XII 13

ORGANISMS AND POPULATIONS

SYLLABUS

Habitat and niche; Population and ecological adaptations; Population interactions-mutualism, competition, predation, parasitism; Population attributes-growth, birth rate and death rate, age distribution.

KEY CONCEPTS

ORGANISM AND ITS ENVIRONMENT

* The study of interaction or inter-relationship of organisms with their environment is called **ecology.**
* The term ecology was coined and described by **E. Haekel.**
* The term ecology was first authentically used by **Reiter.**
* Father of ecology - Reiter.
* Study of ecology was initiated in India by - **W. Dudgeon.**
* Father of India Ecology-**Prof. Ram Deo Mishra.**
* **Ecological Hiereachy :**
  Organism $\rightarrow$ Population (species) $\rightarrow$ community $\rightarrow$ Ecosystem $\rightarrow$ Biome $\rightarrow$ Biosphere
* **Habitat** is a specific place (or locality) where an organism usually lives.
* Both abiotic (physic-chemical) and biotic components (pathogen, parasites, predators, competitions) characterize the habitat of an organism.
* **Ecological Niche (Concept given by J. Grinnel).** It represents functional role and status of a species in the environment. It represents habitat and trophic position of a species. No two species can have the same niche if they are found in same environment.

* **Population :** Group of individuals of same species in a well defined geographical area which share or compete for similar resources and can potentially interbreed. Their study links ecology to genetics and evolution of a population.
* **Community** : A number of different interrelated populations of different species sharing a common environment.
* **Ecosystem:** A functional unit of nature, where living organisms interact among themselves and with surrounding physical environment.
* **Biome :** A large regional unit characterized by a major vegetation type and associated fauna found in a specific climatic zone.
* **Biosphere** : Any part of atmosphere inhabited by biological organisms.
* **Environmental Factors:** Components, conditions and forces of environment which have a direct or indirect effect on the form, functioning, behaviour, survival and reproduction of organisms are called **environmental factors.** They are of two types-abiotic and biotic.
* **Abiotic factors** are divisible into three categories atmospheric, edaphic and topographic.
* **Atmospheric factors** are light, temperature, water and wind.
* **Edaphic factors** are factors related to soil.

* **Topographic factors** are abiotic or physical factors related to slope, altitude and others concerned with surface of earth. **Biotic factors** include all interactions between living organisms.

TERRESTRIAL BIOMES

* Large ecosystem is called biome, mainly large aquatic and terrestrial ecosystem are called biomes.
* Altitude and latitude determine the boundary of biome.

1. **Tundra Biome :**
* This region lies above 60° North latitude (or North of timber line or tree line) is known as Tundra. (Timber line – Line beyond which trees are not found).
* In this region soil is covered by snow and ice (perma frost) almost whole of the year.
* At 3600 m height of Himalayas called Alpine tundra.
* The annual rain fall is low and generally below 25 cm/year.
* This biome is without trees so it is called tree less biome. The trees and shrubs are absent in this biome so it is also known as Arctic desert. It is most delicated and fragile biome.
* **Vegetation :** Lichens, Mosses, Grasses etc.
* **Animals :** Foxes, Reindeer, Migratory birds, Polar bear etc.

2. **The northern coniferous or Needle-leaf forest :**
* The northern or temperate coniferous forest is also known as Taiga or North wood.
* It is situated immediately south of the Tundra.
* Distributed over 1700 to 3000 m altitude in Himalaya.
* Annual rain fall is 50 -170 cm/year.
* The average winter temperature is 6°C and 20°C in summer.
* The evergreen temperate forests are found on Himalaya.
* 30-35 m tall trees.
* **Vegetation :** Pines, Silver fir, Maple, Hemlock, Spruce, Deodar, Cypress
* **Animals :** Deer, Rabbit, Squirrels, Elks, Insects, Snakes, Lizards.

3. **The Temperate Deciduous Forest :**
* The deciduous forest lies in temperate zone about 40°-60° N latitude and 1500-2400 m altitude central location.
* The annual rainfall about 100-250 c.m.
  Vegetation : Broad leaved forest which includes oak(Quercus), Birch, Maple, Hickory Beech etc.
  Note : The trees shed their leaves in autumn and bear again in spring.
* **Animals:** The animals include frog, salamander, Turtle, Lizard, Squirrel, Rabbit, Deer and Foxes etc.

4. **The Tropical Rain forest :**
* The tropical rain forest biome lies on the equatorial region around the earth.
* In India tropical rain forest is found in Eastern Himalaya and Western Ghats.
* Tropical rain forest are present in Assam, W.Bengal, Kerela and Andman in India.
* The main feature of this biome is the large amount of annual rainfall which is more that at least 200-300cm. per year.
* The tropical rain forest are richest in flora and fauna. The highest species of plants and animals are found here.
* The temperature is high and uniform throughout the year. Climate warm and humid.
* Mean annual temperature 23-27°C.
* **Vegetation :** Dipterocarpus and Hopea.
* Generally parasitic plants are found in these places such as - Cuscuta, Viscum, Loranthus, Orobanche, Rafflesia, Striga and Santalum (Chandan).
* In addition of these saprophytic plants also found like Monotrapa.
* 30-40m tall trees
* Woody climbers and epiphytes.

5. **Tropical Deciduous Forest :**
* Occurs widely in the northern and southern part of our country in plain and low hilly area.
* **Annual Rain fall :** 90-160 cm/year
* Leaves of most of the trees fall before the summer.
  Vegetation : Sal (*Shorea robusta*), Teak (*Tectona grandis*), Tendu, Chiraungi, Khair.

6. The Chaparral (Mediterranean Scrub forest) Biome :

* The mediterranean forests occur along the pacific coast of North America and South coast of Australia.
* It is also called temperate evergreen forest.
* Limited rain during the winter and remaining time it is dry.
* The drought resistant species of plants and animals are found in this biome.

  Vegetation : Broad, leaved, fire resistant evergreen plants, small trees and shrub like sage.

  Animals : Mule, deer, brush rabbit and wood rates etc.

7. The Tropical Savanna Biome :

* The Tropical Savanna biome is located in South America and Australia.
* It is also called tropical grassland.
* The rain fall is seasonal and very high.
* In this biome grass are found with few scattered tree.

  Vegetation :

* **Coarse grass:** *Dichanthium, Sechima, Phragmites*
* **Trees :** *Acacia, Eucalyptus, Zizyphus, Prosopis*

  Animals : The biome supports the hoofed mammals in large number. They include the herbivores like Zebra, Giraffe, Elephant and several antelope and kangaroo which are confined to Australia.

8. The Grass land Biome :

* Annual rainfall between 25 -75 cm
* Winter and summer have longer duration and the maximum rain fall is in summer.

Name of Grass lands	Place
Prairies	North America
Pampas	South America
Steppes	Europe & Asia (Russia)
Tussocks	Newzealand
Veldts	Africa

9. The Desert Biome :

* The desert biome stretches in the dry region of the world where there is very little rainfall.
* The deserts are located around the tropic of cancer and tropic of capricorn, between latitude 15° to 35° north and south.

* The annual rainfall is very less (less than 25 cm).
* Flora and fauna are found very less.

  The main deserts sare the Sahara desert of North Africa, the Thar, Gobi and Tibet desert of Asia. Sahara- North Africa ; Tibet, Gobi, Thar - Asia Gobi desert is cold desert; Sahara and Thar are hot desert.

* Important trees of Indian desert are *Prosopis cineraria, Acacia* sp., *Salvadora* sp. and *Tamarix* sp. common succulents are species of *Euphorbia* and many members of family Cactaceae. *Cenchrus* is an abundant grass of these biomes.

NOTE

1. The basal region of the tropical mountain range is called Terai.
2. In temperate forest soils, the top horizon of soil is a rich mixuture of humus and inorganic components but top soil of tropical rain forest is nutrient poor and shallow due to heavy rainfall and high temperature.
3. Sub-soil of tropical rain forest is dense and thick.
4. Biome distribution with respect to annual temperature and precipitation
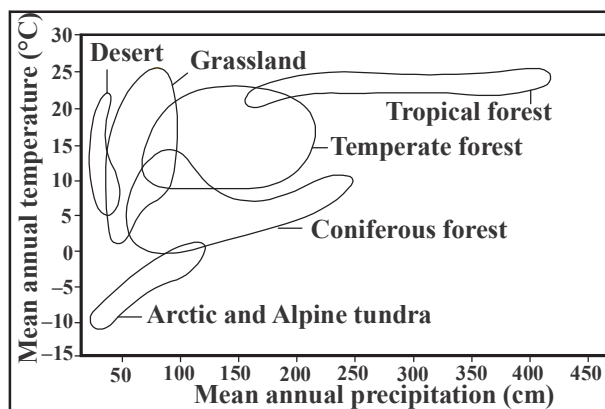
MAJOR ABIOTIC FACTORS

(a) Temperature:

* Ecologically most important factor.
* Temperature decreases progressively from equator towards the pole and high altitudes to > 50°C in tropical deserts in summer.

* Thermal springs and deep-sea hydrothermal vents are unique with >100°C. Thermophiles are found in such harsh habitats.
* Temperature affects the kinetics of enzymes, BMR and other physiological actions.
* Thermal tolerance decides the geographical distribution of different species to a large extent as for example ; mango trees do not and cannot grow in temperate countries like Canada and Germany, snow leopards are not found in Kerala forests and tuna fish are rarely caught beyond tropical latitudes in the ocean.
* **Eurythermals:** Organism which can tolerate wide range of temperatures.
* **Stenothermal:** Organism which can tolerate narrow range of temperatures.
* The occurrence of temperature variations in different horizontal layers as in a deep water body is called **thermal stratification.**

(b) **Water:**
* Productivity and distribution of plants depends on water.
* The salt concentration (measured as salinity in parts per thousand) is less than 5 percent in inland water, 30 -35 percent for sea and more than 100 percent in some hypersaline lagoons.
* **Euryhaline :** Organisms that can tolerate wide range of salinity. (eg., Salmon)
* **Stenohaline :** Organisms that can only tolerate narrow range of salinity. (eg. Shark)
* Freshwater animals cannot live in sea water and vice versa because of osmotic problems.

(c) **Light:**
* Light is the visible part of electromagnetic spectrum (390-760 nm).
* Photosynthetically active radiations (PAR) have a range of 400- 700 nm.
* Radiations below the visible light are ultraviolet (UV) radiations while those above the visible light are infra-red or heat waves.
* Amount of light and its intensity vary with latitude and season.

Importance of light for plants :
* Importance of light can be understand by its role in the process of photosynthesis-production of organic food by autotrophs.
* Depending upon requirement of light intensity, plants are of two types - (a) **heliophytes,** require high intensity light and (b) **Sciophytes**, require low intensity light and grow in shaded area.
* Many species of small plants (herbs and shrubs) growing in forests are adapted to photosynthesise optimally under very low light condition (sciophytes), because they are constantly overshadowed by tall, canopied trees (heliophytes).
* Many plants are also dependent on sunlight to meet their photoperiodic requirement for flowering.
* Light also affects other processes like growth, reproduction, movements and phenology in plants.

Importance of light for animals:
* Many animals use the diurnal and seasonal variations in light intensity and duration (photoperiod) as cues for timing their foraging, reproductive and migratory activities.
* The availability of light on land is closely linked with that of temperature. Since the sun is the source for both (sun is the ultimate source of all type of energy).
* Deep in the oceans (>500 m), the environment is perpetually dark and its inhabitants not aware of the existence of a celestial source of energy called Sun.
* Such organisms, in majority are decomposers/consumers categories and they are dependent upon food material derived from producers found in upper light regime of oceans.
* The spectral quality of solar radiation is also important for life.
* Short wave radiations (wavelengths below visible light) which includes cosmic rays ($< 10^{-5}$nm λ), gamma rays (10^{-3} to 10^{-5} nm λ) X-rays (10^{-1} to 10^{-2} nm λ) and UV rays (100 to 400 nm λ) are extremely harmful.
* Most of them are trapped in ionosphere and mesosphere. The UV component of the spectrum is harmful to many organisms.
* Marine plants living at different depths of the ocean, not receive all the colour components of the visible spectrum.

* The vertical and horizontal distributions of red, green and brown algae are limited in part by the availability of sunlight and therefore vary by depth, latitude, sea conditions and season.
* The vertical distribution of red, brown and green algae can be explained by their accessory photosynthetic pigments, the presence of which gives the sea weeds their characteristic colours, a concept known as **chromatic adaptation**.
* Because blue-green light penetrates deepest in coastal waters and the accessory pigments of red algae absorb mostly green wavelengths, red algae extend to the greatest depth of primary producers.
* Green algae, which have pigments absorbing mostly blue and red wavelengths that are diminished rapidly in seawater, found at shallowest depths.
* The accessory pigments of brown algae absorb intermediate wavelengths of light therefore brown algae would be expected to be most abundant at intermediate depths.

(d)   Soil:
*   **Nature of soil depends on**
    I.   Climate
    II.   Weathering process
    III.   Sedimentary or transported
    IV.   Soil development

Characteristics of soil :
a.   Soil composition b. Grain size; c. Aggregation-determine percolation & water holding capacity of soil
*   These characteristics along with pH, mineral composition and topography determine to a large extent the vegetation in any area.
*   The sediment-characteristic often determine the type of benthic animal in aquatic environment.
*   The study of soil is called edaphology or pedology.
*   Best pH of the soil for cultivation of plant is 5.5 – 6.5.
*   Excess water produces salinity problem in soil.

Response to Abiotic factors:
*   **Homeostasis**; the process by which the organism maintain a constant internal environment in respect to changing external environment.

How does organism cope with the changing environment?
(i)   Regulate: maintain homeostasis by ensuring constant body temp (thermoregulation), and constant osmotic concentration (osmoregulation). Examples - mammals regulate temperature by shivering in cold and sweating in heat.

(ii)   Conform:
*   Majority (99%) of animals and plants cannot maintain a constant internal environment; their body temperature varies according to ambient temperature.
*   In aquatic animals the osmotic concentration of body fluid varies with ambient water osmotic concentration.
*   All the above animals and plants are simply called as conformer.

Why the conformer not evolved to became regulators?
*   Thermoregulation is energetically expensive for many animals.
*   Small animal like shrews and humming birds cannot afford so much energy for thermoregulation.
*   Heat loss or heat gain is a function of surface area.
*   Small animals have larger surface area relative to their volume, they tend to lose body heat very fast when it is cold outside; then has to expend much energy to generate body heat through metabolism.
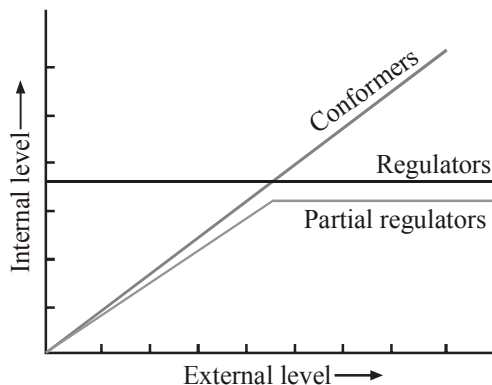

Figure : Diagrammatic representation of organismic response

*   This is why very small animals are rarely found in Polar Regions.

* Alternative response for stressful conditions is localized or remains for short duration.

(iii) Migrate:
* The organism moved away temporarily from the stressful habitat to a more hospitable area and return when stressful condition is over.
* Bird migrate form the colder region to warmer region.
* E.g.- Migration of birds to Keolado National Park, Rajasthan from Siberia.

(iv) Suspend:
* The organisms may avoid the stress by escaping in time.
* Thick walled spores are formed in microbes to overcome unfavourable stressful external environment. Spores germinate in favourable condition.
* In higher plants seeds and other vegetative reproductive structures are means to tide over the stress. They reduce their metabolic activity and going into a state of 'dormancy'.
* **Hibernation:** during winter animals like bears escape in time
* **Aestivation:** animals like snail and fish avoid summer related problem like heat and desiccation.
* **Diapauses:** many zooplanktons undergo a stage of suspended development in unfavourable conditions.

ADAPTATION

* It is any attribute of the organism (morphological, physiological, behavioural) that enables the organism to survive and reproduce in its habitat.
* Many adaptations have evolved over a long evolutionary time and are genetically fixed. However, these may remain epigenetic (not fixed genetically).
* Some of the adaptations are as follows:
(i) Kangaroo rat, for example, in North American deserts is capable of meeting all of its water requirements through its internal fat oxidation where water is released as by-product.

* It can also concentrate its urine so that minimal volume of water is used to remove excretory products.
(ii) Many desert plants (xerophytes) have a thick cuticle on their leaf surface and have their stomata arranged in deep pits (sunken) to minimize water loss through transpiration. They also have a special photosynthetic pathway called as CAM (Crassulacean Acid Metabolism) that enables their stomata to remain closed during day time (scotoactive stomata open at night only). Some desert plants like *Opuntia*, leaves are modified to spines (reduction in surface area) to minimize water loss. Under such conditions, the stem becomes flattened, green-coloured (phylloclade) and perform photosynthetic activity of plant.
(iii) Mammals from colder climates generally have shorter ears and limbs (extremities) to minimise heat loss. This is called as **Allen's rule.**
(iv) A thick layer of fat (blubber) is found in the polar seas, aquatic mammals like seals below their skin. This acts as an insulator and reduces loss of body heat.
(v) **Altitude sickness** can be experienced at high altitude where body does not get enough oxygen due to low atmospheric pressure and causes nausea, fatigue and heart palpitations. Under these conditions, body increases RBCs production, decreases binding capacity of haemoglobin and increases breathing rate. These physiological adaptations allow organisms to respond quickly to stressful conditions.
(vi) In most of animals, the metabolic reactions or entire physiological functions proceed optimally in a narrow temperature range. In humans it occurs at 37° C temperature. However, there are microbes like *Archaebacteria* that flourish in hot springs and deep sea hydrothermal vents where temperatures far exceed 100°C.
(vii) Antarctic fishes can survive below 0°C. The body fluid of these fishes contains antifreeze solutes by which they can manage to keep their body fluids from freezing.
(viii) A large variety of marine invertebrates and fishes are adapted biochemically to survive great depths in the ocean where the pressure (called as crushing pressure) could be >100 times than the normal atmospheric pressure.

(ix) Some organisms like desert lizards lack the physiological ability to cope with extreme temperature but manage the body temperature by behavioural means. They bask in the sun and absorb heat when their body temperature drops below the comfort zone, but move into shade when the ambient temperature starts increasing. Some other organisms are capable of burrowing into the soil to hide and escape from the above ground heat.

POPULATION

* A group of individual living in a well defined geographical area, share or compete for similar resources, potentially interbreed.

Population attributes:
1. **Birth rate-** Average number of young ones born in in a period of time w.r.t members of the population.
2. **Death rates-** Average no. of deaths in a period of time w.r.t members of the population.
3. **Sex Ratio-** Number of females and males per 1000 individuals
4. **Age pyramid:** Plot of age distribution (% individuals of a given age or age group). It reflects whether growth is
   (i) Expanding   (ii) Stable (iii) Declining

Figure : Representation of age pyramids for human population
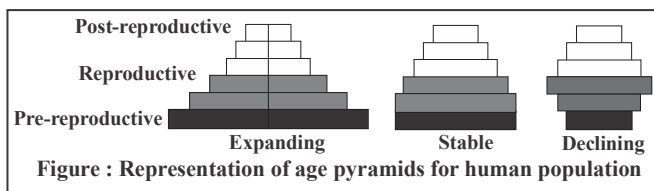
5. **Population density :**
* Number of individuals present per unit area at a given time.
* The population size is more technically called as population density.
* **Methods for measurement of population density:**
  • Counting the number.
  • Percent cover.
  • Biomass.
  • Pug marks and fecal pellets for tiger census.

Population growth:
* The size of the population changes depending on food availability, predation pressure and reduce weather.
* Population size fluctuated due to changes in four basic processes, two of which (Natality and immigration) contribute an increase in population density and two (mortality and emigration) to a decrease.
1. **Natality (B) :** Number of births during given period in the population that are added to the initial density.
2. **Mortality (D) :** Number of deaths in the population during a given period.
3. **Emigration (E) :** Number of individuals of the population who left the habitat and went elsewhere during the given period
4. **Immigration (I) :** Number of individuals of the same species that have come into the habitat from elsewhere during the time under consideration.
* If 'N' is the population density at time 't', then its density at time $t+1$ is :
$$N_{t+1} = N_t + [(B + I) - (D + E)]$$
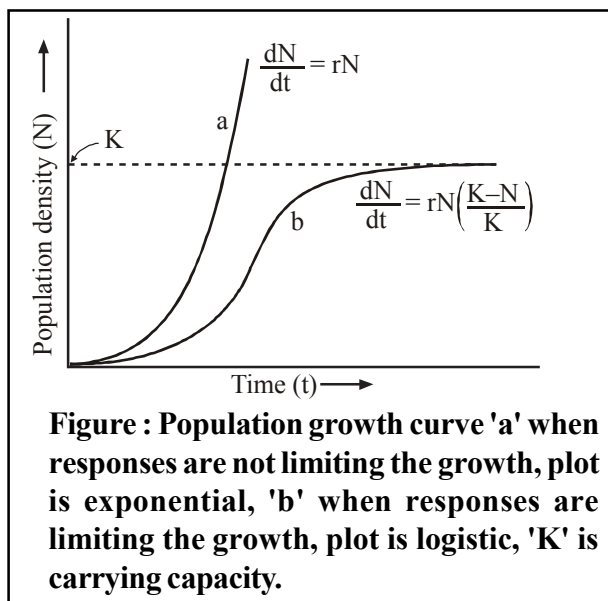Population density will increase if
$$(B + I) > (D + E)$$
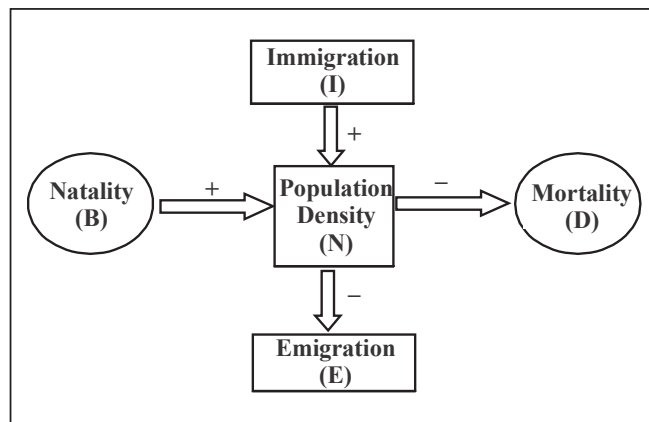
Growth models:
(i) **Exponential growth :**
('J' shape curve is obtained).
* When resources in the habitat are unlimited, each species has the ability to realise fully its innate potential to grow in number, as Darwin observed while developing his theory of natural selection. Then the population grows in an exponential or geometric fashion.

* The Exponential growth equation is
$$N_t = N_0 \, e^{rt}$$
where, N_t = Population density after time t,
N_0 = Population density at time zero
r = intrinsic rate of natural increase,
e = the base of natural logarithms (2.71828)
The equation describes the exponential or geometric growth pattern of a population and results in a J-shaped curve.

Figure : Population growth curve 'a' when responses are not limiting the growth, plot is exponential, 'b' when responses are limiting the growth, plot is logistic, 'K' is carrying capacity.

Derivation : If in a population of size N, the birth rates (not total number but per capita births) are represented as b and death rates (again, per capita death rates) as d, then the increase or decrease in N during a unit time period t (dN/dt) will be $dN/dt = (b - d) \times N$
Let $(b - d) = r$, then $dN/dt = rN$
Integrating, $N_t = N_0 \, e^{rt}$
The r in this equation is called the 'intrinsic rate of natural increase.'

(ii) Logistic growth model (Sigmoid curve is obtained)
* No population has unlimited resources-leads to competition for resources
* Fittest individual survive and reproduce
* Carrying capacity (K)- Max. population density a habitat's resources can support
* The logistic growth model is a more realistic one
* **Verhulst-Pearl Logistic Growth equation:**

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

Where N = Population density at time t,
r = Intrinsic rate of natural increase,
K = Carrying capacity.

Life history variations :
* Populations evolve to maximise their reproductive fitness, also called **Darwinian fitness** (high r value), in the habitat in which they live.
* Under a particular set of selection pressures, organisms evolve towards the most efficient reproductive strategy.
* **Examples :**
(i) Breed once in lifetime - pacific salmon fish, Bamboo
(ii) Breed many times in life time - birds, mammals
(iii) Produce large number of small sized offspring - Oysters, pelagic fishes
(iv) Produce small number of large sized offspring - birds, mammals
* Ecologists say life history traits depend on constraints of biotic and abiotic parts.

POPULATION INTERACTIONS

* Interspecific interactions - Interactions of populations of two different species
* '+' sign for beneficial interaction, '–' sign for detrimental (negative) & 0 for neutral interaction, All the possible outcomes of interspecific interactions are–

Species A	Species B	Name of Interaction
+	+	Mutualism
–	–	Competition
+	–	Predation
+	–	Parasitism
+	0	Commensalism
–	0	Amensalism

(i) Predation:
* Interaction between species involving killing and consumption of prey is called predation. The species which eats the other is called the predator and the one consumed is termed the prey. The predator keeps check on prey population. The reduction in predator population may lead to increase in prey population.

* Exotic species have no natural predator hence they grow very rapidly. (**prickly pear cactus** introduced in Australia created problem)
* Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species. (**Pisaster** starfish field experiment)

Defense developed by prey against predators:
  Animals:
* Insects and frogs are cryptically coloured (**camouflaged**) to avoid being detected by the predator.
* Some are poisonous and therefore avoided by the predators.
* **Monarch butterfly** is highly distasteful to its predator (bird) due to presence of special chemical it its body. The chemical acquired by feeding a poisonous weed during caterpillar stage.
  Plants:
* **Thorns** in Acacia, Cactus are morphological means of defense.
* Many plants produce and store some chemical which make the herbivore sick if eaten, inhibit feeding, digestion disrupt reproduction, even kill the predators.
* **Calotropis** produces poisonous **cardiac glycosides** against herbivores.
* Nicotine, caffeine, quinine, strychnine, opium etc. are produced by plant actually as defenses against the grazers and browsers.

(ii)   Competition:
* In this fitness of one species is significantly lower in presence of another species.
* Competition occurs among individuals within a population (intraspecific competition) or between different species (interspecific competition).
* Interspecific competition is a potent force in organic evolution.
* Competition generally occurs when closely related species compete for the same resources that are limiting, but this not entirely true:
  Firstly: totally unrelated species could also compete for the same resources.
* American lakes visiting flamingoes and resident fishes have their common food, zooplanktons.

Secondly: resources need not be limiting for competition to occur.
* **Abingdon tortoise** in Galapagos Islands became extinct within a decade after **goats** were introduced on the island, due to greater browsing ability.
* **Competitive release:** A species, whose distribution is restricted to a small geographical area because of the presence of a competitively superior species, is found to expand its distributional range dramatically when the competing species is experimentally removed.
* **Connell's** elegant field experiment showed that superior barnacle *Balanus* dominates the intertidal area and excludes the smaller barnacle *Chathamalus* from that zone.
* **Gause's 'competitive Exclusion Principle':** two closely related species competing for the same resources cannot co-exist indefinitely and the competitively inferior will be eliminated eventually.
* **Resource partitioning:** If two species compete for the same resource, they could avoid competition by choosing, for instance, different times for feeding or different foraging pattern.
* **MacArthur** showed five closely related species of warblers living on the same tree were able to avoid competition and co-exist due to behavioral differences in their foraging activities.

(iii)   Parasitism:
* Parasitic mode of life ensures free lodging and meals.
* Some parasites are host-specific (one parasite has a single host) in such a way that both host and parasite tend to co-evolve.

Parasitic adaptation
* Loss of unnecessary sense organs.
* Presence of adhesive organs or suckers to cling on to the host.
* Loss of digestive system.
* High reproductive capacity
* Parasites having one or more intermediate host or vectors to facilitate parasitisation of its primary host.
* Liver fluke has two intermediate hosts (snail and a fish) to complete its live cycle.

Effects on the host:
* Parasite always harms the host.
* They reduce the survival, growth and reproduction of the host.
* Reduce its population density.
* They make the host more vulnerable to the predators, by making it physically weak.

Types of parasite :
* **Ectoparasite:** feeds on the external surface of the host.
  • Lice on human.
  • Ticks on dog.
  • Marine fish infested with copepods.
  • Cuscutaa parasitic plant grow on hedge plants.
* **Endoparasites:** are those that live inside the host body at different sites.
  • Life cycle is more complex.
  • Morphological and anatomical features are greatly simplified.
  • Highly developed reproductive system.
* **Brood parasitism:**
  • Special type of parasitism found in birds.
  • The parasitic birds lay its eggs in the nest of its host and let the host incubate them.
  • The egg of the host is very similar with the egg of the host.
  • Cuckoo lays eggs in the nest of the crow.

(iv) Commensalism:
* This is the interactio in which one species benefits and the other is neither harmed nor benefited under normal conditions.
* **Examples of Commensalism :**
(a) Clown fish living among tentacles of sea anemone.
(b) Pilot fish (Remora) accompanies sharks.
(c) Orchid growing on mango tree.
(d) Sea anemone on the shell of hermit crab.
(e) Barnacles on back of whales.
(f) Egret and grazing cattle.

(v) Mutualism:
* In mutualism both the interacting species are benefited mutually. It is also known as symbiosis.
  Examples :
(a) The *mycorrhizae* are associations between fungi and the roots of higher plants. The fungi help the plant in the absorption of essential nutrients from the soil while the plant in turn provides the fungi with energy-yielding carbohydrates.
(b) Rhizobium in root nodules of legumes.
(c) Lichens represent close association between fungus and photosynthetic algae or cyanobacteria, where the fungus helps in the absorption of nutrients and provides protection while algae or cyanobacterium prepares the food.
(d) Mutalism are found in plant-animal relationships. Plants take the help of animals for pollination and dispersal of their seeds and animals are rewarded in the form of vector or edible pollen or oviposition (site for laying egg).

(a)

(b)
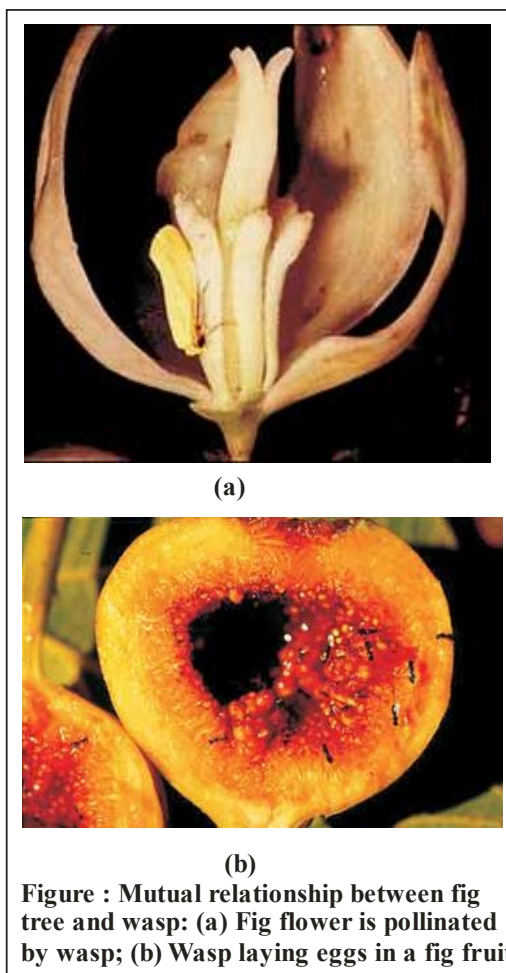
Figure : Mutual relationship between fig tree and wasp: (a) Fig flower is pollinated by wasp; (b) Wasp laying eggs in a fig fruit.

(e) **Co-evolution :**
(1) **Fig species and wasp:** Female wasp uses the fruit as an oviposition (egg-laying) and also uses the developing seeds within the fruits for nourishing its larvae. Wasp pollinates the fig inflorescence while searching for egg laying site, in return fig offers developing seeds as food for developing larvae.

(2) . . . . *Ophrys* **:** employs 'sexual deceit' to get pollination done by a species of bee. One petal of its flower bears an uncanny resemblance to the female of the bee in size, colour and markings.

The male bee is attracted to what it perceives as a female, 'pseudocopulates' with the flower, and during that process is dusted with pollen from the flower. When this same bee 'pseudocopulates' with another flower, it transfers pollen to it and thus, pollinates the flower.

(vi) **Amensalism :** Interaction between two different species, in which one species is harmed and the other is neither benefited nor harmed. Ex: Penicillium whose toxin kills many bacteria is neither benefitted nor harmed.

CONCEPT REVIEW

* **Population density** is the number of individuals of a species per unit of area or volume at a given time.

* Population size is affected by the average per capita birth rate (b), average per capita death rate (d), and two measures of dispersal: average per capita **immigration rate (i)**, and average per capita **emigration rate (e).**

* The **growth rate (r)** is the rate of change (increase or decrease) of a population on a per capita basis.

* $r = b - d$ on a global scale (when dispersal is not a factor). Populations increase in size as long as the average per capita birth rate (**natality**) is greater than the average per capita death rate (**mortality**).

* $r = (b - d) + (i - e)$ for a local population (where dispersal is a factor).

* **Intrinsic rate of increase (r_{max})** is the maximum rate at which a species or population could increase in number under ideal conditions.

* Although certain populations exhibit an accelerated pattern of growth known as **exponential population growth** for limited periods of time (the J-shaped curve), eventually the growth rate decreases to around zero or becomes negative.

* Population size is modified by limits set by the environment. The **carrying capacity (K)** of the environment is the largest population that can be maintained for an indefinite time by a particular environment.

* **Logistic population growth**, when graphed, shows a characteristic S-shaped curve. Seldom do natural populations follow the logistic growth curve very closely.

* The distinctive lifestyle and role of an organism in a community is its **ecological niche**. An organism's ecological niche takes into account all abiotic and biotic aspects of the organism's existence. An organism's **habitat** (where it lives) is one of the parameters used to describe the niche.

* Organisms potentially exploit more resources and play a broader role in the life of their community than they actually do. The potential ecological niche for an organism is **its fundamental niche**, whereas the niche it actually occupies is its **realized niche.**

* An organism's **limiting resources**, such as the mineral content of soil, temperature extremes, and amount of precipitation, tend to restrict its realized niche.

* **Competition** occurs when two or more individuals attempt to use the same essential resource, such as food, water, shelter, living space, or sunlight.

* Competition occurs among individuals within a population (**intraspecific competition**) or between different species (**interspecific competition**).

* According to the **competitive exclusion principle**, two species can't occupy the same niche in the same community for an indefinite period; one species is excluded by another as a result of competition for a limiting resource.

* **Predation** is the consumption of one species (the prey) by another (the predator).

During **coevolution** between predator and prey, the predator evolves more efficient ways to catch prey, and the prey evolves better ways to escape the predator.

* Two effective predator strategies are pursuit and ambush.

* Plant adaptations that protect them from being eaten include spines; thorns; tough, leathery leaves; and chemicals that are unpalatable or toxic to herbivores.
* **Symbiosis** is any intimate or long-term association between two or more species. The three types of symbiosis are mutualism, commensalism, and parasitism.
* In **mutualism**, both partners benefit. Three examples of mutualism are **nitrogen-fixing bacteria** and legumes, **zooxanthellae** and corals, and **mycorrhizae** (fungi and plant roots).
* In **commensalism**, one organism benefits and the other is unaffected. Two examples of commensalism are silverfish and army ants, and epiphytes and larger plants.
* In **parasitism**, one organism (the parasite) benefits while the other (the host) is harmed. One example of parasitism is mites that grow in or on honeybees. Some parasites are pathogens that cause disease.
* **Keystone species** are present in relatively small numbers but are crucial in determining the species composition and ecosystem functioning of the entire community.
* Community complexity is expressed in terms of **species richness**, the number of species within a community, and **species diversity**, a measure of the relative importance of each species within a community based on abundance, productivity, or size.
* Mutualism between animal and animal e.g. Termites and Aagellates (Trichonympha)
* Mutualism between plant and animals e.g. (a) Zoochlorella and Hydra (b) Yucca plant flowers and Pronuba insects - Pollination of yucca plant by pronuba (Female yucca moth)
* Mutualism between plant and bacteria e.g. legume plant and Rhizobium
* Mutualism between algae and higher plant e.g. Nostoc, Anabaena and Anthoceros plant
* Mutualism between algae and fungi, e.g. Lichens
* Mutualism between fungi and higher plants e.g. Mycorrhizal association
* **Types of parasite :**
(i) Ectoparasite : lives on the body of host.

Ectozooparasite : Leech on cattle, ticks on dogs, copends on marine fish and lice, mosquitoes, sandfly live on man.
Ectophytoparasite : Amphids, Lac insects, Red cotton bug

(ii) Endoparasites : live in the body of host
Tapeworm, Taenia, Ascaris, Entamoeba $\rightarrow$ live in intestine of man.
Plasmodium $\rightarrow$ live in R.B.C. of human.
Hyper parasitism $\rightarrow$ A parasite living on another parasite. e.g. plasmodium on female anopheles mosquito, Bacteriophages on bacteria.
Brood parasitism $\rightarrow$ Parasitism in which the parasitic bird (cuckoo) lays its eggs in the nest of its host (crow) and lets the host incubate them, this relation is known as brood parasitism.
Holo parasite $\rightarrow$ Parasite which are totally dependent upon the host for their requirement e.g. Rafflesia, (Total root parasite)
Cuscutta (Total stem parasite)
Hemiparasite $\rightarrow$ Parasite which partially depend on the host. e.g. Viscum – on oak and Loaranthus – on mango: both are partial stem parasite.
Santalum – partial root parasite.

* **Consociation :** Subunit of association, means a community with a single dominant species.
* A **biome** is a large, relatively distinct terrestrial region with characteristic climate, soil, plants, and animals.
* A frozen layer of subsoil **(permafrost)**, and low-growing vegetation that is adapted to extreme cold and a short growing season characterize **tundra**, the northernmost biome. Coniferous trees adapted to cold winters, a short growing season, and acidic, mineral-poor soil dominate the taiga, or boreal forest.
* Large conifers dominate **temperate rain forest**, which receives high precipitation. **Temperate deciduous forest** occurs where precipitation is relatively high and soils are rich in organic matter. Broad-leaf trees that lose their leaves seasonally dominate temperate deciduous forest.
* **Temperate grassland** typically has a deep, mineral-rich soil and has moderate but uncertain precipitation.
Temperate grassland is well suited to growing grain crops. Thickets of small-leaf evergreen

shrubs and trees and a climate of wet, mild winters and dry summers characterize chaparral.

* **Desert**, found in both temperate (cold deserts) and subtropical or tropical regions (warm deserts) with low levels of precipitation, contains organisms with specialized water-conserving adaptations.

* Tropical grassland, called **savanna**, has widely scattered trees interspersed with grassy areas. Savanna occurs in tropical areas with low or seasonal rainfall.

* Mineral-poor soil and high rainfall that is evenly distributed throughout the year characterize **tropical rain forest**. Tropical rain forest has high species richness and high productivity.

IMPORTANT POINTS

* The term of ecology was actually coined by Reiter.
* Amongst hydrophytes finely dissected leaves occur in submerged plants.
* Benthoic animals live deep in sea.
* Sun loving plants are heliophytes.
* Viviparity and pneumatophores are features of halophytes.
* Mangrove of marshy Sunderbans is characterised by pneumatophores, prop roots and vivipary.
* Nutrient enrichment of water body is eutrophication.
* Plants growing in dry habitat are xerophytes.
* Photosynthesis is absent in aphotic layer.
* *Cuscuta* = Insectivorous plant.
  Eichhornia = Saprophyte
  Monotropa = Root pocket
  Rhizophora = Parasite
  Utricularia = Pneumatophore
* Aerenchyma occurs in hydrophytes.
* Organisms capable of maintaining constant body temperature are homoiothermal.
* Association between Sea Anemone and Hermit Crab in gastropod shell is that of commensalism.
* Zoochlorellae in Hydra produces an association called mutualism.
* A community, which starts succession in a habitat is pioneer community.
* Last stabilised community in a plant succession is known as climax community.

* Mutualism = Beneficial to both a and b.
  Competition = Harmful to both a and b.
  Parasitism = Beneficial to a and harmful for b.
  Predation = Beneficial to a and inhibitory for b.
  Commensalism = Beneficial to a, no effect for b.
* Lichen is first colonized to bare rock/pioneer community in Xerarch.
* 11th July is World Population day.
* Plant species with wide range distribution evolves into local populations called ecotypes.
* One species is harmed whereas the other is unaffected. Such type of interaction is called Amensalism.
* A nonflowering plant of submerged stage is *Chara*.
* Population growth is indicated by emigration, mortality and natality.
* Population exponential growth : $N_t = N_0 e^{rt}$
  where, N_t = Population density after time t
  N_0 = Population density at time zero
  r = intrinsic rate of natural increase
  e = the base of natural logarithms (2.71828)
  The equation describes the exponential or geometric growth pattern of a population and results in a J-shaped curve.
* Verhulst-Pearl Logistic Growth equation:

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

  Where N = Population density at time t
  r = Intrinsic rate of natural increase
  K = Carrying capacity
* Total stem parasite, e.g., *Cuscuta.*
* Total root parasite, e.g., *Rafflesia & Orobanche.*
* Partial stem parasite, e.g., *Viscum & Loranthus.*
* Partial root parasites, e.g., *Santalum &Thesium.*
* **Population Growth :**
  If N is the population density at time t, then its density at time t +1 is
  $N_{t+1} = N_t + [(B + I) - (D + E)]$
* On the basis of variation in mean temperature along latitude the main climatic regions are
  (i) Tropical = 0° – 20° latitude
  (ii) Subtropical = 20° – 40° latitude
  (iii) Temperate = 40° – 60° latitude
  (iv) Arctic and antarctic = 60° – 80° latitude

QUESTION BANK

EXERCISE - 1 (LEVEL-1) [NCERT EXTRACT]

SECTION - 1 (VOCABULARY BUILDER)

Choose one correct response for each question.
For Q.1-Q.4

Match the column I with column II.

Q.1

	Column I	Column II
a.	Hydrophytes	i. Dry habitat
b.	Mesophytes	ii. Wet habitat
c.	Xerophytes	iii. Moist habitat

(A) (a) – (ii), (b) – (iii), (c) – (i)
(B) (a) – (i), (b) – (ii), (c) – (iii)
(C) (a) – (iii), (b) – (ii), (c) – (i)
(D) (a) – (ii), (b) – (i), (c) – (iii)

Q.2

	Column I (Population Interaction)		Column II (Examples)
a.	Mutualism	i.	Ticks on dogs
b.	Commensalism	ii.	*Balanus* and *Chathamalus*
c.	Parasitism	iii.	Sparrow and any seed
d.	Competition	iv.	Epiphyte on a mango branch
e.	Predation	v.	Orchid, Ophrys and bee

(A) (a)-(i), (b)-(v), (c)-(iv), (d)-(iii), (e)-(ii)
(B) (a)-(ii), (b)-(i), (c)-(v), (d)-(iv), (e)-(iii)
(C) (a)-(iii), (b)-(ii), (c)-(i), (d)-(v), (e)-(iv)
(D) (a)-(v), (b)-(iv), (c)-(i), (d)-(ii), (e)-(iii)

Q.3

	Column I		Column II
a.	Mortality	i.	Individuals of same species going out from population.
b.	Immigration	ii.	Individuals of same species coming in population.
c.	Emigration	iii.	Numbers of deaths in population during given period.
		iv.	Numbers of birth in population during given period.

(A) (a) – (iv), (b) – (iii), (c) – (ii)
(B) (a) – (iv), (b) – (ii), (c) – (i)
(C) (a) – (iii), (b) – (ii), (c) – (i)
(D) (a) – (ii), (b) – (i), (c) – (iv)

Q.4 Match the species groupings with the terrestrial biome in which they are likely to be common.

	Column I		Column II
(a)	Desert	i.	Cacti, mosquito, scorpions, lizards
(b)	Temperate grassland	ii.	Grasses, sunflowers, jackrabbits, wolves
(c)	Savanna	iii.	Grasses, shrubby tress, zebras, giraffes
(d)	Taiga (boreal forest)	iv.	Oak and maple tress, squirrels, deer.
(e)	Temperate deciduous forest	v.	Shade tolerant shrubs, lianas, epiphytes, orchids
(f)	Tropical rain forest	vi.	Mosses, lichens, lemmings, lynx.
(g)	Tundra	vii.	White spruce, balsam fir, moose, bears.

(A) (a)-(i), (b)-(ii), (c)-(iii), (d)-(vii), (e)-(iv), (f)-(v), (g)-(vi)
(B) (a)-(ii), (b)-(i), (c)-(iii), (d)-(vii), (e)-(v), (f)-(iv), (g)-(vi)
(C) (a)-(iv), (b)-(ii), (c)-(vii), (d)-(iii), (e)-(i), (f)-(v), (g)-(vi)
(D) (a)-(i), (b)-(iii), (c)-(ii), (d)-(vii), (e)-(iv), (f)-(vi), (g)-(v)

SECTION - 2 (BASIC CONCEPTS BUILDER)

For Q.5 to Q.25 :

Choose one word for the given statement from the list.

> **Vital index, Autoecology, Exponential, logistic, Parasitism, Mutualism, Adaptations, Euryhaline, Commensalism, Megatherms, Competition, Amensalism.**

Q.5 The interaction of species with their environment is called as _____.

Q.6 Attribute of the organisms (morphological, physiological and behavioural) that enables organism to survive and reproduce in its habitat is called _____.

Q.7 Ratio between mortality and natality is called _____.

Q.8 The organism which are present in tropical regions called _____.

Q.9 _____ and _____ contribute an increase in population density while mortality and _____ to a decrease.

Q.10 Growth pattern is _____ if resources are unlimited and it is _____ if resources are limiting.

Q.11 Both the species benefit to each other in _____.

Q.12 In _____, one species benefits and the other is unaffected while in _____, one species is harmed while the other suffers.

Q.13 Organisms which have a wide range of salinity tolerance are called as _____.

For Q.14-Q.19

Name the type of interaction seen in each of the following examples :

Q.14 Ascaris worms living in the intestine of human.

Q.15 Wasp pollinating fig inflorescence.

Q.16 Clown fish living among the tentacles of sea-anemone.

Q.17 Mycorrhizae living on the roots of higher plants

Q.18 Orchid growing on a branch of a mango tree

Q.19 Disappearance of smaller barnacles when Balanus dominated in the Coast of Scotland.

Q.20 Predators help to maintain species diversity in a community.   **[True / False]**

Q.21 Crow lays its eggs in the nest of cuckoo and lets the cuckoo incubate them.   **[True / False]**

For Q.22-Q.25

If the statement is false, make it correct by changing the underlined word(s) and writing the correct word(s).

Q.22 Populations <u>cannot</u> exhibit exponential growth indefinitely.

Q.23 The logistic model of population growth predicts that r <u>increases</u> with population size.

Q.24 The logistic model of population growth accounts for increasing <u>interspecific competition</u> as population size increases.

Q.25 In the logistic model of population growth, when dN/dt = 0, <u>the population has gone extinct.</u>

SECTION - 3 (ENHANCE DIAGRAM SKILLS)

Q.26 Identify the lines present in the given graph a, b c.
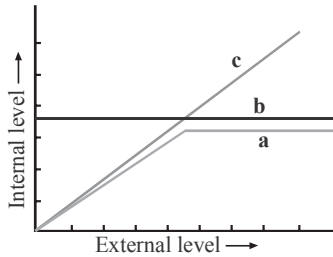
(A) a-Partial regulators, b-Regulators, c-Endotherms

(B) a-Partial regulators, b-Ectotherms, c-Endotherms

(C) a-Partial regulators, b-Regulators, c-Conformers

(D) a-Conformers, b-Ectotherms, c-Partial regulators

Q.27 Given population growth curve represents the logistic growth curve. In this curve find out what does a, b and c indicates.

(A) a-Log phase, b-Log phase, c-Stationary phase

(B) a-Log phase, b-Lag phase, c-Stationary phase
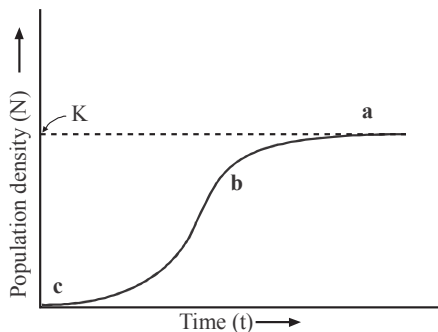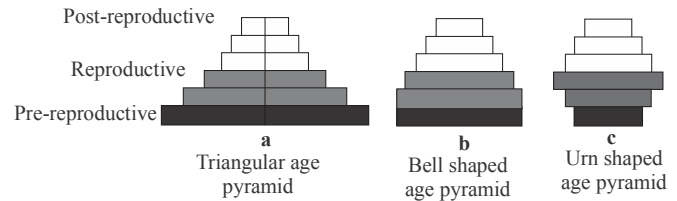
(C) a-Stationary phase, b-Log phase, c-Lag phase

(D) a-Stationary phase, b-Lag phase, c-Log phase

Q.28 Age pyramid a, b and c indicates.

a
Triangular age pyramid

b
Bell shaped age pyramid

c
Urn shaped age pyramid

(A) a-Expanding population, b-Stable population, c-Declining population

(B) a-Expanding population, b-Declining population, c-Stable population

(C) a-Stable population, b-Declining population c-Expanding population

(D) a-Declining population, b-Stable population c-Expanding population

SECTION - 4 (ENHANCE PROBLEM SOLVING SKILLS)

Choose one correct response for each question.

PART - 1 : ORGANISM AND ITS ENVIRONMENT

Q.29 Ecological hierarchy comprises, which of the following sequence

(A) Population → Species → Community → Ecosystem → Biosphere

(B) Species → Population → Community → Ecosystem → Biosphere

(C) Species → Population → Biosphere → Community → Ecosystem

(D) Species → Population → Biosphere → Ecosystem → Community

Q.30 Diapause is
(A) stage of development
(B) stage of suspended development
(C) stage of delayed morphology
(D) rapid developmental stage

Q.31 Differentiation of various tissue and organs in response to light is called
(A) morphogenesis   (B) photomorphogenesis
(C) organogenesis   (D) embryogenesis

Q.32 Eurythermals are the organism which
(A) can tolerate wide range of temperature
(B) can tolerate low range of temperature
(C) cannot tolerate low range of temperature
(D) cannot tolerate wide range of temperature

Q.33 According to Allen's Rule, the mammals from colder climates have:
(A) shorter ears and longer limbs
(B) longer ears and shorter limbs
(C) longer ears and longer limbs
(D) shorter ears and shorter limbs

Q.34 Regulators are also called
(A) endotherms   (B) exotherms
(C) ectotherms   (D) Either (B) or (C)

Q.35 Which is the characteristics of desert plant adaptation?
(A) Thick cuticle on their leaf surface
(B) Stomata arranged in deep pits
(C) Stomata remain closed during day
(D) All of the above

Q.36 Biosphere is:
(A) a component in the ecosystem.
(B) composed of the plants present in the soil.
(C) life in the outer space.
(D) composed of all living organisms present on earth which interact with the physical environment.

Q.37 Pneumatophores have lenticels for
(A) excretion   (B) gaseous exchange
(C) reproduction   (D) All of these

Q.38 The term 'ecology' is believed to be coined by
(A) Reiter   (B) Ernst Haeckel
(C) Von Bear   (D) Mendel

Q.39 All aquatic vertebrates and most molluscs and cry fishes are
(A) thermoconformers   (B) osmoconformers
(C) oxyregulators   (D) All of these

Q.40 Organisms can be classified as _____ based on how they obtain the energy necessary for life.
(A) consumers   (B) decomposers
(C) detritivores   (D) all of the above

Q.41 Many fishes of freshwater can't live in sea water and vice-versa because of –
(A) nutrient   (B) osmotic problems
(C) breathing problems   (D) excretion problems

Q.42 Which characteristics determine the percolation and water holding capacity of soils?
(A) Soil composition   (B) Grain size
(C) Aggregation   (D) All of these

Q.43 Salt concentration (Salinity) of the sea measured in parts per thousand is:
(A) 10 – 15   (B) 30 – 70
(C) 0 – 5   (D) 30 – 35

Q.44 Altitude sickness is
(A) genotypic adaptation
(B) phenotypic adaptation
(C) physiological adaptation
(D) cold hardening

Q.45 Ecological niche is:
(A) the surface area of the ocean.
(B) an ecologically adapted zone.
(C) the physical position and functional role of a species within the community.
(D) formed of all plants and animals living at the bottom of a lake.

Q.46 Smallest unit of ecology is
(A) organism   (B) species
(C) population   (D) ecosystem

Q.47 Which of the following forest plants controls the light conditions at the ground?
(A) Lianas and climbers (B) Shrubs
(C) Tall trees (D) Herbs

Q.48 Phenotypic variants formed in a population due to change in environment are called
(A) Ecophenes (B) Ecotypes
(C) Sciophytes (D) Heliophytes

Q.49 Climate is the
(A) average weather (B) dynamic weather
(C) static weather (D) None of these

Q.50 Formation of tropical forests needs mean annual temperature and mean annual precipitation as:
(A) 18-25°C and 150-400 cm
(B) 5-15°C and 50-100 cm
(C) 30-50°C and 100-150 cm
(D) 5-15°C and 100-200 cm

Q.51 Percentage of animals on this earth are regulators.
(A) 2% (B) 3%
(C) 4% (D) 1%

Q.52 Photosynthesis in *Opuntia* is done by
(A) leaves (B) stem
(C) roots (D) shoot

PART - 2 : POPULATION ATTRIBUTES

Q.53 The age of pyramid with broad base indicates
(A) high percentage of young individuals
(B) low percentage of young individuals
(C) high percentage of old individuals
(D) All of the above

Q.54 A population has more young individuals compared to the older individuals. What would be the status of the population after some years?
(A) It will decline
(B) It will stabilise
(C) It will increase
(D) It will first decline and then stabilise

Q.55 When there are large number of post-reproductive or older individuals and lesser number of pre-reproductive individuals then that population is
(A) growing (B) decline
(C) stable (D) None of the above

PART - 3 : POPULATION GROWTH

Q.56 In a population, maximum reproductive capacity
....
....
....

Q.57 Phenomenal and rapid increase of population in a short period is called
(A) natural increase (B) population growth
(C) population explosion (D) population mortality

Q.58 Choose the wrong statement.
(A) Natality and immigration increases the population density.
(B) Mortality and emigration decreases the population density.
(C) Adverse condition does not effect the population density.
(D) Food availability and predation pressure affect population density.

Q.59 Which of the following would necessarily decrease the density of a population in a given habitat?
(A) Natality > mortality
(B) Immigration > emigration
(C) Mortality and emigration
(D) Natality and immigration

Q.60 If a population of 50 *Paramoecium* present in a pool increases to 150 after an hour, what would be the growth rate of population?
(A) 50 per hour (B) 200 per hour
(C) 5 per hour (D) 100 per hour

Q.61 What would be the per cent growth or birth rate per individual per hour for the same population mentioned in the previous question.
(A) 100 (B) 200
(C) 50 (D) 150

Q.62 Pattern of population results in a J-shaped curve obtained in
(A) logistic growth (B) exponential growth
(C) sigmoid growth (D) All of these

Q.63 Which model is considered a more realistic one?
(A) Logistic model (B) Exponential model
(C) Geometric model (D) J-shaped model

Q.64 If b : Birth rate, d : Death rate
dN : Increase or decrease in population size
Then exponential growth is represented by
(A) $dN/dt = (b+d) \times N$ (B) $dN/dt = (b-d) \times N$
(C) $dN/dt = (d-b) \times N$ (D) $dN/dt = (d-b)^N$

Q.65 A protozoan reproduces by binary fission. What will be the number of protozoans in its population after six generations?
(A) 128   (B) 24
(C) 64   (D) 32

Q.66 Populations evolve to maximise their reproductive fitness are also called
(A) Mendel's fitness   (B) Darwinian fitness
(C) Lamarck's fitness   (D) Individual fitness

Q.67 Exponential growth occurs when –
(A) there is only sexual reproduction
(B) there is only asexual reproduction
(C) there is a fixed carrying capacity
(D) no inhibition from crowding

Q.68 Logistic growth is represented by which equation

(A) $\dfrac{dN}{dt} = rN\left(\dfrac{K-N}{K}\right)$ (B) $\dfrac{dN}{dt} = rN\left(\dfrac{K-N}{N}\right)$

(C) $\dfrac{dN}{dt} = rN\left(\dfrac{K+N}{K}\right)$ (D) $\dfrac{dN}{dt} = rN\left(\dfrac{K}{K+N}\right)$

PART - 4 : POPULATION INTERACTIONS

Q.69 Predator helps to create checks on
(A) prey population
(B) biological control of weeds and pests
(C) species diversity
(D) All of the above

Q.70 Which of the following is a partial root parasite?
(A) Sandal wood   (B) Mistletoe
(C) Orobanche   (D) Ganoderma

Q.71 Pollination is an example of
(A) mutualism   (B) protocooperation
(C) synergism   (D) commensalism

Q.72 Commensalism is the interaction in which –
(A) one species benefits and other is neither harmed nor benefitted.
(B) one species do not benefits and other is harmed.

(C) one species do not benefits and other is not harmed.
(D) one species benefits & other is also benefitted.

Q.73 Mycorrhizal represents an intimate mutualistic relationship between
(A) fungi and stem of higher plants
(B) fungi and roots of higher plants
(C) fungi and leaves of higher plants
(D) fungi and leaflets of higher plants

Q.74 Lichens are the associations of:
(A) bacteria and fungus (B) algae and bacterium
(C) fungus and algae   (D) fungus and virus

Q.75 *Trichonympha campanular* is the example of
(A) protocooperation   (B) mutualism
(C) commensalism   (D) All of these

Q.76 Amensalism is an association between two species where:
(A) one species is harmed & other is benefitted.
(B) one species is harmed & other is unaffected.
(C) one species is benefitted & other is unaffected.
(D) both the species are harmed.

Q.77 An indirect competition for shared resources such as a particular nutrient is called
(A) mutualism   (B) exploitation
(C) advantageous   (D) symbiosis

Q.79 Which competition is more intense?
(A) Intraspecific   (B) Interspecific
(C) Both (A) and (B) (D) Predation

Q.80 Correct matching pair of certain organism(s) and the kind of association–
(A) Shark and sucker fish – Commensalism
(B) Red algae and fungi in lichens – Mutualism
(C) Orchids growing on trees – Parasitism
(D) *Cuscuta* (dodder) growing on other flowering plants – Epiphytes

Q.81 Epiphyte is an example of
(A) predation   (B) competition
(C) parasitism   (D) commensalism

EXERCISE - 2 (LEVEL-2)

Choose one correct response for each question.

Q.1 The relationship between ants and *Acacia* plants in the tropics is a co-evolved mutualism because–
(A) the ants are well-suited to live in the swollen red thorns of the Acacia.
(B) the ants are immune to the chemical secondary defenses of the Acacia.
(C) the plants rapidly lose their leaves when ants are removed.
(D) both the plants and the ants benefit from the interaction.

Q.2 Majority of plants belongs to which of the following category
(A) Regulaters
(B) Conformers
(C) Partial regulaters
(D) More than one correct

Q.3 The statistical study of the factors that affect population size and density is called
(A) biogeography (B) demography
(C) community ecology (D) logistics

Q.4 What is a keystone species?
(A) A species which makes up only a small proportion of the total biomass of a community, yet has a huge impact on the community's organization and survival.
(B) A common species that has plenty of biomass, yet has a fairly low impact on the community's organization.
(C) A rare species that has minimal impact on the biomass and on other species in the community.
(D) A dominant species that constitutes a large proportion of the biomass and which affects many other species.

Q.5 Which of the following is NOT a density dependent factor affecting population size?
(A) crowding
(B) intraspecific competition
(C) nighttime air temperature
(D) spread of disease

Q.6 Which of the following is NOT a symbiosis?
(A) commensalism
(B) intraspecific competition
(C) mutualism
(D) predation

Q.7 What is / are key elements that leads to so much variation in the physical and chemical conditions of different habitats
(A) Temperature (B) Water and light
(C) Soil (D) All above

Q.8 Population ____ is the number of individuals of a species per unit of habitat area or volume at a given time.
(A) dispersion (B) density
(C) survivorship (D) age structure

Q.9 The famous australlion 'havoc' is associated with which of the following invasive species
(A) Nile pearch (B) Opuntia
(C) Red fox (D) Rabbits

Q.10 The transition zone between adjacent communities that often has a high species diversity is called a(n)
(A) climax community (B) ecotone
(C) ecotype (D) trophic zone

Q.11 Which of the following mean was used by warblers to avoid competetion and coexist
(A) Difference in foraging activities
(B) Habitat fragmentation
(C) Competetive release
(D) All above

Q.12 Phytoplanktons are dominant in which of the following zones?
(A) Limnetic zone (B) Profound zone
(C) Littoral zone (D) Benthic zone

Q.13 Regional and local variation within each biome lead to formation of
(A) Climate (B) Weather
(C) Habitat (D) Niche

Q.14 ___ cycles in population size may be due to predation or food availability.
(A) Exponential (B) Extrinsic
(C) Intrinsic (D) Logistic

Q.15 If birth rate is 100, death rate is 10 and number of individuals in population group is 1000, then what will be the percentage of natural growth rate ?
(A) 0.09% (B) 9.0%
(C) 0.9% (D) 90%

Q.16 Territoriality occurs as a result of
(A) co-operation (B) parasitism
(C) competition (D) predation

Q.17 Which of the following are components of species diversity in a community?
(A) number of species
(B) relative abundance of the different species
(C) uniqueness of density
(D) (A) and (B)

Q.18 Exotic species are also called
I. introduced species
II. alien species
III. non-indigenous species
IV. non-native species
Choose the correct combination.
(A) I, II and III (B) II, III and IV
(C) I, III and IV (D) I, II, III and IV

Q.19 Which of the following is a correct statement?
(A) Commensalism - when none of the interacting populations affect each other.
(B) Symbiosis - when the interaction is useful to both the populations.
(C) Symbiosis - when neither populations affects each other.
(D) Commensalism - when the interaction is useful to both the populations.

Q.20 Which of the following is NOT a branch the science of ecology?
(A) abiotic ecology (B) community ecology
(C) organismal ecology (D) population ecology

Q.21 Parasite lives on the other parasite called
(A) fittest parasite (B) parasite on parasite
(C) hyperparasite (D) hypo parasite

Q.22 Two opposite forces operate in the growth & development of every population. One of them is related to the ability to reproduce at a given rate. The force opposite to it is called
(A) fecundity
(B) environmental resistance
(C) biotic control
(D) mortality

Q.23 A ____ is an organism that has a greater impact on community structure than its numbers might suggest.
(A) keystone species (B) Mullerian mimic
(C) mutualist (D) primary producer

Q.24 The exponential model of population growth assumes
(A) birthrate is higher than deathrate.
(B) density dependent factors are involved.
(C) ideal conditions with no limits to growth.
(D) that species are K-selected.

Q.25 Which of the following is a key component of the logistic model of population growth?
(A) carrying capacity
(B) density dependent factors
(C) density independent factors
(D) A and B

Q.26 The term niche of a species refers to
(A) specific place where an organism lives
(B) competitive power of an organism
(C) specific function of an organism
(D) specific and habitual function.

Q.27 Temperature is the most ecologically relevant environment factor. In which of the following habitats temperature can exceed 100°C.
(A) Tropical desert
(B) Thermal springs
(C) Deep sea / hydrothermal vents
(D) Both B and C

Q.28 Which population characteristic would be most important in determining whether a community should spend money on schools vs. nursing homes?
(A) age structure   (B) carrying capacity
(C) population density   (D) sex ratio

Q.29 At organismic level which type of ecology exists
(A) Synecology
(B) Physiological ecology
(C) Behavioural ecology
(D) Systematic ecology

Q.30 Formation of different kind of biomes depends on
(A) Rain fall   (B) Temperature
(C) Precipitation   (D) Both B & C

Q.31 Find out the correct match with reference to their habitat
(A) Mango tree – Canada.
(B) Snow leopards – Kerla forest.
(C) Tuna fish – Temperate lattitudes in oceans.
(D) Lion – Gujarat.

Q.32 Temperature is one of the important abiotic factor. Significance of temperature on living beings can be realised through –
(A) Kinetics of enzymes
(B) Basal metabolism
(C) Physiological functions
(D) All the above

Q.33 Next to temperature, water is the most important factor influencing the life of organism. Which among the following water characteristics is not an influencing character
(A) pH   (B) Turbedity
(C) Colour   (D) Salanity

Q.34 Among the following algae that inhabit the sea, which is likely to be found in the deepest waters
(A) Red algae   (B) Brown algae
(C) Green algae   (D) Golden brown algae

Q.35 Percolation and water holding capacity of soil does not depend on
(A) Soil Composition   (B) Biota
(C) Size of grains   (D) Aggregation

Q.36 Which of the following alternative used by zooplanktons to overcome partial stressful conditions
(A) Migration   (B) Diapause
(C) Hibernation   (D) Aestivation

Q.37 In a graph of population size versus time, a J-shaped curve is characteristic of –
(A) exponential population growth.
(B) logistic population growth.
(C) zero population growth.
(D) replacement level fertility.

Q.38 During interaction between sea anemone and dawn fish, which get benefitted
(A) Seaanemone only   (B) Clown fish only
(C) Both   (D) Neither A nor B

Q.39 In which biome 75-150 cm. annual rain fall take place –
(A) Grass land
(B) Mediterranian shrub forest
(C) Deciduous forest
(D) North coniferotls forest

Q.40 Shortening of ears, limbs and other extremeties of mammals so that heat loss can be minimise, is associated with
(A) Allen's rule   (B) Bergeman's rule
(C) Jordans rule   (D) Rensch's rule

Q.41 Which of the following is not an adaptation for altitude sickness –
(A) Increase in red blood cell production.
(B) Decrease in binding capacity of oxygen.
(C) Increasing breathing rate.
(D) Heart palpitations.

Q.42 Epizoic algae which grow on the body of animals like Cladophora on shell of Mollusca, Oscillatoria on shell of tortoises exhibit which type of relationship –
(A) Mutualism   (B) Commensalism
(C) Parasitism   (D) Predation

Q.43 What will happen to a well growing herbaceous plant in the forest if it is transplanted outside the forest in a park?
(A) It will grow normally.
(B) It will grow well because it is planted in the same locality.
(C) It may not survive because of change in its micro climate.
(D) It grows very well because the plant gets more sunlight.

Q.44 Phytophagous insects show which of the following interaction
(A) Predation   (B) Competetion
(C) Parasitism   (D) Commensalism

Q.45 Population growth is most frequently checked by which one of the following?
(A) Environmental resistance
(B) Predation
(C) Disease
(D) Behavioral modifications

Q.46 The maximum rate at which a population could increase under ideal conditions is known as its
(A) total fertility rate
(B) survivorship
(C) intrinsic rate of increase
(D) doubling time

Q.47 Which of the following can not to be used by prey for defence against predator
(A) Cardiac glycosides (B) Strychnine
(C) Nector   (D) Quinine

Q.48 I.   Many xerophytic plants have thick cuticle on leaf epidermis and sunken stomata.
II. Some xerophytic plants have special photosynthetic pathway (CAM) that enables their stomata close during day.
III. Opuntia has spines (modified leaves), photosynthetic phylloclade (stem).
IV. All adaptations are genetically fixed in all organisms.
V.   All adaptation are genetically not fixed.
Choose the combinations of correct option.
(A) I, II, III and IV   (B) II, III, IV and V
(C) III, IV, V and I   (D) I, II, III and V

Q.49 The largest population that can be maintained by a particular environment for an indefinite period is known as –
(A) semelparous population.
(B) population undergoing exponential growth.
(C) metapopulation.
(D) population's carrying capacity.

Q.50 Which of the following is not a mean of removal of competetion –
(A) Behaviour diversification
(B) Choosing different time for feeding
(C) Habitat diversification
(D) All the above

Q.51 Which of the following is not an adaptation of parasites for assurance of parasite host interaction
(A) Loss of sensory organs
(B) Presence of adhesive organs
(C) Loss of digestive system
(D) Low reproductive potential

Q.52 Which of the following match is incorrect for commensalism interaction
(A) Epiphytes on trees
(B) Egrets with grazing cattles
(C) Hermit crab and sea anemone
(D) Sea anemone and clown fish

Q.53 Which of the folloiwng is main reason for non occurrence of small size conformers
(A) Karyoplasmic index (B) Area / volume ratio
(C) Basal metabolism   (D) All the above

Q.54 Adaptation of parasite may be
I.   loss of unnecessary organs
II. presence of adhesive organs
III. origin of suckers to cling to host
IV. loss of digestive system
V.   high reproductive capacity
Choose the correct combination.
(A) I, III and IV   (B) II, IV and V
(C) I, IV and V   (D) I, II, III, IV and V

Q.55 Which type of plants are found in Taiga & Tundra
(A) Halophytes   (B) Xerophytes
(C) Epiphytes   (D) Psychrophytes

Q.56 In commensalism –
- (A) Population of commensal and host remains unaffected.
- (B) Population of commensal may be increases while that of host remains unaffected.
- (C) Population of both commensal and host increases.
- (D) Population of commensal increases while the population of host gradually decreases.

Q.57 Behavioural response to cope with variations in the environment can be seen in –

(A) Fishes   (B) Kangaroo Rat
(C) Desert lizards   (D) Archaebacteria

Q.58 Population ecology is an important area of ecology because it links ecology with
(A) Population genetics (B) Evolution
(C) Physiognomy   (D) Both A and B

Q.59 Presence of flagellated protozoans in the gut of termites are the example –
(A) Symbiosis   (B) Parasitism
(C) Antibiosis   (D) Commensalism

EXERCISE - 3 (LEVEL-3)

Choose one correct response for each question.

Q.1 A community comprises of three species (K, L and M). The pyramids below show the distribution of pre-reproductive, reproductive and post-reproductive individuals.
Which of the following statements are correct regarding given age pyramids?

Species K   Species L   Species M
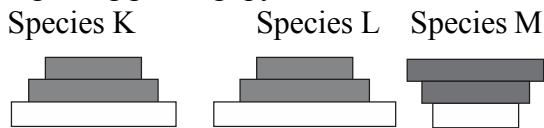
- I. Species K is a growing population.
- II. Species L is a growing population.
- III. Species M is a decreasing population.
- IV. The community is increasing in population.
- (A) I and II   (B) II and III
- (C) I, II and III   (D) I, II, III and IV

Q.2 ___ competition occurs within a population and ___ competition occurs among populations of different species.
- (A) interspecific; intraspecific
- (B) intraspecific; interspecific
- (C) Type I survivorship; Type II survivorship
- (D) interference; exploitation

Q.3 Match the following
- (a) Breeding once in life   (i) Mammals
- (b) Breeding several time in life   (ii) Oysters
- (c) Large no. of small size of offspring.   (iii) most of birds

- (D) Small no. of large size of offspring   (iv) Pacific salmon fish
- (A) a-iv, b-ii, c-iii, d-i   (B) a-iv, b-iii, c-ii, d-i
- (C) a-iii, b-iv, c-ii, d-i   (D) a-ii, b-iii, c-iv, d-i

Q.4 The feature of the xerophytic plant leaves are
- (i) Leathery surface
- (ii) Large surface area
- (iii) Waxy cuticle
- (iv) Sunken stomata on upper epidermis
- (A) i, ii and iv   (B) ii and iii
- (C) i, iii and iv   (D) i and iv

Q.5 In 2005, for each of the 14 million people present in a country, 0.028 were born and 0.008 died during the year. Using exponential equation, the number of people present in 2015 is predicted as:
- (A) 25 millions   (B) 17 millions
- (C) 20 millions   (D) 18 millions

Q.6 The average per capita birth rate, or ___, increases population size, whereas the average per capita death rate, or __, decreases population size.
- (A) natality; demography.
- (B) exploitation competition; interference competition.
- (C) mortality; natality.
- (D) natality; mortality.

Q.7 Which of the following community characteristics would be predicted by the intermediate disturbance hypothesis?
(A) a preponderance of K-selected species.
(B) a preponderance of r-selected species.
(C) extreme sensitivity to slight disturbances.
(D) high species diversity.

Q.8 The continued growth of a population with a young age structure, even after its fertility rate has declined, is known as –
(A) population doubling
(B) iteroparity
(C) population growth momentum
(D) r selection

Q.9 Which one is the example of sexual parasite?
(A) An male angler fish (*Photocorynus*)
(B) Male *Bonellia*
(C) Male *Schistosoma*
(D) All of the above

Q.10 Match list I with list II and choose the correct option.

List I	List II
a. Pacific salmon fish	1. Verhulst-Pearl Logistic growth
b. $N_t = N_0 e^{rt}$	2. Breeds only once in lifetime
c. Oyster	3. Exponential growth
d. $\dfrac{dN}{dt} = rN\left(\dfrac{K-N}{K}\right)$	4. A large number of small sized offsprings.

(A) a-4, b-3, c-1, d-2
(B) a-3, b-4, c-1, d-2
(C) a-3, b-1, c-4, d-2
(D) a-2, b-3, c-4, d-1

Q.11 Match the following given population interactions
(A) + / +   (i) Predation
(B) – / –   (ii) Ammensalism
(C) + / –   (iii) Competition
(D) – / 0   (iv) Mutualism
(A) a-i, b-ii, c-iii, d-iv   (B) a-i, b-iii, c-ii, d-iv
(C) a-iv, b-iii, c-i, d-ii   (D) a-iv, b-iii, c-ii, d-i

Q.12 A two month study on a population of 500 rats showed that the emigration of individuals from the population was 1.5 times the rate of immigration. At the same time the birth rate was found to be two times the rate of death. If the number of emigrants during the period of study was 75 and the birth rate was 10 %, what would be the number of rat individuals in the population at the end of the study?
(A) 500   (B) 475
(C) 450   (D) 525

Note (Q.13-Q.15) :
(A) Statement- 1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement -1.
(B) Statement -1 is True, Statement -2 is True ; Statement-2 is NOT a correct explanation for Statement-1.
(C) Statement-1 is True, Statement- 2 is False.
(D) Statement- is False, Statement -2 is False.

Q.13 **Statement 1 :** With increase in population size, environmental resistance tends to increase.
Statement 2 : This is a nature's way to check the expression of biotic potential.

Q.14 **Statement 1 :** Biotic community has higher position than population in ecological hierarchy.
Statement 2 : Population of similar individuals remains isolated in the community.

Q.15 **Statement 1 :** Predation is an interspecific interaction with a feeding strategy.
Statement 2 : Predator and their prey maintain fairly stable population through time and rarely one population become abundant or scarce.

Q.16 A population growing in a habitat with limited resources shows four phases of growth in the following sequence.
(A) Acceleration → Deceleration → Lag phase → Asymptote
(B) Asymptote → Acceleration → Deceleration → Lag phase
(C) Lag phase → Acceleration → Deceleration → Asymptote
(D) Acceleration → Lag phase → Deceleration → Asymptote

EXERCISE - 4 (PREVIOUS YEARS AIPMT/NEET EXAM QUESTIONS)

Choose one correct response for each question.

Q.1 Besides paddy fields, cyanobacteria are also found inside vegetative part of : **[NEET 2013]**
(A) *Psilotum* (B) *Pinus*
(C) *Cycas* (D) *Equisetum*

Q.2 A sedentary sea anemone gets attached to the shell lining of hermit crab. The association is – **[NEET 2013]**
(A) Amensalism (B) Ectoparasitism
(C) Symboisis (D) Commensalism

Q.3 A biologist studied the population of rats in a barn. He found that the average natality was 250, average mortality 240, immigration 20 and emigration 30. The net increase in population is
(A) Zero (B) 10 **[NEET 2013]**
(C) 15 (D) 5

Q.4 Just as a person moving from Delhi to Shimla to escape the heat for the duration of hot summer, thousands of migratory birds from Siberia and other extremely cold northern regions move to –
(A) Western Ghat **[AIPMT 2014]**
(B) Meghalaya
(C) Corbett National Park
(D) Keolado National Park

Q.5 The following graph depicts changes in two populations (a and b) of herbivores in a grassy field. A possible reason for these is that **[AIPMT 2015]**
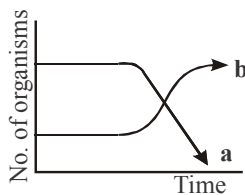
(A) Population b competed more successfully for food than population a.
(B) Population a produced more offspring than population b.
(C) Population a consumed the members of population b.
(D) Both plant populations in this habitat decreased.

Q.6 In which of the following interactions both partners are adversely affected ?
[RE-AIPMT 2015]
(A) Predation (B) Parasitism
(C) Mutualism (D) Competition

Q.7 An association of individuals of different species living in the same habitat and having functional interactions is: **[RE-AIPMT 2015]**
(A) Biotic community (B) Ecosystem
(C) Population (D) Ecological niche

Q.8 When does the growth rate of a population following the logistic model equal zero? The logistic model is given as dN/dt = rN (1 – N/K)
(A) When N/K is exactly one.
(B) When N nears the carrying capacity of the habitat. **[NEET 2016 PHASE 1]**
(C) When N/K equals zero.
(D) When death rate is greater than birth rate.

Q.9 Gause's principle of competitive exclusion states that – **[NEET 2016 PHASE 1]**
(A) More abundant species will exclude the less abundant species through competition.
(B) Competition for the same resources excludes species having different food preferences.
(C) No two species can occupy the same niche indefinitely for the same limiting resources.
(D) Larger organisms exclude smaller ones through competition.

Q.10 If '+' sign is assigned to beneficial interaction, '–' sign to detrimental and '0' sign to neutral interaction, then the population interaction represented by '+' '–' refers to –
[NEET 2016 PHASE 2]
(A) Mutualism (B) Amensalism
(C) Commensalism (D) Parasitism

Q.11 The principle of competitive exclusion was stated by – **[NEET 2016 PHASE 2]**
(A) C. Darwin (B) G. F. Gause
(C) MacArthur (D) Verhulst and Pearl

Q.12 Asymptote in a logistic growth curve is obtained when **[NEET 2017]**
(A) The value of 'r' approaches zero (B) K = N
(C) K > N (D) K < N

Q.13 Presence of plants arranged into well defined vertical layers depending on their height can be seen best in : **[NEET 2017]**
(A) Tropical Savannah (B) Tropical Rain Forest
(C) Grassland (D) Temperate Forest

Q.14 Which one of the following plants shows a very close relationship with a species of moth, where none of the two can complete its life cycle without the other? **[NEET 2018]**
(A) Banana
(B) *Yucca*
(C) *Hydrilla*
(D) *Viola*

Q.15 Natality refers to **[NEET 2018]**
(A) Number of individuals leaving the habitat
(B) Birth rate
(C) Death rate
(D) Number of individuals entering a habitat

Q.16 Which one of the following population interactions is widely used in medical science for the production of antibiotics? **[NEET 2018]**
(A) Parasitism
(B) Mutualism
(C) Commensalism
(D) Amensalism

Q.17 In a species, the weight of newborn ranges from 2 to 5 kg. 97% of the newborn with an average weight between 3 to 3.3 kg survive whereas 99% of the infants born with weight from 2 to 2.5 kg or 4.5 to 5 kg die. Which type of selection process is taking place? **[NEET 2019]**
(A) Directional Selection
(B) Stabilizing Selection
(C) Disruptive Selection
(D) Cyclical Selection

ANSWER KEY
EXERCISE-1 (SECTION-1&2)

(1) (A)   **(2)** (D)   **(3)** (C).

(4) (A)   **(5)** Autoecology

(6) Adaptations

(7) Vital index

(8) Megatherms

(9) Natality, immigration, emigration

(10) Exponential, logistic   **(11)** Mutualism

(12) Commensalism, amensalism

(13) Euryhaline   **(14)** Parasitism

(15) Mutualism   **(16)** Commensalism

(17) Mutualism   **(18)** Commensalism

(19) Competition   **(20)** True

(21) False   **(22)** True

(23) False   **(24)** False

(25) False

EXERCISE - 1 [SECTION 3 & 4]

Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
A	C	C	A	B	B	B	A	D	A	D	D	B	B	D	D	B	D	D	C	C
Q	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
A	A	C	A	A	A	D	B	A	C	B	A	C	C	C	D	B	B	A	B	C
Q	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81				
A	B	D	A	D	A	A	A	B	C	B	B	B	A	A	A	D				

EXERCISE - 2

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	D	B	B	A	C	B	D	B	B	C	A	A	C	B	B	C	D	D	B	A
Q	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A	C	B	A	B	D	D	D	A	B	D	D	D	C	A	B	B	A	B	B	A
Q	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	
A	B	B	C	A	A	C	C	D	D	D	D	C	B	D	D	B	C	D	A	

EXERCISE - 3

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
A	D	B	B	C	B	D	D	C	D	D	C	A	A	C	A	C

EXERCISE - 4

	Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	C	D	A	D	A	D	A	A	C	D	B	B	B	B	B	D	B

SOLUTIONS

EXERCISE-1

(1) (A) **(2)** (D)

(3) **(C). Mortality :** Numbers of deaths in population during given period.
Immigration : Individuals of same species coming in population.
Emigration : Individuals of same species going out from population.

(4) (A) **(5)** Autoecology

(6) **Adaptations.** Adaptation develop due to natural selection of suitable variations appearing in living beings through mutation and recombination. It enables organism to survive and reproduce in its habitat.

(7) **Vital index.** Vital index represents the ratio between natality (birth rate) and mortality (death rate). It determines the normal rate of growth of population and can be calculated by

$$\text{Vital index} = \frac{\text{Natality}}{\text{Mortality}} \times 100$$

(8) **Megatherms.** Organism, which present in tropical regions are called megatherms.

(9) Natality, immigration, emigration

(10) Exponential, logistic **(11)** Mutualism

(12) Commensalism, amensalism

(13) Euryhaline **(14)** Parasitism

(15) Mutualism **(16)** Commensalism

(17) Mutualism **(18)** Commensalism

(19) Competition **(20)** True

(21) False **(22)** True

(23) False. Decreases

(24) False. Intraspecific competition

(25) False. Population size does not change;

(26) **(C). Conformers :** Their body temperature changes with the surrounding temperature they are also called ectothermes.
99% of animals are conformers.
Regulators : Some organisms are able to maintain a constant body temperature and constant osmotic concentration despite change in external environment. They are called regulators.

Partial regulaors : Some organisms have the ability to regulate their body functions to a limited extent called partial regulators. Beyond that limit they become conformers.

(27) **(C).** A population growing in a habitat with limited resources shows three phases.

(i) **Lag phase :** It is the initial phase in which a population adapt themself according to the environment and starts to increase their number.

(ii) **Log phase :** It is the second phase in which a population use its resources maximally and increases their number exponentially. Number of birth > > Number of death

(iii) **Stationary phase :** It is the 3rd phase in which the population reaches the carrying capacity level and population get in stationary position.
No. of birth = No. of death.

(28) (A)

(29) **(B).** Ecological hierarchy or ecological levels of organisation.

(30) **(B).** Under favourable conditions many zooplanktons in lakes and ponds are known to enter in diapause, i.e., a stage in suspended development. Infact diapause is stage in the development of certain animals, during which developmental growth is suspended during winter when days are short.

(31) **(B).** In plants growth is favoured by increased availability of food, moderate light intensity and red light. Maximum photosynthesis occurs in red light Blue light favours moderate but normal growth. Differentiation of various tissue and organs in response to light is called photomorphogenesis. Aphids develops wings in response to alternate light and darkness.

(32) **(A).** Eurythermal organisms are those organisms, which can tolerate wide range of temperature variations. Most mammals and birds can live in very wide temperature variation.

(33) **(D).** Animals in colder climates generally have shorter ears and limbs. This is known as Allen's rule. It is a mechanism to conserve heat by checking heat loss from the body. Heat gain can be maximised and heat loss can be minimised by decreasing the surface area to volume ratio of body. In the polar regions, small animals are rarely found because of their more surface area and less volume.

(34) **(A).** Regulators are also called endotherms. Evolutionary biologist believe that the success of mammals is mainly due to their ability to maintain a constant body temperature (endotherms) and live comfortably whether they are in Antarctica or Sahara Desert.

(35) **(D).** **Plant Adaptation to Water and Heat** (xerophytes) They are plants of dry habitats where the environment favours higher rate of transpiration than the absorption. xerophytes plants normally have thick cuticle on their leaf surface, stomata arranged in deep pits, stomata of xerophyte plant remain closed during day to reduce the high transpiration.
Xerophytes are four types

(i) **Ephemerals** (Drought escapers) The plant live for a brief period during rain. The rest of year is passed in the form of seed.
e. g., *Euphorbia prostrate, Boerhaavia*.

(ii) **Annuals or Drought Evaders :** They live even after the few weeks of rain. Their size are small, leaves have thick waxy, hairy coating with or withour prickles, e.g., *Echinops, Solanum*.

(iii) **Succulents or Drought Resistants :** The plants have fleshy organs where water and rnucilage are stored.
e.g., *Opuntia, Aloe, Agave*.

(iv) **Non-succulents or Drought Endurers :** They are true xerophytes which actually tolerate drought conditions. They have smaller shoot system. The root system is very extensive. Many tropical plants of hot & arid regions perform C4-photosynthesis.

They uses less water even at high temperature.

(36) **(D).** Biosphere (also called as ecosphere) is the largest unit in ecological hierarchy and includes all the ecosystems of the world i.e. all organisms interacting with their physical environment.
Abiotic components
↓
Organism→Population→Biotic community → Ecosystem → Biosphere

(37) **(B).** A number of mangroove plants possess small negatively geotrophic vertical roots called pneumatophores. Pneumatophores have lenticels for gaseous exchange. They are connected with internal aerenchymatous tissue. It is a plant adaptation to saline environment.

(38) **(B).** The term 'ecology' is believed to have been coined by Ernst Haeckel in 1869. Its first authentic use was made by the Reiter (1885). Two other terms 'hexicology' and 'ethology' are also used. Which are equivalent to ecology.

(39) **(D).** All vertebrates most molluscs and cry fishes are oxyregulators but with the exception of birds and mammals, they are thermoconformers and osmoconformers.

(40) (D)

(41) (B)

(42) **(D).** Various characteristics of the soil such as soil composition, grain size and aggregation determine the percolation and water holding capacity of the soil. These characteristics along with parameters such as pH, mineral composition and topographv determine the large extent vegetation in any area.

(43) **(D).** Salinity of water bodies is gernerally measured in parts per thousand. It determines what kind of organsims can live in it. Salinity of the sea is 30-35 parts per thousand, while for inland waters and some lagoons is lessthan 5 and more than 100, respectively. Freshwater animals generally can't live for long in sea water and vice versa because of osmotic problems.

(44) (C)

(45) **(C).** 'Niche' literally means specific place. However, in Ecology, it is generally used for the habitat as well as role of a species or population in a community. To understand niche, consider an example of rabbit.
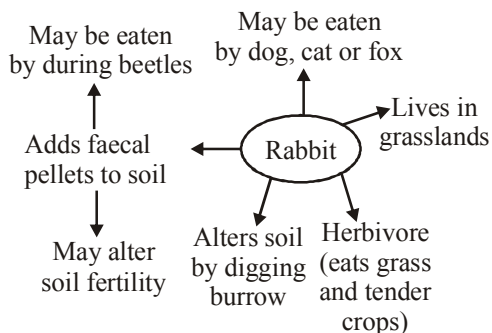
Every interaction of rabbit with its environment is a part of its niche.

(46) **(A).** Organism is the smallest unit of ecological study.

(47) **(C).** Tall trees form the canopy of the forest i.e. roof of the forest, thus, controlling the amount of light reaching the ground.

(48) **(A).** **Ecotype :** Genetically distinct adapted population to a particular habitat of species in different geographical area.
Ecophene : Phenotypic variants of a single genotype in a particular area or habitat.
Phenotypic Plasticity : Shift in an organism's body physiology or behaviour, When shifted to different environment condition. e. g., When a man living in plains went to hilly area or mountain. Thre extra RBC cells are produced, seems to help transport available oxygen around the body is called phenotypic plasticity.

(49) (A)

(50) **(A).** Temperature and precipitation are generally most important climatic abiotic factors that influence the geographical distribution of plants. Average temperature decreases from equator to the poles. Precipitation includes rainfall, snow, dew, etc. Tropical forests, which are very productive, need 18 to 25°C mean annual temperature and 150-400 cm mean annual rainfall. Arctic and alpine tundra, which are generally least productive can grow in –12 to 2°C mean annual temperature and mean annual precipitation of less than 50 cm.

(51) **(D).** About 99% of animals and nearly all plants do not have a mechanism to maintain a constant internal body environment. Their body temperature changes with the surrounding temperature (ectotherms).

(52) **(B).** *Opuntia's* leaves changes into spine to reduce the transpiration during course of evolution and the working of leaves is taken over by stem. *Opuntia's* stem have green colour and perform photosynthesis.

(53) (A)

(54) **(C).** If in a population more young individuals are present as compared to older individuals, population will increase after some years.This is because of the reason that number of individuals in reproductive age is high and high number of individuals will also enter the reproductive age in coming years. Such a population can be represented by an age structure upright pyramid with a wide base, like the one shown below.
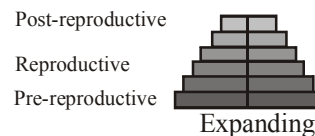

(55) **(B).** A population with large number of post-reproductive or older individuals and lesser number of pre-reproductive individuals will show a negative growth rate or decline growth.

(56) **(A).** Chapman, (1928) proposed the term biotic potential to designate. Maximum Reproductive Power Chapman defined it as the inherent power of an organism to reproduce to survive i.e., to increase in number. But there is natural check called environment resistance.

(57) **(C).** Rapid increase of population in a short duration is called population explosion. It happens in unlimited resources and least resistance.

(58) **(C).** Adverse condition affect the population by influencing the natality and mortality of the population. It also effects the immigration and emigration.

(59) **(C).** Population density in a given habitat is influenced by four processes:

* Natality: It is the number of births in a population during a given period of time.
* Mortality: It is the number of deaths in a population during a given period of time.
* Immigration: Number of individuals coming from other habitats in a given period of time
* Emigration: Number of individuals exiting from a given population in a given period of time.
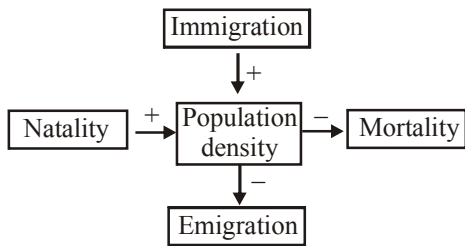
Mortality and emigration will, therefore decrease the population density while natality and immigration will increase it.

(60) **(D).** Population of *Paramecium* at time t = 50
Population of *Paramecium* 1 hour after t = 150
Growth rate of population = 150 – 50 per hour = 100 per hour

(61) **(B).** Initial number of *Paramecium* = 50
Number of *Paramecium* after 1 hour = 150
Birth rate
$= \dfrac{\text{Number of new } Paramecium}{\text{Initial number of } Paramecium} \times 100$
$= \dfrac{100}{50} \times 100 = 200\%$

(62) **(B).** Exponential growth curve.

(63) **(A).** No population have the unlimited resources to survive and reproduction. Every population in nature has given a certain amount of natural resources that is limited. Keeping this point of view logistic growth is the more realistic than the exponential growth curve.

(64) **(B).** dN/dt = (b – d) × N

(65) **(C).** $1 \xrightarrow{G1} 2 \xrightarrow{G2} 4 \xrightarrow{G3} 8 \xrightarrow{G4} 16$
$\xrightarrow{G5} 32 \xrightarrow{G6} 64$

By binary fission, an individual protozoan will divide in two. In this way after six generations their number will be 64.

(66) **(B).** When food and space for population are unlimited. Each species has the ability to realise fully inherited potential to grow, as Darwin observed while developing his theory of natural selection. He called this the reproductive fitness.

(67) **(D).** Ex**ponential Growth Model :** When the resources availability is unlimited in the habitat, the population grows in an exponential or geometric fashion. As resources are unlimited than there is no inhibition from crowding.
The equation is; dN/dt = (b – d) × N
[b = Birth rate, d = Death rate.
N =Population density, dn/dt = Rate of change of population
Let (b – d) = r, then the equation is,
dN/dt = rN, r = Intrinsic rate of natural increase.
When a population shows exponential growth, the curve plotted with N in relation to time, assume J shape. In this there is no fix carrying capacity.

(68) **(A).** $\dfrac{dN}{dt} = rN\left(\dfrac{K-N}{K}\right)$

(69) **(D).** Predators also help in maintaining species diversity in a community by reducing the intensity of competition among competing prey species. Predator can also be used for biological control of weeds and pests.

(70) **(A).** Parasites can be divided into: holoparasites and hemiparasites. Holoparasites are those which are dependent ontheir host for all of their requirements, while hemiparasites are those, which receive only a part of their nourishment from host. Holoparasites and hemiparasites are also known ascomplete and partial parasites, respectively. Sandal wood is partial root parasite, which

synthesises its own food but is dependent on host's roots for water and inorganic nutrients. Mistletoe is partial stem parasite. *Orobanche* (Broomrope) is complete root parasite. *Ganoderma*, a fungus, is parasitic on hardwood.

(71) **(A).** Pollination is an example of mutualism in which pollinator gets nector, pollen grain, etc., and by giving those products to pollinators host gets pollinated.

(72) **(A).** **Commensalism :** This is the interaction in which one species benefits and other is neither harm nor benefitted. e.g., an orchid growing as an epiphytes on mango branch for taking sunlight in tropics.

(73) **(B).** Like lichens, mycorrhiza are associations between fungi and roots of higher plants. The fungi helpd the plant in the absorption of essential nutrients from soil, while the plant in turn provide carbohydrates and shelter to fungi.

(74) **(C).** Lichens are association (mutually beneficial) between fungus and alga. The fungal partner is mycobiont and algal partner is phycobiont. The mycobiont is usually an ascomycete and phycobiont is usually green algae.

Lichens can grow in extremely inhospitable conditions. In many ecosystems they are the pioneer species. The role of mycobiont is providing body structure and anchorage and absorption of minerals and water. The role of phycobiont is mainly in providing food through photosynthesis.

(75) **(B).** In mutualism two species can't live independently Termite feed on wood though they don't possess enzymes for digesting the same. Termites harbour cellulose digesting flagellates (*Trichonympha companula*) for this purpose. Flagellates are unable are live independently. Termites would die of starvation in the absence of flagellates.

(76) **(B).** Amensalism isthe interaction between two populations in which one is adversely affected, whereas other is apparently, neither harmed nor benefitted. For example, *Penicillium* does not allow the growth of *Staphylococcus* bacterium, by secreting certain chemicals, apparently, without any benefit.

(77) **(B).** An indirect competition for shared resources such as particular nutrient is called exploitation.

(79) **(A).** **Competition :** Rivalary between two or more organisms for obtaining the same resources. Competition is of two types i.e., intraspecific and interspecific.

(80) **(A).** **Commensalism** it is the relationship between two living individuals of different species in which one is benefitted, while the other is neither harmed nor benefitted except to a negligible extract. Shark and sucker fish (Echenis) association is an example of commensalism (without continuous contact).

(81) **(D).** Epiphytes (*Epic*-upper; *phytes*- plants) is an example of commensalism in which plant takes the shelter on the upper branches of their host for taking sunlight.

EXERCISE-2

(1) (D)   **(2)** (B)   **(3)** (B)

(4) **(A).** Keystone species in ecology, a species that has a disproportionately large effect on the communities in which it occurs. Such species help to maintain local biodiversity within a community either by controlling populations of other species that would otherwise dominate the community or by providing critical resources for a wide range of species.

(5) **(C).** The effects of temperature on a population are usually unrelated to population density.

(6) **(B).** Symbiosis are interactions between individuals of different species.

(7) (D)   **(8)** (B)   **(9)** (B)

(10) **(C).** In evolutionary ecology, an ecotype, sometimes called ecospecies, describes a genetically distinct geographic variety, population or race within a species, which is adapted to specific environmental conditions.

(11) (A)

(12) **(A).** The limnetic zone derives its oxygen content from the photosynthetic activity of phytoplankton and from the atmosphere immediately over the lake's surface. The atmospheric source of oxygen becomes significant primarily when there is some surface disturbance of water caused by wind action or human activity. The community of the limnetic zone is composed only of plankton, nekton, and sometimes neuston (organisms resting or swimming on the surface).

(13) (C)   **(14)** (B)

(15) **(B).** Birth rate = 100, Death rate = 10
Number of individuals in population = 1000
Natural growth rate = 100 -10 = 90

% of growth rate = $\dfrac{90}{1000} \times 100 = 9\%$

(16) (C)   **(17)** (D)

(18) **(D).** An introduced, alien, exotic, non-indigenous or non-native species is a species living outside its native distributional range, which has arrived there by human activity, either deliberate or accidental.
Some introduced species are damaging to the ecosystem they are introduced into, others have no negative effect and can, in fact, be beneficial as an alternative to pesticides in agriculture. In some instances the potential for being beneficial or detrimental in the long run remains unknown.

(19) (B)

(20) **(A).** All branches of biology, including ecology, involve the study of life. The word "abiotic" implies the absence of life.

(21) **(C). Hyperparasite :** It is the parasite which lives on another parasite, e.g., some bacteriophage (bacterial, viruses), *Bacterium Parteurella* pestis in Xenopsylla chaeopsis (rat flea) which is hyperparasite on rat.

(22) (B)   **(23)** (A)

(24) **(B).** Death rate may be higher than birth rate in both models, resulting in negative population growth; density dependent factors and K-selected species are more typical of logistic growth.

(25) (D)

(26) **(D).** Niche in ecology, all of the interactions of a species with the other members of its community, including competition, predation, parasitism, and mutualism. A variety of abiotic factors, such as soil type and climate, also define a species' niche. Each of the various species that constitute a community occupies its own ecological niche. Informally, a niche is considered the "job" or "role" that a species performs within nature.

(27) (D)

(28) **(A).** Age structure can predict the proportion of a population made up of different age classes in the future.

(29) (B)   **(30)** (D)   **(31)** (D)

(32) (D)   **(33)** (C)

(34) **(A).** Like all algae, red algae depend on photosynthesis to produce food. Most varieties of algae live near the surface of the water in order to get enough sunlight to live. Since they can absorb blue light, red algae can live in much deeper water where light of long wavelengths - like red - can't reach. Red algae have been found living in depths of over 500 feet.

(35) (B)   **(36)** (B)   **(37)** (A)

(38) (B)   **(39)** (B)

(40) **(A).** Allen's rule is a biological rule posited by Joel Asaph Allen in 1877. The rule says that the body shapes and proportions of endotherms vary by climatic temperature by either minimizing exposed surface area to minimize heat loss in cold climates or maximizing exposed surface area to maximize heat loss in hot climates. The rule predicts that endotherms from hot climates usually have ears, tails, limbs, snouts, etc. that are long and thin, whereas equivalent endotherms from cold climates usually have shorter and thicker versions of those body parts.

(41) (B)   **(42)** (B)

(43) **(C).** Herbaceous plants are of small height. Since, this plant is growing in forest, it must have been adapted to the light intensity reaching it, moisture in surrounding air and soil, soil characteristics, a particular association with an animal etc. This constitutes the micro climate of this plant. If this plant is transplanted to a park outside forest, this micro climate might get lost, partially or completely, because of which plant might not be able to survive.

(44) **(A).** Phytophagous insects feed on plants.

(45) (A)   **(46)** (C)   **(47)** (C)

(48) **(D).** All adaptations are not genetically fixed, like behavioural adaptation. Hibernation and aestivation adaptations for avoiding extreme temperature also not genetically fixed.

(49) (D)   **(50)** (D)   **(51)** (D)

(52) **(C).** Symbiosis Between Hermit Crab and Sea Anemone :
One form of symbiosis especially attractive for divers and snorkelers is the one between the hermit crab and the sea anemone. Hermit crabs use empty shells of snails as protection and carry one or more stinging sea anemones on top of their shell to protect themselves from enemies. On the other hand, the anemone benefits from the remaining nutriments of the hermit crab.

(53) (B)

(54) **(D).** In accordance to their life style parasite evolved special adaptation such as loss of digestive systems, loss of unnecessary organs, presence of adhesive organs, origin of suckers and high reproductive capacity in accordance to their host.

(55) (D)   **(56)** (B)   **(57)** (C)

(58) (D)   **(59)** (A)

EXERCISE-3

(1) (D)   **(2)** (B)   **(3)** (B)   **(4)** (C)

(5) **(B).** Exponential equation gives population growth rate as $\dfrac{dN}{dt} = rN$.

Here, r = intrinsic rate of natural increase
N = size of original population

dN/dt = Increase in population size per unit time (1 year in this case)
r is the difference between birth and death rate.
r = 0.028 – 0.008 = 0.02

$\therefore \quad \dfrac{dN}{dt} = 0.02 \times 14$ million = 0.28 million

Over 10 years (2005 – 2015), this number will become = 2.8 million.
Expected population in 2015
= (14 + 2.8) million = 17 million (approx.)

(6) **(D).** **Natality** is number of births per unit population per unit time, e.g., per thousand per year in humans.
Mortality is number of deaths per unit population per unit time, e.g., per one thousand individuals per year in humans.

(7) (D)   **(8)** (C)

(9) **(D).** Sexual parasite is type of parasitism in which a parasite live on the particular sex of the organism. An angler fish (*Photocorynus*) male lives as a small parasite over the head of the famale. In *Bonellia* the male is an internal parasite while in *Schistosoma* male lives in gynecophoral canal of the female.

(10) (D)   **(11)** (C)   **(12)** (A)

(13) **(A).** The inherent maximum capacity of an organism to reproduce or increase in number is termed biotic potential (designated by the symbol r). Biotic potential is realised only when the environmental conditions are non-limiting, so that natality rate (birth-rate) is maximum and mortality rate (death -rate) is minimum. Under these conditions, population size increases at the maximum rate. However, nature keeps a check on the expression of biotic potential. For example, if a pair of flies is allowed to reproduce unchecked, the fly population may outweigh the earth in a few years. The environmental check on population size, or its biotic potential is called environmental resistance. With increase in population size, the environmental resistance (against the population) tends to increase.

(14) **(C).** The organisms of all the species that live in a particular area and interact in various ways with one another form biotic community. Biotic community is a grouping higher than population. It is an assemblage of all the populations of different organisms occurring in an area. The different populations of a community do not remain isolated. They show interactions and inter-dependence.

(15) **(A).** Predation is an interspecific interaction with feeding strategy. The number of predator usually depends upon the population of prey, but later is also controlled by predators.

(16) **(C).** When a population is growing in limited resources the population growth consist five phases.

(i) **Lag phase :** No or very little growth.

(ii) **Acceleration :** Growth at the beginning.

(iii) **Exponential phase :** Number of individual increases at logarithmic rate.

(iv) **Deceleration phase :** Rate of population increases slow down.

(v) **Stationary phase :** Essentially no change in population growth.

EXERCISE-4

(1) **(C).** In *Cycas* small specialised roots called coralloid roots are associated with N_2-fixing cyanobacteria.

(2) **(D).** Facultative mutualism can be illustrated with the example of sea anemone, which gets attached to the shell of hermit crab. The sea anemone grows on the back of the crab, providing camouflage & protection and, in turn, the sea anemone is transported about reaching new food sources. This type of mutualism is also called protocooperation.

(3) **(A).** Net increase in population:
(natalety + immigration) – (Mortality + Emigration)
(250 + 20) – (240 + 30) ; 270 – 270 = 0

(4) **(D).** Every winter the famous Keolado National Park (Bharatpur) in Rajasthan host thousands of migratory birds coming from Siberia and other extremely cold northern region.

(5) **(A).** Population-b had proved to be superiorily adopted for survival and attainment of resources like food, water, shelter, etc., leading to an increase in their number by outgrowing the offsprings, as compared to those of population-a.

(6) **(D).** During competition, both partners are adversely affected.

(7) **(A).** Populations of different species occurring in a habitat comprise the biotic community.

(8) **(A).** In logistic growth model population growth equation is described as $\dfrac{dN}{dt} = rN\left(\dfrac{K-N}{K}\right)$

where N = population density at time t
r = Intrinsic rate of natural increase
K = carrying capacity

when $\dfrac{N}{K} = 1$ then $\dfrac{K-N}{K} = 0$

therefore, $\dfrac{dN}{dt} = 0$

(9) **(C).** Gause's principle of competitive exclusion states that no two species can occupy the same niche indefinitely for the same limiting resources.

(10) **(D).** Parasitism $\Rightarrow$ Parasite is benefitted (+) but host is harmed (–) so it is a (+, –) type of population interaction.

(11) **(B).** The principle of competitive exclusion was stated by G. F. Gause.

(12) **(B).** A population growing in a habitat with limited resources shows logistic growth curve.
For logistic growth

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

If K = N then $\dfrac{K-N}{K} = 0$

The $\dfrac{dN}{dt} = 0$, the population reaches asymptote.

(13) **(B).** The tropical rain forest have five vertical strata on the basis of height of plants. i.e., ground vegetation, shrubs, short canopy trees, tall canopy trees and tall emergent trees.

(14) **(B).** Yucca have an obligate mutualism with a species of moth i.e. Pronuba.

(15) **(B).** Natality refers to birth rate.
- Death rate – Mortality
- Number of individual – Immigration entering a habitat is
- Number of individual – Emigration leaving the habital

(16) **(D).** Amensalism/Antibiosis (0, –)
* Antibiotics are chemicals secreted by one microbial group (eg : *Penicillium*) which harm other microbes (eg : *Staphylococcus*)
* It has no effect on *Penicillium* or the organism which produces it.

(17) **(B).** The given data shows stabilising selection as most of the newborn having average weight between 3 to 3.3 kg survive and babies with less and more weight have low survival rate.