Organisms and Populations

INTRODUCTION

- **Ecology** is the branch of science in which we study the relationships among organisms and with their physical environment and biological surroundings.
- Ecology is concerned with four levels of biological organisation, i.e., organisms, populations,communities and biomes.
- The place where an organisms lives, is called it's habitat.

ORGANISMS AND ITS ENVIRONMENT

Organism

- Every individual of species is called an organism.
- Organisms form the basic unit for the study of ecology.
- Organisms which naturally interbreed among themselves and produce fertile offspring, constitute a population.
- At the organism level, ecology is termed as physiological ecology which deals with the adaptations observed in different organisms. Adaptations are essential for the organisms to survive and reproduce within their environments or habitats.

Population

- Individuals of the same species at any given place and at specific time, constitute a population.
- Individuals of any population remain in competition for their basic needs. Such a competition is called **intraspecific** competition.

Communities

- A biological community is constituted by an assemblage of populations of all different species that live in an area and interact among themselves.
- A biotic community of any area has a peculiar species composition and structure.

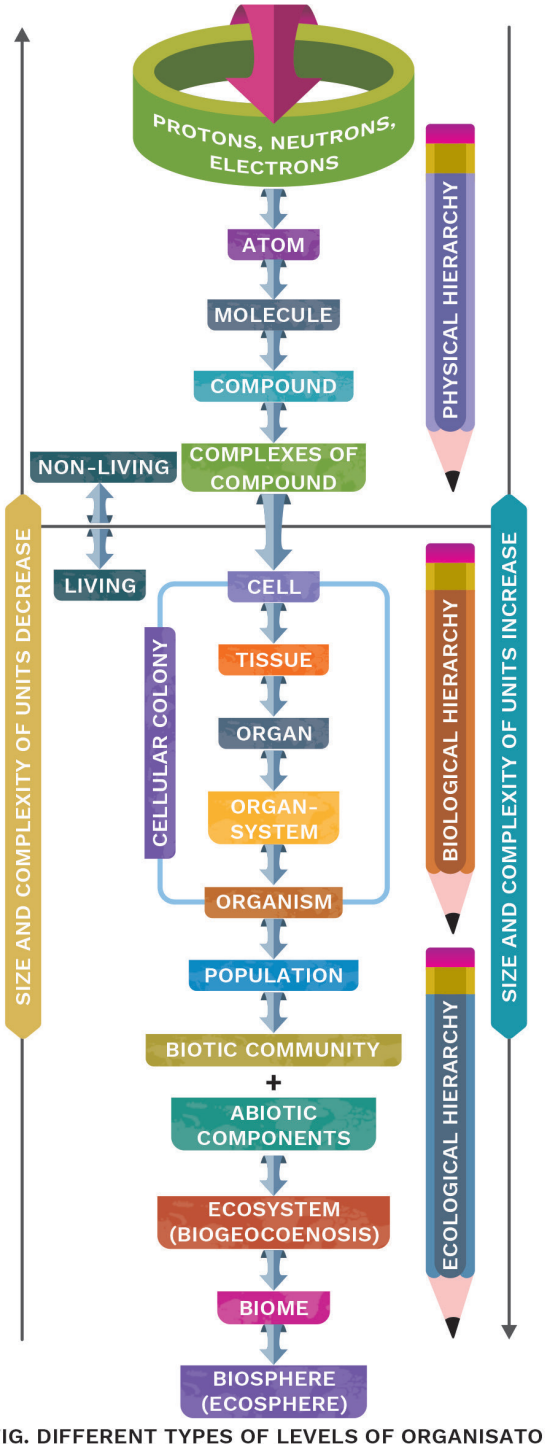


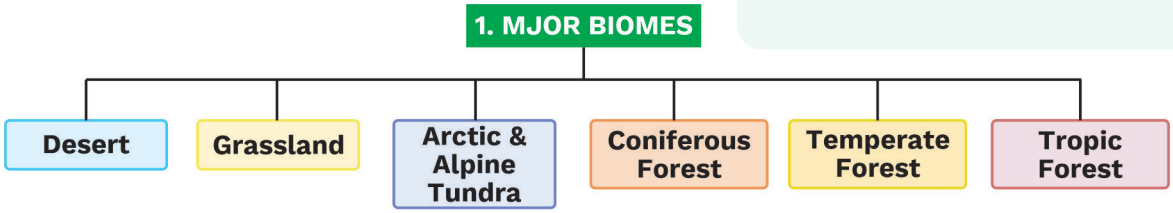
FIG. DIFFERENT TYPES OF LEVELS OF ORGANISATON

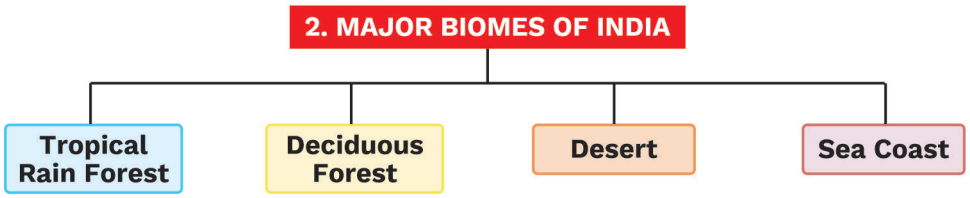
Biomes

- A **biome** is a large unit, consisting of a major vegetation type and associated fauna in a specific climatic zone.
- Major biomes of India include:
  - Tropical rain forest.
  - Deciduous forest
  - Sea coast
  - Desert, etc.

Previous Year's Question

More than 70% of world's freshwater is contained in
(1) polar ice
(2) glaciers and mountains
(3) Antarctica
(4) Greenland.





Environment

- All the biotic (living) and abiotic (non-living) factors that surround and influence an organism greatly, in its survival and reproduction (for continuity of species), constitute its environment.
- Environment fulfills the basic needs of all the organisms.

Seasonal Variation and Biomes

- Earth revolves around the sun and rotates on its own axis, this movement of earth around the sun causes annual seasonal variations as well as variation in temperature.
- The seasonal and annual variations in precipitation is the main cause that leads to the formation of major biomes.

Previous Year's Question

Quercus species are the dominant component in
(1) scrub forests
(2) tropical rain forests
(3) temperate deciduous forests
(4) alpine forests

- The major biomes of the world are:
  - Arctic and Alpine tundra
  - Coniferous forests
  - Temperature forests
  - Grassland
  - Tropical forests
  - Desert

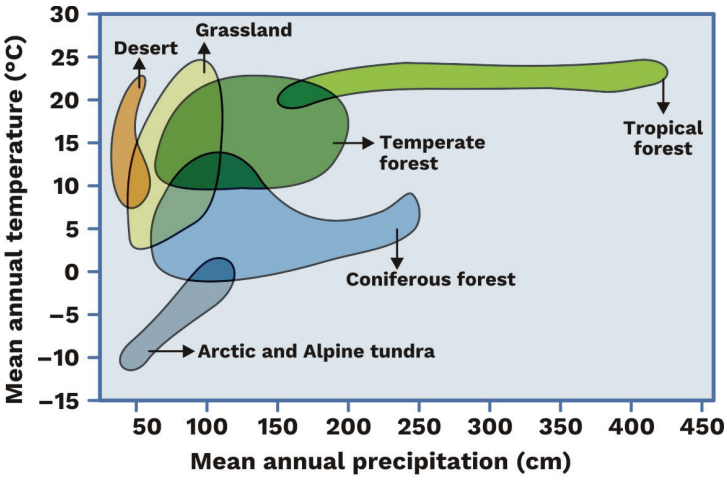


FIG. BIOME DISTRIBUTION WITH RESPECT TO ANNUAL TEMPERATURE AND PRECIPITATION

- Formation of a wide variety of habitats occur due to regional and local variations within each biome.
- On Earth, life exists not only in few favourable habitats but also in extreme and harsh habitats like deep in the oceans , polar regions, boiling thermal springs, snow covered mountain,in human gut,etc.
- The key elements which lead to the variations in the physical and chemical conditions of different habitats include the biotic and abiotic factors.
- The **biotic factor** include **pathogens and parasites, predators, competitors,** etc.
- The abiotic factors of the environment are temperature, water, light and soil.

Previous Year's Question

Which one of the following pairs is mismatched?
(1) Tundra permafrost
(2) Savanna Acacia trees
(3) Prairie Epiphytes
(4) Coniferous forest Evergreen trees

Rack Your Brain

What are the main causes of variation in a given species?

Previous Year's Question

The measure of maximum rate of reproduction under optimal conditions is called
(1) Ultimate level
(2) Carrying capacity
(3) Proximal level
(4) Biotic potential

MAJOR ABIOTIC FACTORS

Temperature

- The average temperature on earth varies in different seasons.
- At the equator temperature is high and on moving towards the poles it decreases and in the same way from plains to mountain tops the temperature decreases.
- The temperature ranges from subzero levels in the polar areas and high altitudes to >50°C in tropical deserts in summer.
- Unique habitats such as thermal springs and deep-sea hydrothermal vents have the average temperature of 100°C.
- Temperature plays an important role in the geographical distribution of organisms and also their physiological functions are influenced by it.
- Though gradual global warming affects organisms both in survival and distribution.

Types of Organisms on the Basis of Temperature Toleration

- **Eurythermal Organisms –** The organisms which can tolerate wide range of temperature for survival and are able to perform their due physiological functions in the same range of temperature.
- Examples – Mammals like human beings, leopard, dog, monkey, cow,desert pupfish, green crab, etc.
- Eurythermal plants are Rose,Ashok plant,Mango,Daisy,etc.
- **Stenothermal Organisms –** The organisms which can tolerate narrow range of temperature only for survival. Soil and marine organisms fall in this category.
- The tolerable range of temperature varies from one species to another.
    - **Types of Stenothermal Organisms**
        - **Thermophilic Organisms-** These animals can live only **in high temperature** areas. For Example – Reptiles like lizards,snakes, etc.

Rack Your Brain

Out of amphibians and birds, which will cope with global warming?

Previous Year's Question

The part of earth and atmosphere supporting life is

(1) Biota (2) Biome
(3) Ecotone (4) Biosphere

Definition

Eurythermal Animals: These tolerate a wide range of temperature and are widely distributed on earth.

Definition

Stenothermal Animals: These tolerate only a very narrow range of temperature and are restricted in distribution accordingly.

- **Cryophilic Organisms-** These animals can live **in low temperature** areas sometimes even at 0 degree centigrade. For example salmon, crustaceans,some species of seal, etc.
- Examples of Stenothermal Plants – Crotons, vines, Bougainvillea, Eucalyptus, Orchids, etc.

Note:
Ectotherms: The animals whose body temperature changes and matches with that of the environment, in which they are living.
Endotherms: The animals whose body temperature is maintained relatively constant by physiological regulations.

Water

- Water is an important factor that influences the life of organisms.
- Life on earth has originated in water and it cannot sustain without water.
- Plants are dependent on water for their productivity and distribution. In the same way for aquatic organisms, the chemical composition, pH, salinity and temperature of water are important too.

Types of Organisms on the Basis of Salt Toleration

- **Euryhaline Organisms -** The organisms which can adapt themselves to a wide range of salinity for survival and are able to perform their due physiological functions in the same range of salinity.
  - Estuaries and rock pools are the common habitats for euryhaline organisms. In these areas the salinity fluctuates quite often, this is one of the reason of salt adaptation in these animals.

Gray Matter Alert!!!

Ecological Niche: It refers to the range of conditions an organism can tolerate, the resources it utilises and its distinct functional role in the ecological system.

Rack Your Brain

Why fresh water animals cannot survive for a long time in marine waters?

Previous Year's Question

The factor related to structure of earth surface is
(1) Edaphic (2) Biotic
(3) Temperature (4) Topographic

Rack Your Brain

Why are green algae not likely to be found in the deepest strata of the ocean?

Definition

Euryhaline Animals: These are the animals, which can tolerate a wide range of salinity.

- Molly fish (vertebrate) is capable of survival in salt water, brackish water or even in fresh water.
- An invertebrate, green crab can survive in brackish water as well as in salt water. Oyster and blue crabs are other examples.
- Euryhaline plants are mangrove trees and most of the sea grasses.

- **Stenohaline Organisms -** The organisms which can tolerate narrow range of salinity for survival and are able to perform their due physiological functions in this narrow range of salinity.
- Examples –.
- Stenothermal plants are.

Light

- Appropriate amount of light falls on earth with desired duration which makes it an essential factor for sustaining life on earth.
- It is important for the plants to prepare food, (for all living organisms) and release oxygen.
- Small herbaceous plants and plants and some shrubs that live under the canopy of forest trees are adopted to photosynthesise under very low light intensities; they are called schizophytes.
- Many animals use the diurnal and seasonal variation in the light intensity and **photoperiod** (duration of light) as cues for timing of forage, reproduction and migration.
- The UV-component of light is harmful for many organisms.
- Red, brown and green algae are found thriving in different zones in the ocean which depends on the light, reaching the different depths; the red algae can live in very deep waters.

Soil

- The nature and properties of soil in a given place are dependent on the
  - Climate
  - Weathering process

Definition

Stenohaline Animals: These are the animals, which can tolerate a very narrow range of salinity.

Previous Year's Question

Organisms living at the bottom of a lake are called
(1) Nektons (2) Benthos
(3) Planktons (4) Pelagic

Rack Your Brain

Why is polar regions not a suitable habitat for humming birds?

Previous Year's Question

Different life forms, among organisms in relation to environment were given by
(1) Reiter (2) Odum
(3) Raunkiers (4) Warming

- Sedimentary soil or transported soil
- Soil development

- Properties of soil like soil composition, soil particle size and their aggregation determine its water holding capacity of the.
- Which type of vegetation will be suitable for any area depends on the physical and chemical properties of soil such as particle size, porosity, pH and mineral composition, and the type of animals that depend on these plants.
- At the oceanic floor,characteristics of the sediments of aquatic environment determine the type of benthic animals that can live there.

RESPONSE TO ABIOTIC FACTORS

- Many organisms have evolved a relatively constant internal environment, that is helpful for all the biochemical reactions to happen with maximum efficiency they are called the regulators.
- Their constancy could be in terms of optimal temperature, osmotic concentration of body fluids, etc.
- Types of Organisms depending on the response to their abiotic environment are as follows-
  - Regulators
  - Partial regulators
  - Conformers

Regulators

- These are organisms that can maintain homeostasis by physiological or behavioural ways. For example, mammals and birds.
- The organisms maintain homeostasis by **physiological** processes and/or **behavioural** means, and ensure a constant body temperature (thermoregulation), osmotic concentration, (osmoregulation), etc.
- Evolutionary biologists believe mammals have succeded other animals in due course of time is due to their ability to maintain a constant body

Gray Matter Alert!!!

Ecesis: It is the establishment of organisms in an area into which they have come by dispersal or migration.

Rack Your Brain

How do snails escape from stressful time in summers?

Definition

Regulators: Organisms which maintain a constant internal (within the body) environment (homeostasis), despite the fluctuations in the environment.

Gray Matter Alert!!!

Homeostasis: Homeostasis refers to the maintenance of a steady internal environment by organisms.

temperature, they are able to survive in Antarctica as well as in Sahara desert.

Partial Regulators

- These try and regulate their internal environment by means of physiological mechanisms or behavioural attitude, but beyond a certain limit, they have to conform to the external environmental conditions for survival.

Conformers

- According to the inhabited area conformers change their body temperature or osmolarity of the body fluid. These organisms do not have any internal mechanism to regulate and no energy is spent.

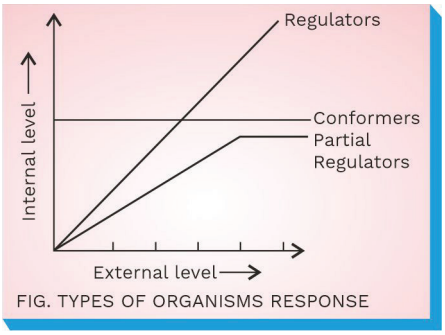


FIG. TYPES OF ORGANISMS RESPONSE

- In most of the animals and nearly all plants are unable to **maintain a steady and constant internal** body environment.
- Their body temperature changes with the fluctuations in their ambient temperature.
- In aquatic animals the osmotic concentration of their body fluids changes with those of the immediate surrounding water or osmotic concentration; such animals are called **osmoconformers.**
- Thermoregulation i.e. constant body temperature is an energy-expensive process; heat loss or gain is related to surface area of the body .

Gray Matter Alert!!!

Chasmophytes (Chasmaphils): Plants growing in rock crevices.
Chasmochomophyte: A plant growing on detritus present in rock crevices.
Psychrophytes: Plants growing in cold soils.

Definition

Conformers: Those organisms which cannot maintain homeostasis, but change according to the external environment.

Previous Year's Question

Plants growing on sand and gravel are called as
(1) Eremophytes
(2) Psammophytes
(3) Psilophytes
(4) Oxylophytes

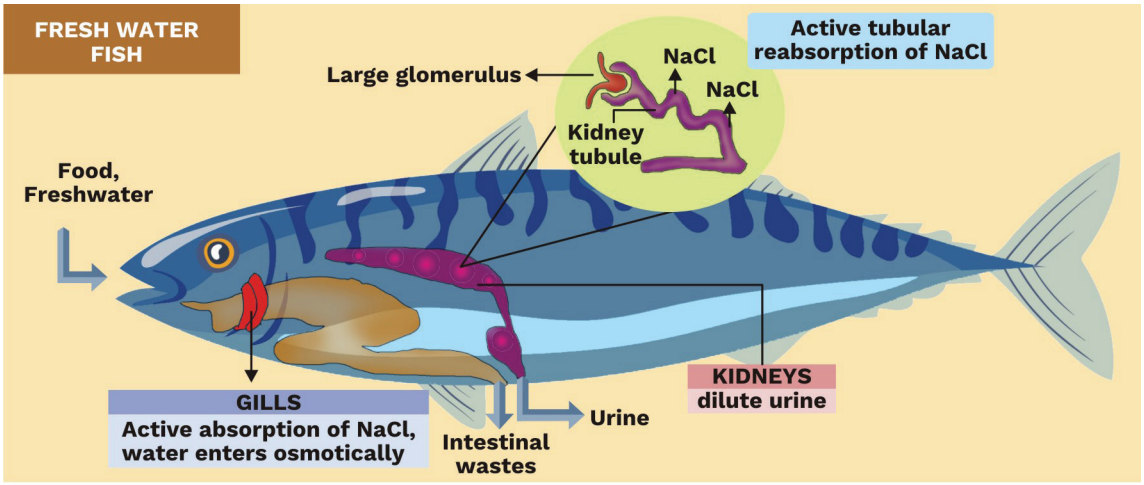
Rack Your Brain

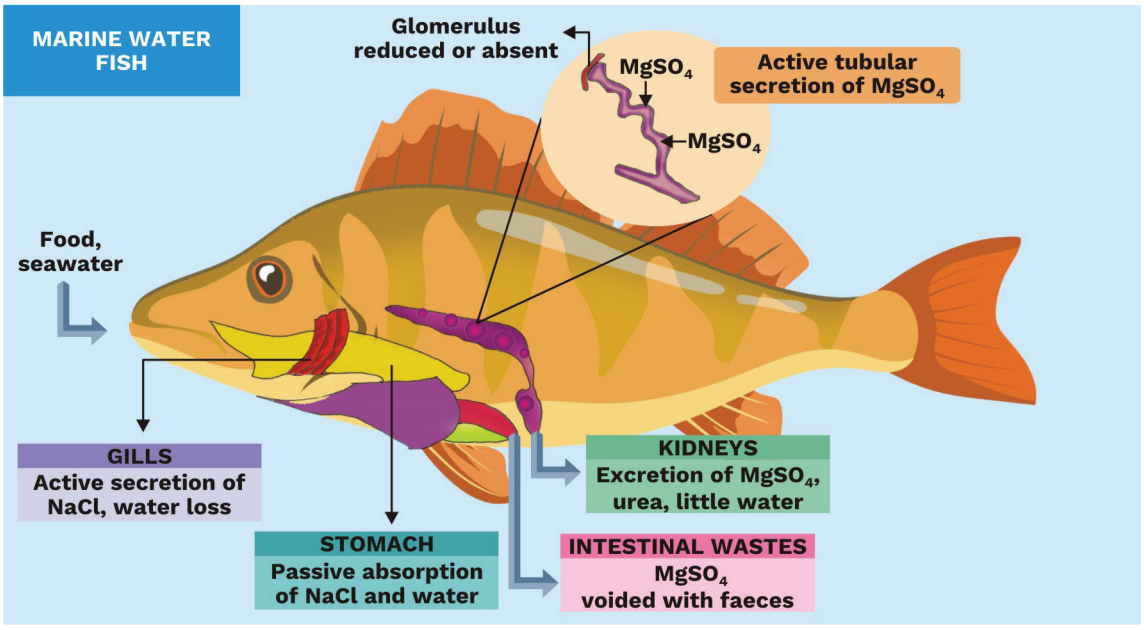
Give an example where population cover is a more meaningful measure of the population.

- Smaller animals like shrews, have a larger surface area of their body compared to their body volume and lose heat quite fast when the outside environment is cold; they need to spend more metabolically produced energy to generate the required body heat and this is one of the main reason that such small animals (shrews, humming bird, etc.) are not found in polar regions.

Rack Your Brain

On higher altitudes animals with longer arms and ears are not found. Justify.





Migration

- Organisms which can leave their habitat often migrate to areas that suitable for them for the time being.
- It is a way to dodge inhospitable conditions temporarily by shifting to an area with better environmental conditions.
- Generally big birds undertake long distance migrations during winter as these have strong flight muscles.
- For example in India, migratory birds in large number from Siberia and other extremely cold northern regions reach Keol Dev Ghana (Bharatpur) National Park.

Suspension

- Organisms which cannot migrate have another means to tolerate unfavourable conditions i.e. these suspend their metabolic functions temporarily during the stressful period and resume their functions at the onset of the favourable conditions.
- For example hibernation is seen in amphibians, certain reptiles and polar bears and aestivation is observed in some snails and fish along with amphibians.
- Zooplanktons (microscopic animals) demonatrate **Diapause** which is a stage of suspended development under unfavourable conditions.

Note:
Hibernation: During winters or very cold conditions some of the animals cannot maintain steady body temperature and it may drop down. So, they undergo long winter sleep by remaining inactive during adverse conditions.
Aestivation: During extreme summers some of the animals cannot maintain steady body temperature and it may rise which is fatal. So, they remain inactive and hide themselves.

Previous Year's Question

The mesophytes are characterised by
(1) Uniform mesophyll
(2) Absence of cuticle
(3) Well developed root-shoot systems
(4) All of these

Definition

Diapause: It is a stage of suspended development shown by many zooplankton species in fresh water bodies.

Previous Year's Question

Mark the true xerophyte
(1) *Capparis aphylla*
(2) *Solanum xanthocarpum*
(3) *Euphorbia milli*
(4) All of these

ADAPTATIONS

- Many adaptations have evolved over a long period of time and they are genetically controlled.
- A few examples of adaptation in animals are given below:
  - The kangaroo found in North American deserts has unique quality to meet all its water requirement and that is through its internal oxidation of fat, where water is by-product; it also can concentrate its urine to a minimal volume thus, reduces water in urine.
  - Mammals living in extremely colder climates have comparatively shorter ears and limbs to minimize heat loss.This is known as **Allen's Rule.**
  - Aquatic mammals like scales in the polar seas have a thick layer of fat, called blubber below their skin; this fat acts as an insulator and prevents loss of body heat.
  - Desert lizards have to face high temperature and survive also so these keep their body temperature constant by behavioural means. Lizards lay in the sun and absorb heat if their body temperature is below the comfort level and move into shade, when it is higher.
  - Some animals are capable of burrowing into the soil and hide to escape the ground heat.
  - The tribes living at high altitudes of mountain (like Himalayas) have a higher count of red blood cells and total haemoglobin and also high vital capacity than people living in plains.
- A few examples of adaptations in plants are as follows:
  - **Desert Plants:**
    - They have a **thick cuticle** on the leaf surfaces and other aerial parts.
    - They have **sunken stomata,** i.e., stomata are arranged in hairy grooves, to minimize water loss through transpiration.
    - They show special photosynthetic pathway called CAM pathway, where the stomata

Definition

Adaptation: Any morphological, physiological or behavioural attribute of an organism, that enables it to survive and reproduce in its habitat.

Rack Your Brain

How will you measure the population density of fish in lake?

Previous Year's Question

Reduction in vascular tissue, mechanical tissue and cuticle is characteristic of
(1) mesophytes
(2) epiphytes
(3) hydrophytes
(4) xerophytes.

remain closed during day (stomatal transpiration is under check) and open during night.
    - In cactus like *Opuntia,* leaves are modified into spines to reduce transpiration and photosynthesis is carried out by the flattened fleshy stems.
    - Leaves are generally pinnately compound to reduce their surface area like in *Acacia.*
    - Desert plants have deep root system to fetch water from the deeper layers of soil.
  - **Aquatic Plants:**
    - In aquatic plants air filled tissue (aerenchyma) is found which is vital for buoyancy and floating.
    - Plant parts have a waxy covering to avoid damage by water.
- Some of the human beings when go from plains to high altitude (>3,500 m, like Rohtang pass) they experience altitude sickness. The main cause of this sickness is low atmospheric pressure and oxygen availability; its symptoms are fatigue, nausea and heart palpitations.
- After few days the body gets acclimatised by increasing red blood cell production, decreasing the binding capacity of haemoglobin with oxygen and increasing the breathing rate.

POPULATION

Population Attributes

- Population ecology is a link between ecology with population genetics and evolution.
- Natural selection is a processes for the survival of the fittest and it operates at the level of each population.
- A population has certain attributes (characteristics) that are not found in individual organism. Such as-
  - Birth rate (natality)
  - Death rate (mortality)

Rack Your Brain

Give an example where population cover is a more meaningful measure of the population.

Previous Year's Question

If the rate of addition of new members increases with respect to the individuals lost from the same population, the graph obtained has
(1) Declined growth
(2) Exponential growth
(3) Zero population growth
(4) None of these

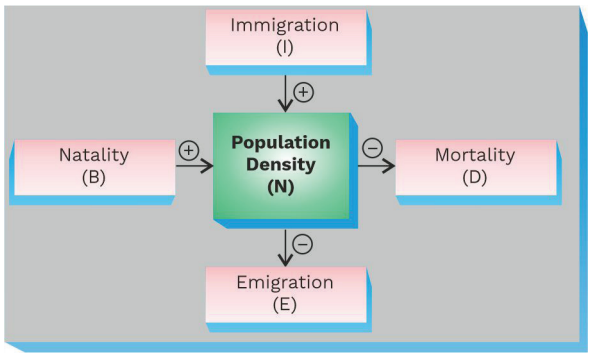
Previous Year's Question

Study of trends in human population is called
(1) Psychology (2) Demography
(3) Biography (4) Kalography

Definitions

Natality: Number of births in a population during a given period.
Mortality: Number of deaths in a population, during a given period.

- Sex ratio
- Population density



- A population is composed of individuals that belong to different ages/age groups at a specific time.
- The three ecological age groups are:
  - **Pre-reproductive age group**
  - **Reproductive age group**
  - **Post-reproductive age group**
- If the age distribution, i.e., number of individuals in the different age groups, is plotted an age-pyramid results.
- The shape of the pyramids is helpful in finding the growth status of the population, i.e.,
  - **Expanding or growing population**
  - **Stable population**
  - **Declining population**

Definitions

Immigration. The number of individuals of the same species that come into a habitat from elsewhere during the time period under consideration.

Emigration. The number of individuals of the same species that have left the habitat during the time period under consideration.

Previous Year's Question

One of the critical mechanisms by which environment controls the population of a species is
(1) Biotic control
(2) Mortality
(3) Fecundity
(4) Environmental resistance

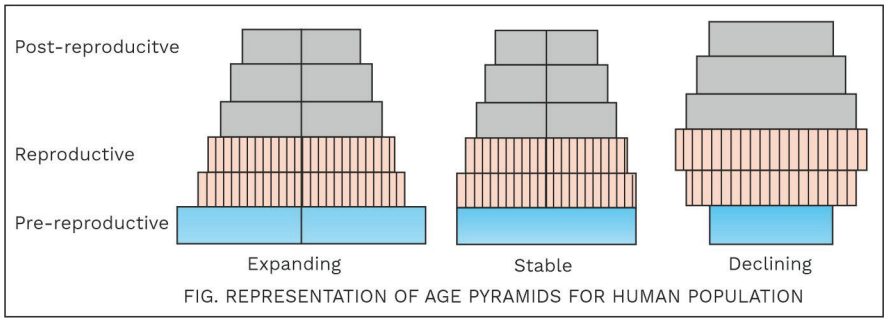


FIG. REPRESENTATION OF AGE PYRAMIDS FOR HUMAN POPULATION

Population Growth

- The size of any population is never the same it keeps changing with time depending on the factors like:
  - Food availability
  - Weather
  - Predation pressure
  - Competition among individuals
- The change in the density of a population in a given habitat during a given period,is due to four basic processes namely:
  - Natality
  - Mortality
  - Immigration
  - Emigration
- **Natality** and **immigration** always contribute to an **increase** in the size and density of a population.
- **Mortality** and **emigration** always contribute to a **decrease** the population.
- So, the equation for population growth is:
- Nt+1 = Nt + [(B + I) - (D + E)],
- Where, Nt = population density at time t,
- B = birth rate,
- I = immigration,
- D = death rate,
- E = emigration.
- If B + I is more than D + E, the population density increases.
- If B + I is less than D + E, the population density decrease.

Population Growth Models

- There are two models of population growth:
  - Exponential growth model
  - Logistic growth model

Exponential Growth Model

- With unlimited **resource availability** in the habitat, the population grows in an exponential or geometric fashion.

Previous Year's Question

Certain characteristic demographic features of developing countries are

(1) high fertility, low or rapidly falling mortality rate, rapid population growth and a very young age distribution

(2) high fertility, high density, rapidly rising mortality rate and a very young age distribution

(3) high infant mortality, low fertility, uneven population growth and a very young age distribution

(4) high mortality, high density, uneven population growth and a very old age distribution.

Previous Year's Question

What is the most important factor for the success of animal population?

(1) Natality

(2) Adaptability

(3) Unlimited food

(4) Interspecific activity

Previous Year's Question

The exponential growth is maximum in

(1) Tissue culture cells

(2) Embryo

(3) Unicellular organisms

(4) Multicellular organisms

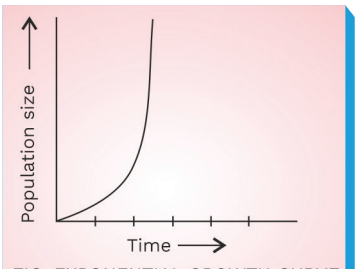


FIG. EXPONENTIAL GROWTH CURVE

- The equation is: dN/dt = (b - d) × N
  - Let, (b - d) = r, then the equation is dN/dt = rN
  - r in the equation is called the intrinsic rate of natural increase and is an important parameter to assess the impacts of biotic or abiotic factors on the growth of the population.
- When a population shows exponential growth, the curve plotted with N in relation to time assumes **J shape.**
- The exponential growth equation becomes, $N_t = N_0 e^{rt}$, where
  Nt = population density after time t
  N_0 = population density at time 0 (beginning)
  r = intrinsic rate of natural increase
  e = the base of natural logarithm (2.71828)

Logistic Growth Model

- It is not possible for a population to grow continuously and exponentially because the resource availability becomes limited at certain point of time.
- Every environment or habitat has resources to support a particular maximum number of individuals, called its carrying capacity; beyond this there is no increase in the size or density of a population.
- A population which demonstrates logistic growth, shows sigmoid curve, when we plot N in relation to time; such a growth is also called **Verhulst-Pearl Logistic Growth.**

Previous Year's Question

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

(1) The food plants mature and die at the end of the rainy season.
(2) Its population growth curve is of J-type.
(3) The population of its predators increases enormously.
(4) S-shaped or sigmoid growth of this insect.

Gray Matter Alert!!!

Carrying Capacity: The maximum number of individuals of a population (or size of a population) that can be sustained by a given habitat, is called its carrying capacity.

Previous Year's Question

Two opposite forces operate in the growth and development of a population, one of these is ability to reproduce at a given rate. The force opposite to it is called

(1) Biotic potential
(2) Mortality
(3) Fecundity
(4) Environmental resistance

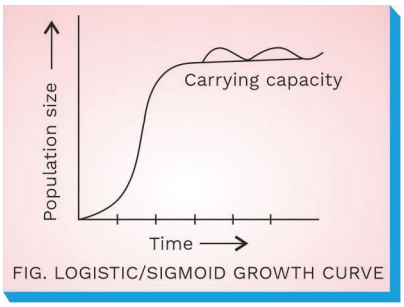


FIG. LOGISTIC/SIGMOID GROWTH CURVE

- It is described by the equation,
  $N_t = N_0 e^{rt}$
  Where N = Population density at time t.
  r = Intrinsic rate of natural increase
  K = Carrying capacity.
- This growth model is more realistic in nature because no population can sustain exponential growth indefinitely, as there will be completion for the basic needs among organisms.

Life History Variation

- Evolution of population aims at improving the reproductive fitness or Darwinian fitness to the maximum in their habitats.
- In due course of time organisms have evolved the efficient reproductive strategy.
- According to ecologists, organisms have developed life history traits to cope with various biotic and abiotic factors in their habitats in order to strengthen their survival and continuity of species.
- Few examples are-
  - Some organisms breed only once in their lifespan like Pacific Salmon fish and bamboo.
  - Most animals breed many times during their life time like man, birds, cattle, etc.
  - Smaller animals produce large number of offsprings as most of them die before maturing due to various environmental stress e.g. oysters, insects and pelagic fishes produce a

Previous Year's Question

Consider the following four statements (14) about certain desert animals such as kangaroo rat.

(A) They have dark colour and high rate of reproduction and excrete solid urine.
(B) They do not drink water, breathe at a slow rate to conserve water and have their body covered with thick hairs.
(C) They feed on dry seeds and do not require drinking water.
(D) They excrete very concentrated urine and do not use water to regulate body temperature. Which two of the above statements for such animals are true?

(1) C and A
(2) A and B
(3) C and D
(4) B and C

Rack Your Brain

In the absence of all predators in a jungle, which growth modal can be seen of the animals?

large number of small-sized offsprings.
- Macro-organisms produce less number of offsprings which are comparatively large in size and have more chance to reach adulthood e.g.,birds and mammals.

POPULATION INTERACTIONS

- Living organism cannot live in isolation and they do interact in various ways to form biological communities.
- Interspecific interactions are those interactions of individuals or populations of two different species.
- Such interactions are of the following types:
  - Beneficial to both organisms involved (mutualism).
  - Beneficial or helpful to one organism and harmful or detrimental to the other organism (parasitism and predation).
  - Beneficial to one and neutral (neither beneficial nor harmful) to the other (commensalism).
  - Detrimental to both (competition).
  - Detrimental to one and neutral to the other (ammensalism).

Name of Interaction	Species A	Species B
(i) Mutualism	+	+
(ii) Predation	+	–
(iii) Parasitism	+	–
(iv) Commensalism	+	0
(v) Competition	–	–
(vi) Amensalism	–	0

Mutualism

- It is interspecific interaction in which both the interacting species are benefited.
- The following are examples of mutualism:
  - **Lichens**
    - Lichens is the best example of intimate mutualistic relationship between a **fungus** and an **alga** or a cyanobacterium.
    - Here the fungus helps in absorption of nutrients and provides protection, while

Previous Year's Question

Animals have the innate ability to escape from predation. Examples for the same are given below. Select the incorrect example.
(1) Colour change in Chamaeleon
(2) Enlargement of body size by swallowing air in puffer fish
(3) Poison fangs in snakes
(4) Melanism in moths.

Previous Year's Question

A high density of elephant population in an area can result in
(1) intraspecific competition
(2) interspecific competition
(3) predation on one another
(4) mutualism.

Gray Matter Alert!!!

Parasitoids: Organisms which live as parasites in larval stage but become free living later on, e.g., *Trichogramma*. Parasitoids are used to control crop pests.

the algan or cyanobacterium prepares the food.

- **Mycorrhizae**
  - Mycorrhizae are mutualistic association between fungi an the roots of higher plants.
  - In this, the fungus helps the plant in absorption of essential nutrients while the plant provides food for the fungus.
- Plants depend on insects for pollination; the pollinators are rewarded in the form of nectar or edible pollen or site for oviposition.
- **Sexual deceit by Mediterranean orchid**
  - The Mediterranean Orchid, *Orphreys* employs sexual deceit for pollinating its flowers.
  - In this orchid, flowers are zygomorphic where one petal of the flower resembles the female bee species particulary in size, colour, markings, etc.
  - The male bee **pseudocopulates** with the floral petal perceiving it as a female bee.
  - During the process, the pollen grains are dusted on the body of male bee.
  - When the same male bee is attracted by another flower of this species it repeats the process, the pollen grains get attached on the stigma, i.e. pollination is achieved.

FIG. BEE ORCHID

Previous Year's Question

As an adaptation to fire, some plants produce lignotubers which are
(1) Born on the leaves
(2) Present on the main stem
(3) Born underground
(4) Suspended from the branches

Rack Your Brain

What is the relationship known as was one population is harmed while the other remains unaffected?

Previous Year's Question

The rate of individuals taking birth per 1,000 per year is called
(1) Mortality rate
(2) Vital rate
(3) Natality rate
(4) Growth rate

Predation

- It is interspecific interaction, where one animal (predator) kills and eats the other animal (prey).
- Predation is part of forest food chain where the energy fixed by plants is transferred to the higher trophic levels. For example
  - A tiger killing and eating a deer.
  - A snake eating a frog.
  - A sparrow eating an insect, fruit or seed.
- Predators play the following important roles in an ecosystem:
  - They act as a channel for energy transfer to highest trophic levels.
  - They keep the population (herbivores) under control, which otherwise can reach very high population density and disturb the balance of the ecosystem.
  - Species diversity in a community is maintained by reducing the intensity of competition among the competing prey species.
- Organisms of prey species have also evolved various defence mechanisms to save themselves from predation; few are as follows -
  - Camouflage (cryptic colouration) observed in certain insect species and frogs is to avoid detection by their predators.

Previous Year's Question

Competition of species leads to
(1) extinction
(2) mutation
(3) greater number of niches
(4) symbiosis

Rack Your Brain

Name an interspecific interaction was one organism depends on other for its nutritional needs but is not a parasite.

FIG. VIETNAMESE MOSSY FROG

FIG. LEAF MANTIS

FIG. GREEN CHAMELEON CAMOUFLAGED BY TAKING COLOURS

- Some animals are highly distasteful to their predators so are saved from predation.
- The Monarch butterfly species accumulates a chemical by feeding on a poisonous weed (*Calotropis*) during its caterpillar stage.

FIG. MONARCH CATERPILLAR

- Some prey are poisonous and hence are avoided by predators, e.g., Dart frogs like *Phyllobates bicolour* and Dendrobates.

- We can define herbivores as the predators of the plants.
- Phytophagus organisms- Approximately 25% of the known insects are phytophagous and feed on the sap and other parts of plants.

Rack Your Brain

Monarch caterpillars are not eaten by the birds, why?

Previous Year's Question

Assertion: Animals adopt different strategies to survive in hostile environment.
Reason: Praying mantis is green in colour which merges with plant foliage.

(1) Both the statements are true.
(2) Assertion is true but reason is false.
(3) Assertion is false but reason is correct statement.
(4) Both the statements are false.

Rack Your Brain

Grazing animals avoid which of the following plants:
Calotropis, grass, neem, carrot grass.

- Plants cannot hide from grazing animals so some of the plants have developed some morphological and chemical defence mechanisms against herbivores; a few of them are listed below:
  - Thorns (*Bougainvillea*) and spines (*Acacia*, Cactus etc.) are the most common morphological means of defence.
  - Plants produce and store certain chemicals which functions in one or more of the following ways:
    - They may make the animal feel sick.
    - They may inhibit them from feeding.
    - They may interfere with digestion.
    - They may even directly kill them, e.g., *Calotropis* produces a highly poisonous glycoside, that is a cardiac poison.
    - Nicotine, strychnine, optimum, quinine, etc. are the chemicals produced by plants for their defence against herbivores.
- Starfish *Pisaster* is generally found in rocky intertidal areas. It is an example of predation and it feeds on various species of invertebrates. In a particular experiment this predator was removed from small experimental area, it was observed that within a few hundred days approximately ten species of invertebrates got extinct.

FIG. STARFISH (PISASTER)

FIG. CALOTROPIS

Rack Your Brain

In the absence of all predators in a jungle, which growth modal can be seen of the animals?

Parasitism

- It is the interspecific interaction, where one of the species (parasite) depends on the other species (host) for food and shelter; in the process, the host is damaged.
- In this association the parasite is benefited, while the host is either harmed or killed.
- Parasites are host-specific and the parasite and its host tend to co-evolve.
- Some of the parasitic animals have evolved (one or more) the following adaptations:
  - Loss of unnecessary sense organs.
  - Presence of hooks or adhesive organs and suckers.
  - Loss of digestive system.
  - High reproductive capacity.
- The life-cycle of parasites are complex and often involve one or more intermediate hosts. E.g.
  - The human liver fluke completes its life cycle in a snail and a fish.
  - Plasmodium (material parasite) used female Anopheles mosquito as its vecto
- Host is harmed by the parasite in the following ways:
  - Survival of host is threatened .
  - Growth and reproductive rates get adversely reduced.
  - Render the host vulnerable to its predators by making them physically weak.
- **Types of Parasites**
  - Ectoparasites
  - Endoparasites
- Ectoparasites are found on the external surface of the host.
  - Head-lice on humans
  - Ticks on dogs' skin
  - Marine copepods on fish
  - *Cuscuta* on hedge plants
- Endoparasites take shelter within the body of host in the organs like intestine, liver, lungs, blood cells, etc. E.g.,

Gray Matter Alert!!!

Antibiosis: An association of two organisms which is harmful to one of them.

Gray Matter Alert!!!

Gloger Rule: Some insects, birds and mammals in warm humid climates bear darker pigment than the races of same species present in cool and dry climates. This phenomenon is known as Gloger rule.

Previous Year's Question

Niche overlap indicates

(1) mutualism between two species

(2) active cooperation between two species

(3) two different parasites on the same host

(4) sharing of one or more resources between the two species.

- Tapeworm (Intestine)
- Liver fluke (Liver)
- *Plasmodium* (Red blood cells, Liver)

- Brood parasitism, a phenomenon in which one bird species lays its eggs in the nest of another bird species and the foreign eggs are hatched as well as chicks are fed by the host bird.
- Its interesting to know that during evolution the eggs of the parasitic birds have developed resemblance with those of the host bird in size, colour, etc. to avoid the host bird detecting the foreign eggs and rejecting them from the nest.
  - e.g., Cuckoo birds lay eggs in the nest of crows.

Commensalism

- Commensalism is defined as the interspecific interaction, where one species is benefited while the other species is neither benefited nor harmed.
- The following are the examples showing commensalism:
  - Orchids grow as epiphytes on different trees like mango or other fruit trees.
  - Orchids are benefited by getting a shelter, while the tree is neither benefited nor harmed.
  - **Barnacles** growing on the **whale** are benefited to move to where food is a available.
  - The cattle **egrets** always forage near to the grazing cattle.
    - While grazing the cattle animals force the insects to leave the vegetation and move out.
    - The egrets are benefited by this as they spot the insects easily, otherwise the birds have to put lots of effort to detect and catch the insects.
  - The **clown fish** living among **sea anemones** get protection from their predators, which stay away from the stinging tentacles of the sea anemone.

Previous Year's Question

Assertion: Cold blooded animals have no fat layer.
Reason: Cold blooded animals use their fat for metabolic processes during hibernation.
(1) Both the statements are true.
(2) Assertion is true but reason is false.
(3) Assertion is false but reason is correct statement.
(4) Both the statements are false.

Rack Your Brain

Fill up the blank.
Mutualism is shown by mycorrhizae and commensalism is shown by _____

Rack Your Brain

Name any two types of interspecific interactions which are considered as negative interactions.

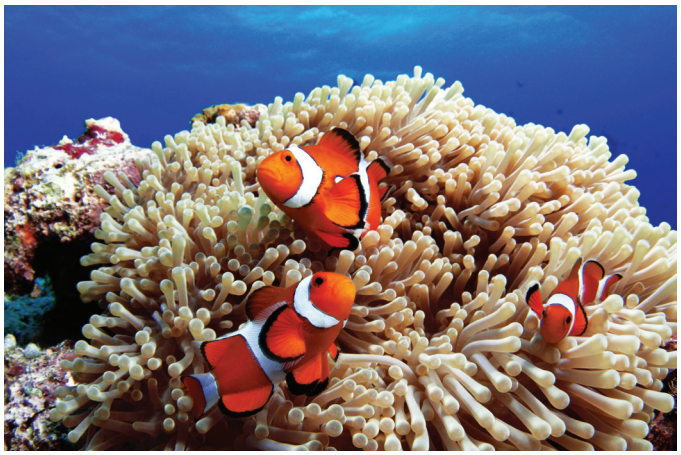


FIG. WESTERN CLOWN ANEMONEFISH

Competition

- Competition is a type of interaction either among individuals of the same species (intraspecific competition) or between individuals or population of different species (interspecific competition).
- Competition occurs mostly among closely related species as they share common eating habits or living conditions so the individuals compete for the same resources that are limited in nature.
- Competition can occur between unrelated species too as these also compete for the same natural sources.
  - E.g. In certain shallow lakes of South America, the visiting flamingos and the native fishes compete for the same zooplanktons as their food.
- It is not necessary that the resources need to be limiting for competition to occur because sometimes the feeding efficiency of one species is far more than the other species which is dependent on the same resource. This might reduce the other species due to interfering and inhibitory presence of the dominating species even if resources are plenty.
  - E.g. when goats were introduced in the Galapagos island the population of Abingdon

Previous Year's Question

Competition is the most severe between two
(1) closely related species growing in different niches
(2) closely related species growingin the same habitat
(3) disgtantly relatd species growing in the same habita
(4) distantly related species growing in different niches

Gray Matter Alert!!!

Synecology: The study of inter-relatoionships between an entire community and its environment.

Previous Year's Question

Ecology is the study of relationships of
(1) members of a family
(2) man and environment
(3) organisms and environment
(4) soil and water

Gray Matter Alert!!!

Antibiosis: An association between two or more organisms and one of them is harmed.

tortoise in Galapagos island became extinct within a decade. This happened as the goats had greater browsing efficiency than the tortoise.

- Competitive release is another evidence for competition.
- A phenomenon in which a competitively superior species forces the weaker species to move out of the habitat. And the superior species expands its distribution range.

Gause's competitive exclusion principle

Condition- Limited Resources

- When two closely related species are competing for the same resources cannot exist together for long if the resources for which there is struggle are limited.
- The competitively inferior species will be eliminated if the resources are limiting.

Second Condition- Unlimited Resources

- If the shared resource is not limited then the species can defeat exclusion.
- Competing species evolve mechanisms that promote co-existence, rather than exclusion.
- Mac Arthur had demonnnstrated that five closely related species of warblers co-existed on the same tree and avoided competition by their behavioural differences in their foraging activities.

Amensalism

- When two organisms or species interact in such a way that one species is harmed and the other species remains unaffected i.e. neither benefited nor harmed.
- The antibiotic secreted by a fungus kills many other bacteria in its vicinity but the fungus remains unaffected.

Previous Year's Question

Adaptation to low temperature and freezing in animals occurs due to the production of
(1) Antifreeze proteins
(2) Chaperonins
(3) Proline
(4) Analine

Gray Matter Alert!!!

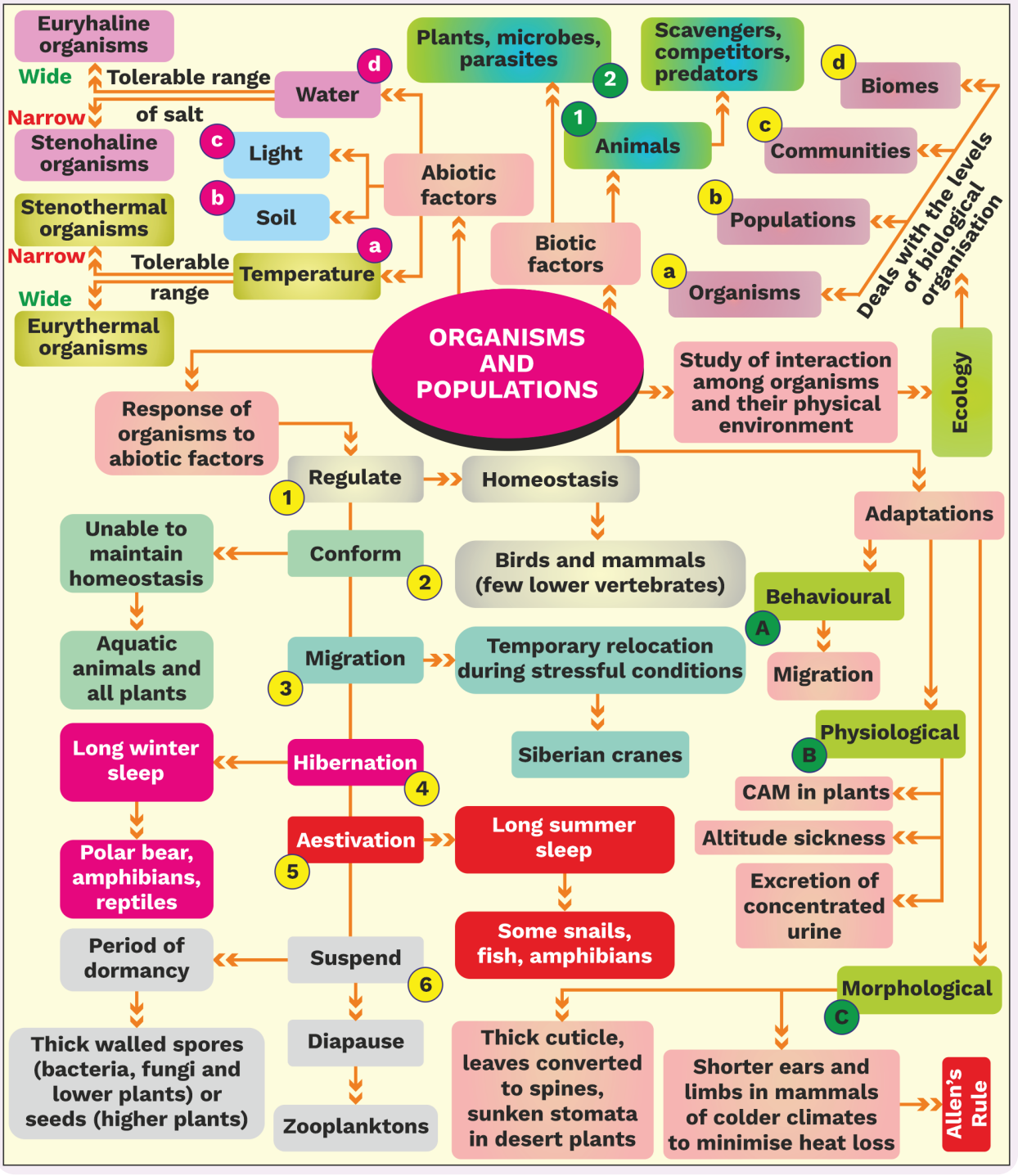
Gloger's Rule: Some insects, birds and mammals in warm humid climates bear darker pigment than the races of same species present in cool and dry climates. This phenomenon is known as Gloger's rule.

Previous Year's Question

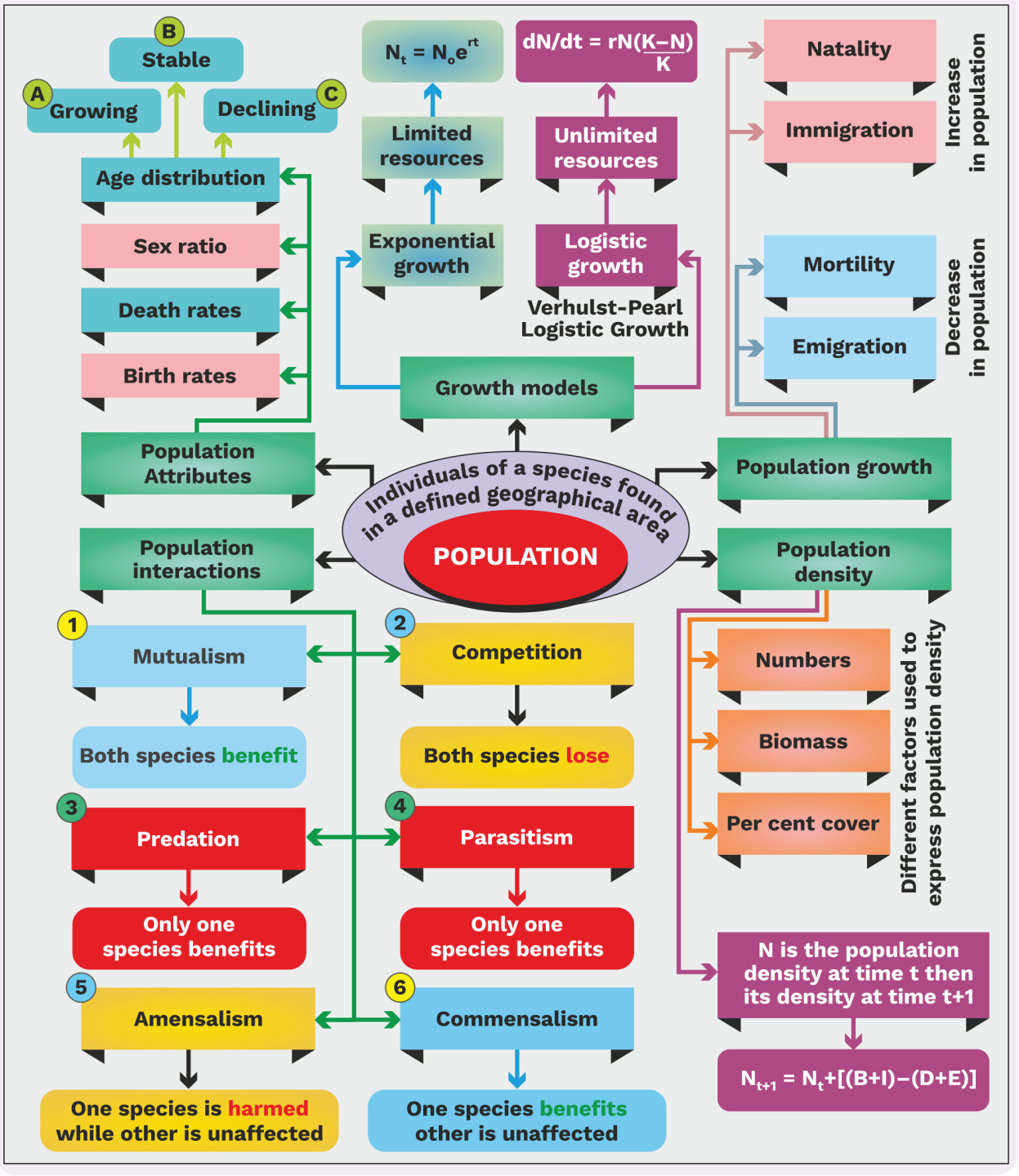
In a population curve, the rate of growth becomes steady towards the end of exponential curve due to
(1) Reproductive power is reduced
(2) Environmental stress
(3) Migration
(4) All of these

Note:
Sibling Species: Morphogically similar sympatric populations which are closely related but reproductively isolated.

Summary


ORGANISMS AND POPULATIONS
Abiotic factors
Biotic factors
Water
Light
Soil
Temperature
Euryhaline organisms
Wide
Tolerable range of salt
Narrow
Stenohaline organisms
Stenothermal organisms
Narrow
Tolerable range
Wide
Eurythermal organisms
Plants, microbes, parasites
Animals
Scavengers, competitors, predators
Organisms
Biomes
Communities
Populations
Deals with the levels of biological organisation
Study of interaction among organisms and their physical environment
Ecology
Response of organisms to abiotic factors
Regulate
Homeostasis
Conform
Unable to maintain homeostasis
Aquatic animals and all plants
Birds and mammals (few lower vertebrates)
Migration
Temporary relocation during stressful conditions
Siberian cranes
Hibernation
Long winter sleep
Polar bear, amphibians, reptiles
Aestivation
Long summer sleep
Some snails, fish, amphibians
Suspend
Period of dormancy
Thick walled spores (bacteria, fungi and lower plants) or seeds (higher plants)
Diapause
Zooplanktons
Adaptations
Behavioural
Migration
Physiological
CAM in plants
Altitude sickness
Excretion of concentrated urine
Morphological
Thick cuticle, leaves converted to spines, sunken stomata in desert plants
Shorter ears and limbs in mammals of colder climates to minimise heat loss
Allen's Rule

Summary


POPULATION
Individuals of a species found in a defined geographical area
Population Attributes
Age distribution
A Growing
B Stable
C Declining
Sex ratio
Death rates
Birth rates
Growth models
$N_t = N_o e^{rt}$
Exponential growth
Limited resources
$dN/dt = rN(\frac{K-N}{K})$
Logistic growth
Unlimited resources
Verhulst-Pearl Logistic Growth
Population growth
Natality
Immigration
Increase in population
Mortility
Emigration
Decrease in population
Population interactions
1 Mutualism
Both species benefit
2 Competition
Both species lose
3 Predation
Only one species benefits
4 Parasitism
Only one species benefits
5 Amensalism
One species is harmed while other is unaffected
6 Commensalism
One species benefits other is unaffected
Population density
Numbers
Biomass
Per cent cover
Different factors used to express population density
N is the population density at time t then its density at time t+1
$N_{t+1} = N_t + [(B+I)-(D+E)]$

Solved Exercise

Q1 **The total of the populations of the same kind of organisms constitute**
(1) colony (2) genus (3) community (4) species

Sol: **(4)**
Species are individuals of the same kind.

Q2 **Relationship of animals when both partners are benefitted**
(1) colony (2) mutualism (3) commensalism (4) ammensalism

Sol: **(2)**
An association in which both are benefitted neither are harm.

Q3 **How can the fertility of soil be measured-**
(1) retain nutrients (2) hold organic materials
(3) hold water (4) support life

Sol: **(4)**
Life supporting availability of the soil to support life in the measure of its fertility.

Q4 **A sedentary sea anemone gets attached to the shell lining of hermit crab. The association is**
(1) commensalism (2) amensalism
(3) ectoparasitism (4) symbiotic

Sol: **(4)**
Both are in benefitted.

Q5 **Identify a non-parasitic adaptation.**

(1) Development of adhesive organs **(2) Loss of digestive organs**

(3) Loss of reproductive capacity **(4) Loss of unnecessary sense organ**

Sol: **(3)**

High ability of reproduction is needed for a parasite.

Q6 **Brood parasitism is seen in**

(1) crow **(2) cuckoo** **(3) sparrow** **(4) pigeon**

Sol: **(1)**

Crow lay its eggs in the nest of cuckoo.

Q7 **Geometric representation of age structure is a characteristic of**

(1) population **(2) landscape**

(3) ecosystem **(4) biotic community**

Sol: **(1)**

It is represented by age pyramid.

Q8 **Two closely related species cannot live for long duration in the same niche or habitat. This law is**

(1) Allen's law **(2) Gause's hypothesis**

(3) Dollo's rule **(4) Weisman's theory**

Sol: **(2)**

Cannot live in the same niche for a long duration if they both are feeding on same resources.

Q9 **The maximum growth rate occurs in**

(1) stationary phase **(2) senescent phase**

(3) lag phase **(4) exponential phase**

Sol: **(4)**

Conditions favour maximum growth rate.

Q10 **The age pyramid with broad base indicates**

(1) high percentage of old individuals

(2) low percentage of young individuals

(3) a stable population

(4) high percentage of young individuals

Sol: **(4)**

Broader base shows higher number of pre-reproductive individuals.