Chapter - 13
Organisms and populations:

Ecology concerned with four level of organisation.
organisms, populations, communities and biomes.

organisms and its environment:

- physiological ecology - tries to understand how different organisms are adapted to their environment in terms of not only survival but also reproduction.
- Regional and local variations within each biome lead to the formation of a wide variety of habitats.
- Abiotic factor - temperature, water light, soil
- biotic factor - pathogen, parasite, predator, competitors.
all this factors characterise the habitat.
- niche - Each organism has an invariably defined range of conditions that it can tolerate, diversity in the resources it utilises and a distinct functional role in the ecological system,

Major abiotic Factors:

Temperature -
lowers towards the poles, and increases in tropical deserts in summer. thermal springs, deep-sea, hydrothermal vents have average temperatures exceed 100°c
mango trees can't grow in temperate country like Canada & germany.
Snow leopard are not found in Kerala forest.
temperature affects the kinetics of enzymes and through it the metabolic activity and other physiological functions of the organism.
eurythermal - organism can thrive and tolerate wide range of temperature
Stenothermal - major animals restricted to narrow temperature range

Water:

- its activity is limited in deserts hence organisms from desert are specially adapted.
- productivity and distribution of plant - depends on water.
- For aquatic organisms the quality of water (chemical composition, pH) becomes important.
- Salt concentration - less than 5 in inland waters, 30-35 in sea, and greater than 100 in some hypersaline lagoon
- ~~Eur~~ Euryhaline - tolerate a wide range of salinities
- sterohaline - restricted to narrow range.
- Many freshwater animals cannot live for long in sea water & vice versa.

Light -

~~Some~~ plants produce food through photosynthesis. Where light is used as a source of energy. plants need light for flowering also. While animal also needs light for foraging, reproduction and migratory activity. UV component of light spectrum is harmful for life.

soil - so

Soil composition, grain size, aggregation determines the percolation and water holding capacity of soil. These characteristics along with pH, mineral composition, topography determines large extent of vegetation in any area.

Response to abiotic factors:

i) Regulate -

homeostasis - constant body temperature, osmotic concentration. (thermoregulation, osmoregulation)

e.g: All birds and mammals, few lower vertebrates, and invertebrate. Used by most animal to regulate their body temperature.

e.g: Human maintain constant body temperature of 37°c. in summer we sweat and try to cool down our body. & in winter we

shiver (kind of exercise) and raise the body temperature.

ii) conform -

99 percent animals and nearly all plants changes their body temperature and osmotic temperature according to outside environment.

Heat loss and heat gain is a function of surface area.

~~Here small animals loose body heat very fast when its cold outside.~~

iii) Migrate -

The organisms can move away temporarily from the stressful habitat to a more hospitable area and return when stressful period is over.

iv) Suspend -

- In bacteria, fungi, lower plants various kinds of thick walled spores are formed which help them to survive unfavourable conditions - these germinate on availability of suitable environment.
- Higher plants - seeds and some other vegetative reproductive organs. (dispersal and germination in favourable condition)
- Hibernation - deep sleep that helps animals to save energy and survive the winter without eating much.
- Aestivation - in snails and fish to avoid summer related problems like heat and dessication.
- diapause - A stage of suspended development (zooplankton)

Adaptation:

Adaptation is any attribute of the organism (morphological, physiological, behavioural) that enables the organism to survive and reproduce in its habitat. many adaptations are genetically fixed.

i) e.g: kangaroo in water absence oxidised internal fat & form water as a byproduct. it also concentrate urine to save water

from excretory product.

2) many desert phants have cuticle on their leaf surface (stomata arranged in deep pits to minimize water loss from transpiration, CAM pathaway - Stomata remain closed in day time. some plants like opuntia have no leaves, leaves reduced to spines

3) cold climate mammals - Short ears & limb - minimise heat loss. (Allen's rule), in polar seas aquatic animal like ~~set~~ seals have thick layer of fat (~~but~~ blubber) below their skin that act as an insulator and reduces loss of body heat.

4) High altitute mammals have high RBC ~~of~~ count to compensate ~~oxygen~~ low oxygen availability.

5) some microbes flourish in hot spring (exceed 100°c), many fish thrive in antartic water (temp below 0°c), many vertebrates live at great depth in the ocean where the pressure could be greater than 100 times the normal atmospheric pressure.

6) Sun basking - absorb heat when body temperature drops below the comfort zone.

Populations:

population attributes:

- population is a group of individual of the same species living and interbreeding within a given area.
- poluation have birth rate and death rate.
- rate - change in number with respect to members of the population.
- e.g. there are 20 lotus, through reproduction 8 new are added.

$\therefore$ birth rate $= \frac{8}{20} = 0.4$,

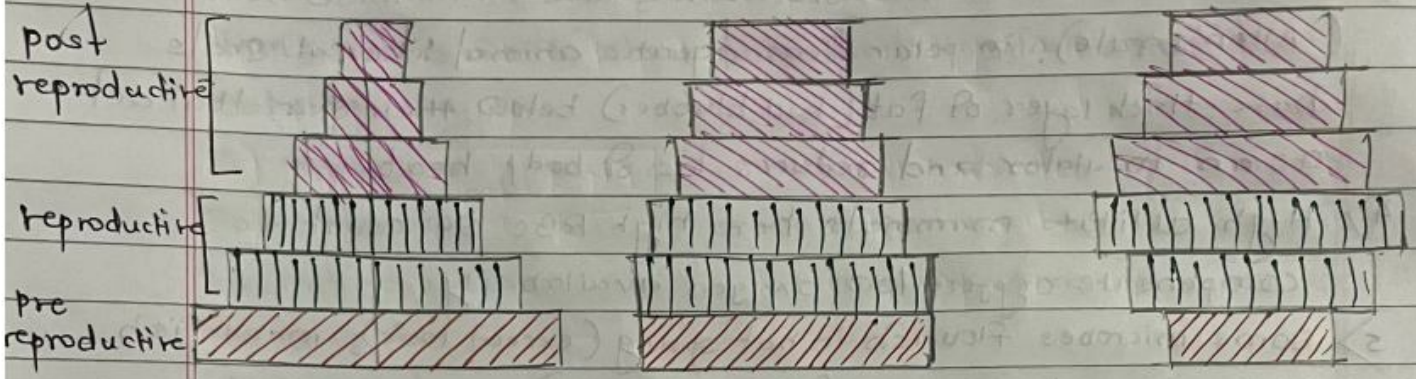
2 flowers ~~dried~~ dried $= \frac{2}{20} = 0.1$

$\therefore$ ~~real~~ death rate $= 0.1$

- Sex ratio - Individual is either a male or female.
  e.g. 40% male, 60% female.

Age pyramid -

i) Expanding ii) stable iii) declining.



Population size technically called population density.

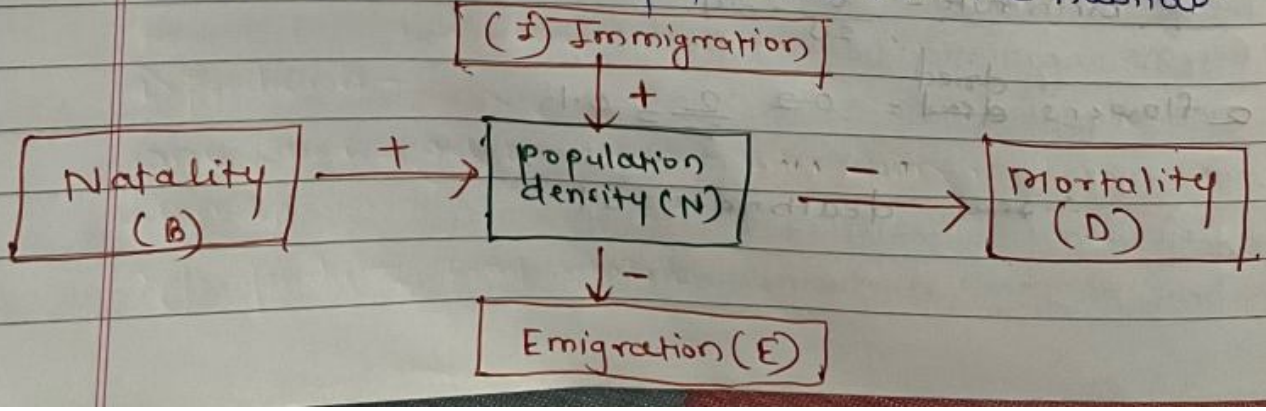
Population growth:

i) Natality -
Number of births during a given period in the population that are added to the final density.

ii) Mortality -
Number of death in the population during a given period.

iii) Immigration -
entry of individuals of the same population in the habitat.

iv) Emigration -
Exit or individual of the population left the habitat.



If N is the population density at time t, then density at time t+1 is

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

- Density increase if Birth and immigration increase.

Growth model -

1) Exponential growth:

When resources in the habitat are unlimited, each species has the ability to realise fully its innate potential to grow in numbers.

$$\frac{dN}{dt} = (b-d) \times N$$

N = population size
b = birth rate per capita
d = death rate per capita
$\frac{dN}{dt}$ = increase or decrease in N during a unit time period.
r = intrinsic growth rate.

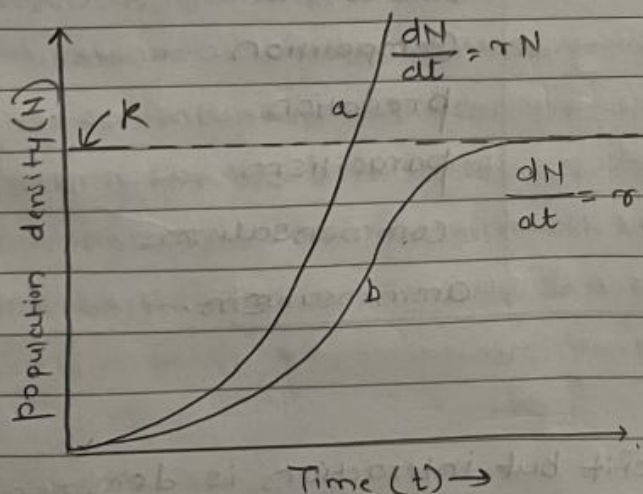
Here $(b-d) = r$ then

$$\boxed{\frac{dN}{dt} = rN}$$

- Here J shape curve formed.
- Here integral growth equation is

$$N_t = N_0 e^{rt}$$

N_t = population density after time t
N_0 = population density at time zero
r = intrinsic rate of natural increase.
e = base of natural logarithms.



$\frac{dN}{dt} = rN$

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

a = Exponential growth curve

b = logistic growth curve

k = carrying capacity.

ii) logistic growth -

No population in a natere has unlimited resources to permit exponential growth. leads to compitition between limited resources. only fittest indivual will survive and reproduce. population growing logistically show initially lage phase then acceleration and decceleration phase. limit above which population cannot grow is called carrying capacity.

$$\frac{dN}{dt} = rN\frac{(k-N)}{k}$$

N = population density at time t.
r = intrensic rate
k = carrying capacity.

Population interactions:

Interspecific interactions arise from the interaction of populations of two different species.

+ = beneficial interaction
- = detrimental
0 = neutral interaction.

Population Interaction.

Species A	Species B	Name of Interaction.
+	+	Mutualism
−	−	Competition
+	−	predation
+	−	parasitism
+	0	commensalism
−	0	ammensalism.

1) predation -

one species get benefit but interaction is detrimental to other species.

e.g: predator prey relation.

Here predator keep prey population under control. If predator is not present, species can become invasive.
predator also help in maintaining species diversity in community.
If a predator is too efficient and overexploits its prey then the prey might become extinct
predator and prey always co-evolve. prey develope some defense mechanism. while predator also overcome it after some time.
e.g: some prey are cryptically coloured (camoflaged)
some are poisonous to predator. e.g: monarch butterfly is highly distasteful to predator.
plant also developed some morphological and chemical defense against herbivory. (chemicals, spines, poisonous-cardiac glycosides)
- chemical substances extracted from plant are nicotine, caffeine, quinine, strychnine, opium.

ii) Competition -
- when resources are limited the competitively superior species will eventually eliminate the weaker species.
- connell's elegant field experiment showed that on the rocky sea coasts of scotland, the larger and competitively superior spec barnacle Balanus dominates the intertidal area and excludes the smaller barnacle chathamalus from the zone.
- Gause's competitive exclusion principle - two closely related species competing for the same resource cannot coexist indefinitely and the competitively inferior one will be eliminating eventually.
- resource partitioning - species can avoid competition by different time for feeding or different foraging pattern.

iii) Parasitism -
many host and parasite co-evolve. host have specific mechanism to reject parasite & parasite neutralise or

counteract them. parasite evolve special adaptation according to host.
e.g: human live fluke depends on two intermediate host or vectors to facilitate parasitisation of its primary host. (snail & fish)
malaria parasite needs a vector (mosquito) to spread to other host. majority of parasite harm the host. parasite that feed on the external surface of the host organism are called ectoparasites. e.g: lice on humans and ticks on dogs. parasite those live inside the host body are called endoparasite.
e.g. Brood parasitism in ~~blo~~ bird.

iii) Commensalism –
Interaction in which one species benefits and other is neither harmed or benefited.
e.g: orchid growing as an epiphyte on a mango branch and barnacles growing on the back of a whale benefit while ~~neig~~ neither the mango tree nor the whale derives any apparent benefit.
Sea anemone and clownfish. Sea anemone has stinging tentacle & fish live among them.

iv) mutualism –
Benefit to both interacting species. relation between fungi and algae (lichen). plant need insect for pollination while insect get nutrition, nectar. fig pollinated by wasp and wasp uses the fruit for nourishing the larvae.
The Mediterranean orchid ophrys employs 'sexual deceit' to get pollination done by species of bee.