can be classified into different types based on the type of organism and the environment it inhabits. Here are some points to better elaborate on adaptations in plants:

Adaptation in plants

Adaptations in Plants: This type of adaptation is specific to plants and refers to any feature or characteristic that helps them survive and reproduce in their environment.

Xerophytic Plants: These are plants that are found in water-deficient regions such as deserts and rocks. Some examples of xerophytic plants include cacti, succulents, and certain grasses.

- **Leaf Modification**: Xerophytic plants have small and modified leaves that help them conserve water. They may have no leaves at all or have leaves that are reduced to spines or scales.
- **Stem Modification**: Xerophytic plants also have stems that are modified to store water, such as flat, fleshy, and green stems called ***phylloclade's*** in the case of the Opuntia, cactus.
- **Root Modification**: Xerophytic plants have highly modified roots that grow deep in search of underground water. These roots may also have a horizontal spread to maximize the area for water absorption.
- **Cuticle Thickness**: Xerophytic plants have a thick cuticle on their leaves, which helps to minimize water loss through transpiration.

Hydrophytic Plants: These are plants that are adapted to living in aquatic environments, either submerged or floating. Some examples of hydrophytic plants include water lilies, duckweeds, and eelgrass.

- **Root System**: Unlike xerophytic plants, hydrophytic plants do not have a well-developed root system. Instead, they have modified roots or structures that allow them to anchor themselves in the water.
- **Leaf Shape**: Hydrophytic plants have thin, ribbon-shaped leaves that help to minimize drag in water and facilitate gas exchange.

Adaptations in plants are crucial for their survival and reproduction in their specific habitats. **Xerophytic plants** have evolved adaptations to cope with water-deficient environments, such as leaf and stem modifications, root modifications, and thick cuticles. **Hydrophytic plants**, on the other hand, have evolved adaptations to cope with living in aquatic environments, such as modified roots and thin, ribbon-shaped leaves.

Adaptation in animals

Adaptations in animals refer to the **physical or behavioral characteristics** that enable them to survive and reproduce in their specific environments. Here are some points to better elaborate on the examples of adaptations in animals:

Kangaroo Rat: This animal is found in North America and has evolved a unique adaptation to survive in water-deficient regions. It is capable of meeting its water requirement by internal oxidation of its body fat.

Allen's Rule: This is a phenomenon observed in mammals from colder climates where they generally have shorter ears and limbs to minimize heat loss. This adaptation helps them conserve heat in their body and maintain their body temperature in cold environments.

Blubber: Aquatic mammals like seals have a thick layer of fat (blubber) below their skin that acts as an insulator and reduces the loss of body heat. This adaptation helps them survive in the cold polar regions.

High Altitude Adaptations: Humans living in high altitude places like Rohtang Pass near Manali (> 3500 m) and Mansarovar (in China occupied Tibet) have evolved adaptations to cope with low oxygen stress. These adaptations include:

- **Increasing Red Blood Cells Production**: The body produces more red blood cells to carry more oxygen to the tissues.
- **Decreasing the Binding Affinity of Hemoglobin**: The body reduces the binding affinity of hemoglobin to oxygen, which helps in the release of oxygen to the tissues.
- **Increasing the Breathing Rate**: The body increases the breathing rate to take in more oxygen and release more carbon dioxide.

Population

A **population** refers to a group of organisms that live in the same geographical area and can interbreed. It is an essential ecological unit that helps us understand the dynamics of an ecosystem.

Here are some points to better elaborate on the attributes of populations:

Density: Density refers to the number of individuals present in a particular area or volume at a specific time. It is calculated by dividing the total number of individuals in a region by the size of the unit area in that region.

The formula for density is D = N/S, where D is density, N is the total number of individuals in the region, and S is the size of the unit area.

Birth Rate or Natality: Birth rate is the number of new individuals produced by a population over a fixed period of time. It is an essential factor that contributes to the growth of a population.

Death Rate or Mortality: Death rate is the number of individuals that die in a population over a fixed period of time. It is an important factor that affects the population size and its growth.

Sex Ratio: The sex ratio refers to the number of males and females in a population. It is usually expressed as the number of females per 1000 males in a given population at a particular time.

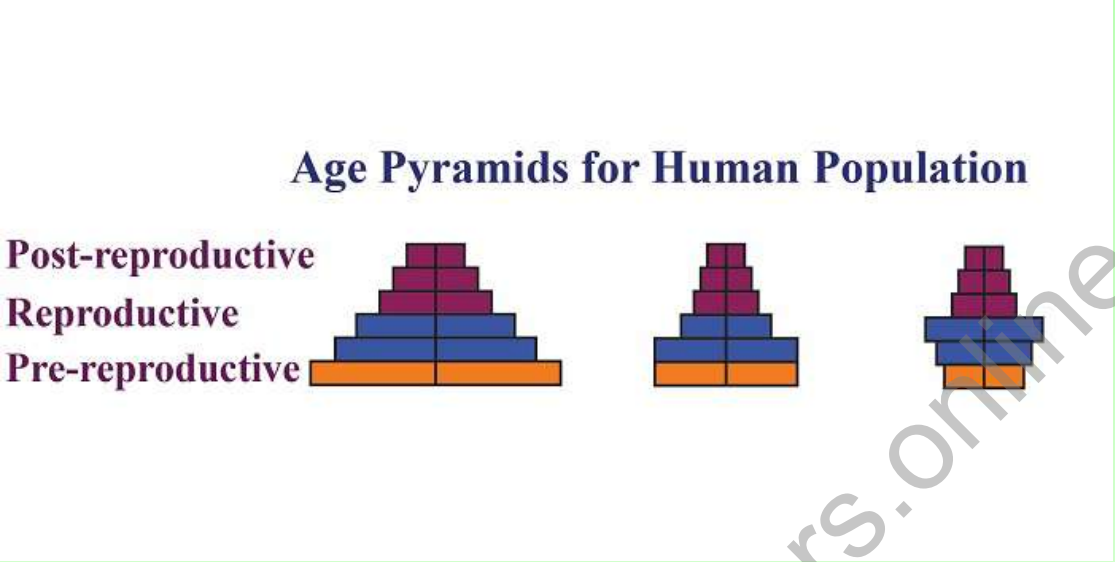
Understanding the attributes of a population is essential for predicting its growth and dynamics in the future. The density, birth rate, death rate, and sex ratio of a population play a critical role in determining its size, structure, and overall health. By studying these attributes, scientists can gain insights into the ecological processes that govern the population dynamics of different species in their respective environments.

Age Pyramid

Population demographics can be analyzed through an age pyramid which is a **graphical representation** of the age distribution of a population at a given point in time. It displays the percentage of individuals in different age groups in the population.

- Age pyramid is a visual representation of the age and sex distribution of a population.
- It shows the percentage of individuals in different age groups.
- Age pyramids can help us understand the current population trends and predict future population changes.
- The age pyramid of a human population is generally divided into male and female categories.
- There are three basic shapes of age pyramids: ***expanding (triangular), stable (bell-shaped), and declining (urn-shaped).***
- An **expanding or triangular age pyramid** indicates a population with a high birth rate and low life expectancy. Such populations are usually found in developing countries.
- A ***stable or bell-shaped age pyramid*** indicates a population with a relatively stable birth rate and life expectancy.
- A ***declining or urn-shaped age pyramid*** indicates a population with a low birth rate and longer life expectancy. Such populations are usually found in developed countries.

The age pyramid is an important tool for understanding the age and sex distribution of a population, and it can provide insights into current population trends and future changes.



Population growth

Population growth refers to the increase in the number of individuals in a population over time.

The rate of population growth is determined by the difference between the **birth rate** and the **death rate**, also known as the natural increase rate.

In addition to natural increase, population growth can also be influenced by **immigration** and **emigration**, which can cause population growth or decline.

Population growth can be represented mathematically using various models, such as the exponential growth model and the logistic growth model. Exponential growth occurs when a population increases at a constant rate over time, whereas logistic growth occurs when a population initially grows rapidly but eventually reaches a carrying capacity and stabilizes.

Population growth can have both positive and negative effects on a society, depending on factors such as resource availability, economic development, and environmental sustainability. Some negative effects of population growth include increased competition for resources, environmental degradation, and social and political instability.

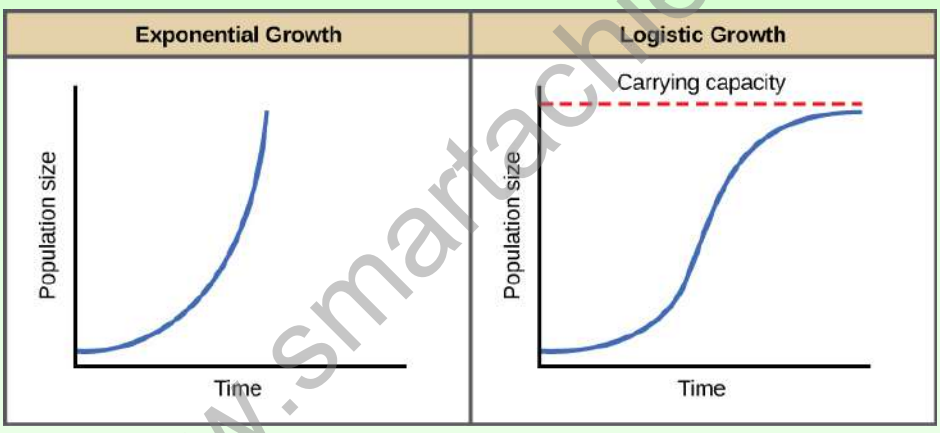
To manage population growth, various strategies can be implemented, such as family planning programs, education, and improving access to healthcare and economic opportunities. Sustainable population growth refers to a rate of population growth that can be maintained over the long-term without causing negative impacts on the environment and society. Populations evolve to maximize their reproductive fitness or Darwinian fitness (high r value) in the habitat where they live. Under a particular set of selection pressures, organisms evolve towards the most efficient reproductive strategy. The rate of breeding varies from species to species.

Growth curve

Population growth can be studied through two models: **exponential growth** and **logistic growth**. **Exponential growth** is represented by a **J-shaped curve** and occurs when resources such as food and space are unlimited. It is calculated using the equation **dN/dt = rN,** where N is the population size, b is the birth per capita, d is the death per capita, t is the time period, and r is the intrinsic rate of natural increase. The intrinsic rate of natural increase ® is an important parameter that assesses the effects of biotic and abiotic factors on population growth.

On the other hand, **logistic growth** occurs when a habitat has enough resources to support a maximum possible number of individuals, known as the carrying capacity (K). This type of growth is represented by a **sigmoid (S-shaped**) curve and is calculated using the equation **dN/dt = rN(K-N/K)**. In this equation, N is the population density at time t, K is the carrying capacity, and r is the intrinsic rate of natural increase.

Populations evolve to maximize their reproductive fitness or Darwinian fitness, which is determined by the efficiency of their reproductive strategy. The rate of breeding varies from species to species, and organisms evolve towards the most efficient reproductive strategy under a particular set of selection pressures.



Population interaction

Population interaction refers to the way different species in a community interact with each other. These interactions can be classified into different categories such as competition, predation, mutualism, commensalism, and parasitism.

Competition occurs when two or more species compete for the same limited resources such as food, water, or space. This can be intraspecific competition, which occurs between individuals of the same species, or interspecific competition, which occurs between individuals of different species. Competition can lead to resource partitioning, where species divide up the available resources to reduce competition.

Predation is the relationship between a predator and its prey. Predators hunt and kill their prey for food, and prey have adaptations to avoid being caught. This relationship can have a significant impact on the population dynamics of both the predator and the prey species.

Mutualism is a relationship where both species benefit. For example, pollinators and flowering plants have a mutualistic relationship, where the pollinators receive nectar and pollen as a food source, while the plants receive the benefit of their pollen being transported to other plants for fertilization.

Commensalism is a relationship where one species benefits, while the other species is not affected. An example of this is epiphytes, which are plants that grow on other plants without harming them, and receive the benefit of being raised off the ground to receive more sunlight.

Parasitism is a relationship where one species benefits at the expense of the other species. Parasites rely on their host for survival and reproduction, but can harm or even kill their host in the process.

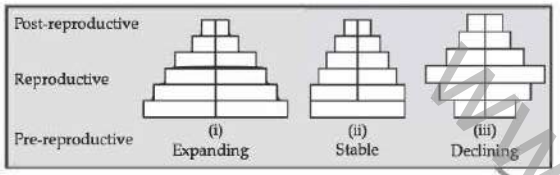
Overall, these interactions play an important role in shaping the structure and dynamics of populations and communities, and understanding them is crucial for predicting and managing ecological systems.

Organisms and Populations

Population

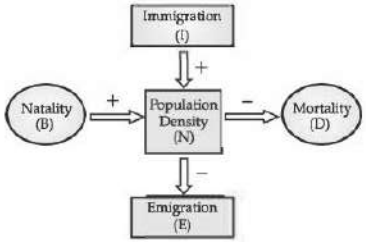
Population Attributes

- Natality rate
- Population Size
- Mortality rate
- Sex Ratio
- Age Pyramids



Population Growth

- Natality
- Mortality
- Immigration
- Emigration



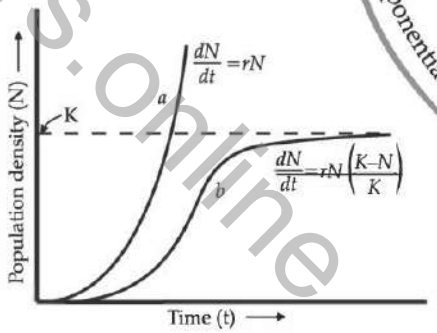
Population Density Equation

$$N_{t+1}=N_t+[(B+I)-(D+E)]$$

Growth Models

Verhulst-Pearl

$$dN/dt=rN\left(\frac{K-N}{K}\right)$$



Logistic Growth

Exponential Growth

$$N_t=N_0e^n$$

Population Interaction

Species A	Species B	Name of Interaction
+	+	Mutualism
−	−	Competition
+	−	Predation
+	−	Parasitism

Trace the Mind Map

First Level · Second Level · Third Level

Practice Questions

1.Which of the following describes interspecific interactions?

a) Beneficial b) Detrimental c) Neutral d) All of the above

2.Which of the following statements are correct?

I. The human liver fluke, a nematode parasite, depends on two intermediate hosts (snail and pig) to complete its life cycle.

II. The malaria parasite needs a vector (mosquito) to spread to other hosts.

III. The female mosquito is not considered a parasite; however, it needs our blood for reproduction.

IV. In the case of brood parasitism, the eggs of parasitic birds (cuckoo) are not detected and ejected from the nest because the parasite's eggs resemble the host's eggs in morphology and color.

V. A population of frogs protected from all predators would increase indefinitely.

a) I and II b) II and III c) III, IV d) All of the above (I, II, III, and IV)

3.The relationship between the alga Microcystis and the surrounding fauna corresponds to:

a) Amensalism b) Parasitism c) Predation d) Exploitation

4.The logistic population growth model describes a population's growth when an upper limit to growth is assumed. This upper limit of growth is known as population A and as it gets larger, B:

A) A-carrying capacity; B-increases b) A-carrying capacity; B-decreases

c) A-reproductive fitness; B-increases d) A-reproductive fitness; B-decreases

5.What is climate?

a) Average weather b) Dynamic weather c) Static weather d) None of the above

6.What is the basic unit of ecological hierarchy?

a) Species b) Genus c) Population d) Individual organism

7.What is an ecotype?

a) Equivalent to ecotone and niche

b) A genetically distinct adapted population to a particular habitat of a species

c) A phenotypically adapted population to a particular habitat

d) All of the above are correct statements regarding ecotype

8.In American lakes, visiting flamingoes and resident fishes compete for their common food. The resources in the lake need to be limiting for competition to occur. In interference competition, the feeding efficiency of one species might be reduced due to the interfering and inhibitory presence of the other species, even if resources (food and space) are abundant. Choose the correct option for the blanks:

A) A – zooplankton, B – need to be, C – increased

b) A – zooplankton, B – need not be, C – reduced

c) A – phytoplankton, B – need to be, C – reduced

d) A – phytoplankton, B – need to be, C – increased

9.What is the mass of living matter at a trophic level in an area at any time called?

a) Detritus b) Humus c) Standing state d) Standing crop

10.Who first used the term “Niche”?

a) Elements b) Grinnel c) Warming d) Odum

11.Which competition is generally more intense?

a) Intraspecific competition b) Interspecific competition

c) Both (a) and (b) d) Predation

12.Newly developed pathogens are often more damaging to their host because they are:

a) Distant pathogens b) Chronic pathogens

c) Instant pathogens d) Genetically improved pathogens

13.What is the exponential growth rate for the previous question?

a) 3 b) 4 c) 5 d) 6

14.In the association between two organisms, if one organism is benefited and the other is not benefited, this relationship is known as:

A) Symbiotic b) Mutualism c) Commensalism d) Parasitism

15.Ephemerals are xerophytes that are:

a) Drought resisting b) Drought enduring c) Drought escaping d) None of these

16.what does Resource partitioning include:

a) Temporal partitioning b) Spatial partitioning

c) Morphological partitioning d) All of the above

17.Which of the following best describes the interaction between figs and fig wasps?

a) Mutualism and host-parasite interaction

b) Mutualism and competition

c) Protocooperation and commensalism

d) Competition and commensalism

18.What shape does the population growth curve take in most animals, except humans?

a) S-shaped b) J-shaped c) J-shaped with a tail d) S-shaped with a tail

19.Nosema notabilis is an example of what type of relationship?

a) Commensalism b) Symbiosis c) Ectoparasites d) Hyperparasitism

20.What is an ecosystem the interaction of?

a) Species with environment b) Individual with environment

c) biological community with environment d) All of the above

21.What is the term for populations that evolve to maximize their reproductive fitness?

a) Mendel's fitness b) Darwinian fitness c) Lamarck's fitness d) Individual fitness

22.Ecologists compare a species' niche to what and a habitat to what?

a) A-education; B-occupation b) A-appearance; B-physiology

c) A-occupation; B-address d) A-physiology; B-anatomy

23.Which of the following best describes the function of "cryptically-colored" technique used by prey?

a) To feed abundantly b) To reduce the impact of predators

c) To increase their population d) To increase their reproductive fitness

24.Among the following options, where is competition for light, nutrients, and space most intense?

a) Between closely related plants growing in different areas

b) Between closely related plants growing in the same area

c) Between distantly related plants growing in the same habitat

d) Between distantly related plants growing in different habitats

26.Which of the following options correctly fills in the blanks A, B, and C in the given statement?

“Many parasites have evolved to be _____ in such a way that both host and the parasite tend to _____, that is, if the host evolves special mechanisms for rejecting or resisting the parasite, the parasite has to evolve mechanisms to _____ and neutralize them, in order to be successful with the same host species.”

A) A-host-specific, B-evolve, C-counteract

b) A-host-specific, B-coevolve, C-counteract

c) A-source-specific, B-coevolve, C-counteract

d) A-source-specific, B-evolve, C-counteract

27.Which of the following statements is true regarding exponential growth?

a) No population can grow exponentially for long periods

b) Exponential growth slows down as the population nears it carrying capacity

c) Bacterial colonies have been observed to maintain exponential growth indefinitely

d) Exponential growth is commonly observed in large, slow-growing species such as humans and elephants

28.What does mycorrhizal represent?

a) An intimate mutualistic relationship between fungi and stems of higher plants

b) An intimate mutualistic relationship between fungi and roots of higher plants

c) An intimate mutualistic relationship between fungi and leaves of higher plants

d) An intimate mutualistic relationship between fungi and leaflets of higher plants

29.If there are 20 lotus plants from last year in a pond, and through reproduction 8 new plants are added, what is the birth rate?

A) 0.8 offspring per lotus per year

b) 0.2 offspring per lotus per year

c) 0.4 offspring per lotus per year

d) 0.6 offspring per lotus per year

30.Any species growing under unlimited resource conditions can reach enormous population densities in a short time. Darwin showed how even a slow-growing animal like an elephant could reach enormous numbers in the absence of checks, and that characteristic of an organism is called:

a) A – logistically, B – fast, C – carrying capacity

b) A – logistically, B – slow, C – biotic potential

c) A – exponentially, B – slow, C – biotic potential

d) A – exponentially, B – fast, C – biotic potential

31.What is observed on July 11th?

a) World Population Day

b) No Tobacco Day

c) World Environment Day

d) World Health Day

32.Which of the following best describes light?

a) The visible part of the electromagnetic spectrum

b) The non-visible part of the electromagnetic spectrum

c) The infrared part of the electromagnetic spectrum

d) The ultraviolet part of the electromagnetic spectrum

33.What does pedology refer to the study of?

a) Soil b) Water c) Population d) Fossils

34.Which of the following is true about weather?

a) Is a long-term property of the atmosphere b) Is a short-term property of the atmosphere

c) Is an unchanged property of climate d) Is an unknown property of climate

35.Sea plants are an example of:

a) Xerophyte b) Mesophytes c) Hydrophyte d) Submerged plant

36.Halophytes are:

a) Fire-resistant b) Cold-resistant c) Salt-resistant d) Sand-loving

37.Adaptation can be:

a) Morphological b) Physiological c) Behavioral d) All of the above

38.Homeostasis regulators are able to maintain constant body temperature, osmotic concentration, etc. All _____ and _____and very few lower vertebrate and invertebrate species are capable of such regulation. Evolutionary biologists believe that the 'successes of mammals are largely due to their ability to maintain a constant body _____ and thrive whether they live in Antarctica or in the Sahara Desert. Choose the correct option for the blanks:

a) A – Physiological, B – bird, C – mammals, D – temperature

b) A – Behavioral, B – vertebrates, C – invertebrates, D – temperature

c) A – Physiological, B – bird, C – mammals, D – morphology

d) A – Behavioral, B – vertebrates, C – invertebrates, D – temperature

39.The physiological capacity to produce offspring is called:

a) Birth rate b) Biotic potential c) Crude natality d) Mortality

40.Which phase is characterized by the population adapting to a new environment and increasing in number?

a) Log phase b) Lag phase c) Decline phase d) Stationary phase

41.What is the term for the association of animals where both partners benefit?

a) Commensalism b) Amensalism c) Mutualism d) Parasitism

42.Which factors determine the vegetation of an area to a large extent?

I. pH of soil

II. Mineral composition of soil

III. Water holding capacity of soil

IV. Weather conditions

a) I and II b) II and III c) I, II, and III d) I, II, III, and IV

43.Which environmental factor is most ecologically relevant?

a) Soil b) Water c) Temperature d) Light

44.What are closely related, morphologically similar sympatric populations that are reproductively isolated called?

a) Demes b) Clones c) Sibling species d) Clines

45.Who coined the term "ecology"?

a) Reiter b) Cuvier c) Haeckel d) Malthus

46.What is another term for regulators?

a) Endotherms b) Exotherms c) Ectotherms d) Either (b) or (c)

47.What is diapause?

a) Stage of development

b) Stage of suspended development

c) Stage of delayed morphology

d) Rapid developmental stage

48.The population of an insect species shows an explosive increase in numbers during the rainy season, followed by its disappearance at the end of the season. What does this demonstrate?

A) S-shaped or sigmoid growth of this insect

b) The food plants mature and die at the end of the rainy season

c) Its population growth curve is of J-type

d) The population of its predators increases enormously

49.Which of the following is a true parasite?

a) Koel (cuckoo)

b) Housefly

c) Human fetus

d) Head louse

50.What is the ratio between mortality and natality called?

a) Population ratio

b) Vital index

c) Density coefficient

d) Census ratio

Answers

1.Answer: d) All of the above

Interspecific interactions are interactions that occur between different species. These interactions can be beneficial, detrimental, or neutral. Beneficial interactions are those in which both species benefit, detrimental interactions are those in which one or both species are harmed, and neutral interactions are those in which neither species is affected.

2.Answer: d) All of the above (I, II, III, and IV)

All of the statements are correct. The human liver fluke, a nematode parasite, depends on two intermediate hosts (snail and pig) to complete its life cycle. The malaria parasite needs a vector (mosquito) to spread to other hosts. The female mosquito is not considered a parasite; however, it needs our blood for reproduction. In the case of brood parasitism, the eggs of parasitic birds (cuckoo) are not detected and ejected from the nest because the parasite's eggs resemble the host's eggs in morphology and color.

3.Answer: d) Exploitation

The relationship between the alga Microcystis and the surrounding fauna corresponds to exploitation. Exploitation is an interaction in which one species benefit by feeding on another species, but the second species is not killed immediately.

4.Answer: A) A-carrying capacity; B-increases

The logistic population growth model describes a population's growth when an upper limit to growth is assumed. This upper limit of growth is known as the carrying capacity, and as it gets larger, the population increases.

5.Answer: a) Average weather

Climate is defined as the average weather conditions in a particular region over a long period of time, usually 30 years or more.

6.Answer: c) Population

The basic unit of ecological hierarchy is the population. A population is a group of individuals of the same species living in the same area at the same time.

7.Answer: b) A genetically distinct adapted population to a particular habitat of a species

An ecotype is a genetically distinct adapted population to a particular habitat of a species. They have evolved specific traits that allow them to survive and thrive in their particular environment.

8.Answer: B) A – zooplankton, B – need not be, C – reduced.

Explanation: The passage describes competition between flamingoes and resident fishes for their common food in American lakes. The competition is interference competition, in which the feeding efficiency of one species might be reduced due to the interfering and inhibitory presence of the other species, even if resources are abundant. Therefore, the blank A should be filled with “zooplankton,” which is the common food that both species are competing for. The blank B should be filled with “need not be,” as the passage states that resources (food and space) are abundant, and the competition can still occur. The blank C should be filled with “reduced,” as the feeding efficiency of one species might be reduced due to the interfering and inhibitory presence of the other species.

9.Answer: D) Standing crop.

Explanation: The mass of living matter at a trophic level in an area at any time is called the standing crop. It represents the amount of biomass present at a particular time and is usually expressed in units of mass per unit area, such as grams per square meter.

10. The correct answer is b) Grinnel. The term "niche" was first introduced by Joseph Grinnel in his 1917 paper "The niche-relationships of the California Thrasher". Grinnel defined a niche as the "total expression of the habits of a species, or more narrowly, as that portion of the habitat which is actually exploited by the organism".

11. The correct answer is a) Intraspecific competition. Intraspecific competition occurs between individuals of the same species and is generally more intense because they are competing for the same resources and have similar ecological requirements. Interspecific competition occurs between individuals of different species, and while it can still be intense, it may be less so because the species have different ecological requirements and can partition resources.

12. The correct answer is c) Instant pathogens. Newly developed pathogens are often more damaging to their host because they have not co-evolved with the host and have not been subjected to natural selection pressures that would favor a more benign relationship. Instant pathogens can cause rapid and severe damage to their host, whereas chronic pathogens may have a lower impact but persist over a longer period of time.

13. The correct answer cannot be determined from the information provided. Exponential growth rate requires a specific formula or data set to calculate.

14. The correct answer is c) Commensalism. In commensalism, one organism benefits from the relationship while the other is neither benefited nor harmed. An example of commensalism is a remora fish attaching itself to a shark to obtain food scraps, while the shark is not affected.

15. The correct answer is c) Drought escaping. Ephemerals are xerophytes that complete their life cycle rapidly during a brief period when soil moisture is available, then enter a dormant state until the next period of moisture. They "escape" the drought by completing their life cycle quickly and spending most of their time dormant.

16. The correct answer is d) All of the above. Resource partitioning refers to the division of resources among competing species or individuals to reduce competition. This can occur in temporal (different times), spatial (different locations), or morphological (different physical traits) dimensions.

17. The correct answer is a) Mutualism and host-parasite interaction. Figs and fig wasps have a mutualistic relationship, where the wasps pollinate the figs and the figs provide a habitat for the wasps to lay their eggs. However, the relationship is also a host-parasite interaction because the figs "cheat" the wasps by producing male flowers that do not provide a suitable habitat for the wasp larvae to develop.

18. The correct answer is b) J-shaped. In most animals, except humans, the population growth curve takes a J-shaped curve, where the population grows rapidly until it reaches the carrying capacity of the environment, at which point growth levels off.

19. The correct answer is d) Hyperparasitism. Nosema notabilis is a species of microsporidian parasite that infects the larvae of a parasitic wasp. The wasp lays its eggs in the eggs of a moth, and the N. notabilis infects the developing wasp larvae, reducing their fitness.

20. The correct answer is c) Biological community with environment. An ecosystem is a biological community of interacting organisms (including both living and non-living components) and their physical environment. It is the interaction between the species within the community and the abiotic factors in their environment that define the ecosystem.

21. The correct answer is b) Darwinian fitness. Darwinian fitness refers to the ability of an organism to survive and reproduce in a particular environment. Populations that are better adapted to their environment will have higher fitness, and their genes will be more likely to be passed on to future generations. This process is known as natural selection, and it is a key mechanism of evolution.

22. The correct answer is c) A-occupation; B-address. Ecologists compare a species' niche to its occupation because a niche is the role or job that a species performs in an ecosystem, including its interactions with other species and its use of resources. Similarly, a habitat is like an address for a species, referring to the specific physical location where it lives and the environmental conditions that it experiences.

23. The correct answer is b) To reduce the impact of predators. Cryptic coloration is a common strategy used by prey species to blend in with their environment and avoid detection by predators. By reducing the chance of being seen or recognized, prey species can increase their chances of survival and reduce the impact of predation.

24. The correct answer is b) Between closely related plants growing in the same area. When closely related plant species compete for resources like light, nutrients, and space in the same area, the competition can be especially intense. This is because they are likely to have similar resource requirements and growth strategies, making it more difficult for either species to gain an advantage.

26. The correct answer is b) A-host-specific, B-coevolve, C-counteract. Many parasites have evolved to be host-specific, meaning they have adapted to infect and exploit particular host species. To do this, both the host and parasite often have to coevolve, meaning they evolve in response to each other's adaptations. For example, if the host evolves mechanisms to resist the parasite, the parasite may have to evolve countermeasures to overcome this resistance.

27. The correct answer is b) Exponential growth slows down as the population nears it carrying capacity. Exponential growth is a pattern of growth in which a population increases at a fixed percentage rate over time, without any limits on resources. However, this type of growth cannot continue indefinitely because resources are finite. As the population nears it carrying capacity (the maximum number of individuals that can be sustained by the environment), the growth rate slows down and eventually levels off.

28. The correct answer is b) An intimate mutualistic relationship between fungi and roots of higher plants. Mycorrhizae are specialized fungal structures that form a mutualistic relationship with the roots of many plants. The fungi provide the plant with nutrients like phosphorus and nitrogen that they absorb from the soil, while the plant provides the fungi with carbohydrates and other organic compounds.

29. The correct answer is c) 0.4 offspring per lotus per year. The birth rate is calculated by dividing the number of new offspring by the number of parent organisms. In this case, there were 20 parent lotus plants, and 8 new plants were produced, so the birth rate is 8/20 = 0.4 offspring per lotus per year.

30. The correct answer is b) A – logistically, B – slow, C – biotic potential. The ability of a species to reproduce and grow rapidly under ideal conditions is known as its biotic potential. However, this potential is often limited by factors such as competition, predation, disease, and resource availability, which create a carrying capacity for the environment. This leads to logistic growth, in which the growth rate slows down as the population nears its carrying capacity. Even slow-growing species like elephants can reach enormous numbers if unchecked, as Darwin famously demonstrated.

31. Answer: (a) World Population Day

Explanation: World Population Day is observed on July 11th every year. The day aims to raise awareness about the impact of population growth on the environment and development. It also focuses on reproductive health and rights issues.

32. Answer: (a) The visible part of the electromagnetic spectrum

Explanation: Light is a type of electromagnetic radiation that can be perceived by the human eye. The visible part of the electromagnetic spectrum consists of wavelengths of light that are visible to the human eye and range from approximately 400 to 700 nanometers.

33.Answer: (a) Soil

Explanation: Pedology is the study of soil in its natural environment. It includes the physical, chemical, biological, and mineralogical properties of soils, as well as their formation, classification, and distribution.

34.Answer: (b) Is a short-term property of the atmosphere

Explanation: Weather refers to the short-term atmospheric conditions of a particular region or location, including temperature, humidity, precipitation, wind, and atmospheric pressure. It can change rapidly over a few hours or days.

35. Answer: (c) Hydrophyte

Explanation: Hydrophytes are plants that grow in water or in soil that is continuously saturated with water. Sea plants, such as seaweed and seagrasses, are examples of hydrophytes.

36. Answer: (c) Salt-resistant

Explanation: Halophytes are plants that are adapted to grow in saline or salty soils. They have special mechanisms to tolerate or exclude salt, such as storing salt in their leaves or having specialized roots that excrete excess salt.

37. Answer: (d) All of the above

Explanation: Adaptation can refer to any process by which an organism adjusts to a new environment or changes in its environment. It can be morphological (changes in physical structure), physiological (changes in bodily function), or behavioral (changes in actions or habits).

38. Answer: (a) A – Physiological, B – bird, C – mammals, D – temperature

Explanation: Homeostasis regulators are organisms that maintain a stable internal environment despite changes in their external environment. Birds and mammals are capable of such regulation, while lower vertebrates and invertebrates have limited ability to maintain homeostasis. Evolutionary biologists believe that the success of mammals is largely due to their ability to maintain a constant body temperature and thrive in a wide range of environments.

39. Answer: (b) Biotic potential

Explanation: Biotic potential is the maximum rate at which a population can increase under ideal conditions, based on the physiological capacity of individuals to reproduce and the availability of resources. It is also called reproductive potential.

40. Answer: (a) Log phase

Explanation: The log phase, also known as the exponential phase, is the period of rapid growth in a population when it adapts to a new environment and reproduces at a high rate. During this phase.

41. Answer: c) Mutualism

Explanation: Mutualism is a type of ecological interaction where both partners benefit. In mutualism, each partner provides a benefit that the other partner needs. For example, pollinators (like bees) help plants to reproduce, while in return, plants provide the pollinators with food (like nectar).

42. Answer: c) I, II, and III

Explanation: The vegetation of an area is determined by a combination of factors, including pH of soil, mineral composition of soil, water holding capacity of soil, and weather conditions. These factors affect the growth and survival of plants, which in turn determine the vegetation of an area.

43. Answer: c) Temperature

Explanation: Temperature is the most ecologically relevant environmental factor because it affects the physiology and behavior of organisms. Many biological processes, such as metabolism and reproduction, are influenced by temperature. The distribution and abundance of organisms are also affected by temperature.

44.Answer: c) Sibling species

Explanation: Closely related, morphologically similar sympatric populations that are reproductively isolated are called sibling species. Sibling species are often difficult to distinguish based on morphological characteristics alone and can only be identified by genetic or behavioral differences.

45. Answer: c) Haeckel

Explanation: The term "ecology" was coined by Ernst Haeckel in 1866. Haeckel defined ecology as "the study of the relationships between organisms and their environment."

46. Answer: a) Endotherms

Explanation: Regulators are organisms that maintain a relatively constant internal environment, regardless of external conditions. Endotherms are one type of regulator, which maintain a constant body temperature through internal physiological mechanisms. The opposite of regulators are conformers, which allow their internal environment to vary with external conditions.

47. Answer: b) Stage of suspended development

Explanation: Diapause is a stage of suspended development that some organisms enter to avoid unfavorable environmental conditions. During diapause, an organism's metabolism and growth are greatly reduced, allowing it to survive through periods of drought, cold, or other unfavorable conditions.

48. Answer: c) Its population growth curve is of J-type

Explanation: The population growth curve of an insect species that shows an explosive increase in numbers during the rainy season, followed by its disappearance at the end of the season is of J-type. In J-type growth, the population grows exponentially at a constant rate until it reaches the carrying capacity of its environment. After the carrying capacity is reached, the population stabilizes or declines.

49. Answer: d) Head louse

Explanation: A true parasite is an organism that lives on or within another organism (the host) and benefits at the host's expense. Head lice are true parasites that live on human scalps and feed on blood. They can cause itching, irritation, and other health problems.

50.Answer: b) Vital index

Explanation: The ratio between mortality and natality is called the vital index. It is a measure of the growth or decline of a population over time.