Organisms and Population

Major Abiotic Factors

Temperature:

- the most ecologically relevant environmental factor.
- the average temperature on land varies seasonally, decreases progressively from the equator towards the poles and from plains to the mountain tops.
- ranges from subzero levels in polar areas and high altitude to >50 degree C in tropical deserts in summer.
- unique habitats such as thermal springs and deep-s a h droth m vents where average temperatures exceed 100 degree C
- mango trees do not and cannot grow in temperate untries l e Canada and Germany, snow leopards are not found in Kerala rests and tuna fish are rarely caught beyond tropical.
- A few organisms can tolerate and thriv i wid range of temperatures (they are called eurythermal), but, a ast maj rity o them are restricted to a narrow range of temperatures (su h organis s are called stenothermal).
- Some organisms are tolerant o a wid range f salinities (euryhaline) but others are restricted to a narr range (ohaline).
- Many freshwater animals canno live for long in sea water and vice versa because of the o motic pro ems, ey would face.
- For aquatic organisms the qua ity (chemical composition, pH) of water becomes important.
- The salt concen ion (measured as salinity in parts per thousand), is less than 5 per ce t in inland w ers, 30-35 per cent the sea and > 100 per cent in some hype saline lagoons.

Re ponse to Abiotic Factors

- S me org nisms are able to maintain homeostasis by physiological (som times behavioural also) means which ensures constant body temper ture, constant osmotic concentration, etc.
- All birds a d mammals, and a very few lower vertebrate and invertebrate species a e indeed capable of such regulation (thermoregulation and osmoregulation).
- Evolutionary biologists believe that the ‘success’ of mammals is largely due to their ability to maintain a constant body temperature and thrive whether they live in Antarctica or in the Sahara desert.

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- An overwhelming majority (99 per cent) of animals and nearly all plants cannot maintain a constant internal environment. Their body temperature changes with the ambient temperature.
- In aquatic animals, the osmotic concentration of the body fluids changes with that of the ambient water osmotic concentration. These animals and plants are simply conformers.
- Thermoregulation is energetically expensive for many organisms.
- This is particularly true for small animals like shrews and humming birds.
- Heat loss or heat gain is a function of surface area.
- Since small animals have a larger surface area relative to th ir vol me, they tend to lose body heat very fast when it is cold outside then hey have to expend much energy to generate body heat throug m taboli m. This is the main reason why very small animals are r ly fou d in p lar regions.
- During the course of evolution, the costs and be s of mai aining a constant internal environment are taken into c nside tion.
- Some species have evolved the ability to reg ate, but o ly over a limited range of environmental conditions,beyond which they simply conform.
- If the stressful external conditions are localiz d or main only for a short duration, the organism has two othe alternati s.
- Keolado National Park (Bhartpu in ajasthan host thousands of migratory birds coming from Siberia and other ex mely cold northern regions.
- In animals, the organism, if una le to migrate, might avoid the stress by escaping in time.
- The familiar case f bears go g into hibernation during winter is an example of escape in me.
- Some snails and fish go into aestivation to avoid summer–related problems-hea and desicc ion.
- Under unfav able con itions many zooplankton species in lakes and ponds are known to en er diapause, a stage of suspended development.

Adaptation

- Ada tation s any attribute of the organism (morphological, physiological, behav ral) that enables the organism to survive and reproduce in its habitat.
- Many des rt plants have a thick cuticle on their leaf surfaces and have their stomata arranged in deep pits to minimize water loss through transpiration.
- They also have a special photosynthetic pathway (CAM) that enables their stomata to remain closed during day
  time.

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- Some desert plants like Opuntia, have no leaves – they are reduced to spines–and the photosynthetic function is taken over by the flattened stems.
- Mammals from colder climates generally have shorter ears and limbs to minimise heat loss. (This is called the Allen's Rule.)
- In the polar seas aquatic mammals like seals have a thick layer of fat (blubber) below their skin that acts as an insulator and reduces loss of body heat.
- Some organisms possess adaptations that are physiological which allow them to respond quickly to a stressful situation.
- altitude sickness symptoms include nausea, fatigue and he rt pal itations.
- This is because in the low atmospheric pressure of high alti ud s, the ody does not get enough oxygen.
- But,gradually you get acclimatised and stop experiencing ltitude sickness.
- Body Solution-The body compensates low oxyg vailability by increasing red blood cell production,decreasing the b ding capacity of hemoglobin and by increasing breathing rate.
- Many tribes live in the high altitude of Himalaya
- In most animals, the metabolic reacti ns an henc all the physiological functions proceed optimally in a nar w tempe ature range (in humans, it is – 37 degree C).
- microbes (archaebacteria) that ourish hot springs and deep sea hydrothermal vents where temp ratures far exceed 100 degree C.
- Desert lizards lack the phy iologic l ability that mammals have to deal with the high temperatu es of their habita , but manage to keep their body temperature fairly co tant by b havioural means.
- They bask in the un and absorb heat when their body temperature drops below the comfort zone, b move into shade when the ambient temperature arts incr asing.
- Some species re capable of burrowing into the soil to hide and escape f m the above-g d heat.
  The ige census in our national parks and tiger reserves is often based on pug m s and fecal pellets.

Population rowth

(i) Natality refer to the number of births during a given period in the population that are added to the initial density.

(ii) Mortalityis the number of deaths in the population during a given period.

(iii) Immigration is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration.

(iv) Emigrationis the number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.

- the 'intrinsic rate of natural increase' is a very important parameter chosen for assessing impacts of any biotic or abiotic factor on population growth.
- Populations evolve to maximise their reproductive fitness, also called Darwinian fitness (high r value), in the habitat in which they li e.
- Some organisms breed only once in their lifetime (Pacific s mon sh bamboo) while others breed many times during their lifetim (m st bir s and mammals).
- Some produce a large number of small-sized offspr ng (Oysters, pelagic fishes) while others produce a small number of l e-sized o fspring (birds, mammals).

Population Interaction

- Interspecific interactions arise from t e interac on of populations of two different species.
- They could be beneficial, detrimental or neutral (neither harm nor benefit) to one of the species or b th.
- Both the species ene t in m tualis and both lose in competition in their interactions with eac other.
- In both parasitism and redation only one species benefits (parasite and predator, resp ctively) an the interaction is detrimental to the other species (hos and prey respectively).
- The interactio where one species is benefitted and the other is neither benefitt d nor h med is called commensalism.
- In men alism on the other hand one species is harmed whereas the other is unaffected
- P edatio parasitism and commensalisms share a common cha acteris ic– the interacting species live closely together.
- Besid s acting as 'conduits' for energy transfer across trophic levels, predator play other important roles. They keep prey populations under control.
- But for predators, prey species could achieve very high population densities and cause ecosystem instability. When certain exotic species are introduced into a geographical area, they become invasive and start spreading fast because the invaded land does not have its natural predators.

- The prickly pear cactus introduced into Australia in the early 1920's caused havoc by spreading rapidly into millions of hectares of rangel and.
- cactus was brought under control only after a cactus-feeding predator (a moth) from its natural habitat was introduced into the country.
- Biological control methods adopted in agricultural pest control are based on the ability of the predator to regulate prey population.
- Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species.
- In the rocky intertidal communities of the American Pacific Coast the starfish Pisaster is an important predator.
- In a field experiment, when all the starfish were removed fr m an nclosed intertidal area, more than 10 species of invertebrates became xtinct ithin a year, because of interspecific competition.
- If a predator is too efficient and overexploits its pre , then he prey might become extinct and following it, the predator will o becom extinct for lack of food. This is the reason why predators n natu e are 'prudent'.
- Prey species have evolved various defenses lessen e impact of predation.
- Some species of insects and frogs ar crypt ally- loured (camouflaged) to avoid being detected easily by th predator
- Some are poisonous and theref e a oided by he predators.
- The Monarch butterfly is highly distaste l to ts predator (bird) because of a special chemical present in it
  body.
- Interestingly, the b tte ly acq ires th s chemical during its caterpillar stage by feeding on a poiso ous weed
- For plants, herbiv res a e the predators.
- Nearly 25 per cent of all in ects are known to be phytophagous (feeding on plant sap an other pa s of plants).
- Thorns (Acaci Cactus are the most common morphological means of d fence
  In g ne l herbivores and plants appear to be more adversely affected by comp on tha carnivores.
- T e life cles of parasites are often complex, involving one or two inte mediate hosts or vectors to facilitate parasitisation of its primary host.
- The human liver fluke (a trematode parasite) depends on two intermediate hosts (a ail and a fish) to complete its life cycle.
- Parasites hat feed on the external surface of the host organism are called ectoparasites.
- The most familiar examples of this group are the lice on humans and ticks on dogs.
- Many marine fish are infested with ectoparasitic copepods.

- Cuscuta, a parasitic plant that is commonly found growing on hedge plants, has lost its chlorophyll and leaves in the course of evolution.
- It derives its nutrition from the host plant which it parasitises.
- The female mosquito is not considered a parasite, although it needs our blood for reproduction.
- In contrast, endoparasitesare those that live inside the host body at different sites (liver, kidney, lungs, red blood cells, etc.).
- The life cycles of endoparasites are more complex because of their extreme specialisation.
- Their morphological and anatomical features are greatly sim lified while emphasising their reproductive potential.
- Brood parasitismin birds is a fascinating example of parasit m n whi the parasitic bird lays its eggs in the nest of its host and l the h st inc bate them.
- During the course of evolution, the eggs of the p sitic bird ave evolved to resemble the host's egg in size and colour t redu e the chances of the host bird detecting the foreign eggs and eject g them f m the nest.
- Try to follow the movements of the cuckoo (koe) and the crow in your neighborhood park during the breeding seas n (sp ing to summer) and watch brood parasitism in action.
- Commensalism: This is the inte ctio in whic one species benefits and the other is neither harmed n r benefited An orchid growing as an epiphyteon a mango branch, and barnacles growing on the back of a whale benefit while neith he ma go tree nor the whale derives any apparent benefit.
- Mutualism: This inter tion conf rs benefits on both the interacting species.
- Lichens repre ent an intim te mutualistic relationship between a fungus and photosyn hesising lgae or cyanobacteria.
- Similarly the mycorrhiz eare associations between fungi and the roots of h gher p ants.
  The fun help the plant in the absorption of essential nutrients from the soil w i the pl nt in turn provides the fungi with energy-yielding c rbohy ates.
- Orc ids sh w a bewildering diversity of floral patterns many of which have evolve to attract the right pollinator insect (bees and bumblebees) and ensure g aranteed pollination by it.
- Not all or hids offer rewards.
- The Mediterranean orchid 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.
- If the female bee’s colour patterns change even slightly for any reason during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.

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