18/09/22 Organism and Population

Ecology :-

Ecology is the interaction between organisms and its surrounding.

- Father of ecology :- Richter
- Term ecology :- Haeckel
- Indian father of ecology :- Ramdev Mishra
- Ecology study initiated in India :- W. Budegoen
- Plant ecology :- Warming

Physical / Physio-chemical Hierarchy

Atom → Molecules → Biomolecules → Cell organelles

Biological Hierarchy

↓ Cell ↓ Cells/Tissue ↓ Organ ↓ Organ system ↓

Organism ↓ population ↓ community ↓ Ecosystem ↓ Landscape

↓ Biome → Biosphere

Ecological Hierarchy

* **Organism and population :-**

* **Organism :-**

→ It is the basic and smallest ecological hierarchy.

→ It may be small, large, unicellular or multicellular

→ It is self-regulating, self-growing and self-sustaining organism.

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→ A new organism produced from pre-existing organism as their own kind.
→ Every organism have fixed life span and organised life cycle (Birth, Growing, Maturity, Senescene and ultimately Death)
→ Organism is not only based on physiological hierarchy for physical activities.
→ In ecology, physio-chemical components are alone do not play characteristic habitation for an organism.
→ For this we need both type of factors i.e. biotic and abiotic.

* **Biotic factors :-**
Plants, animals and microorganism.

* **Abiotic factors :-**
Temperature, water, soil, air, light

* **Temperature.**
→ It is the most relevant abiotic factor that affect the habitat of an organism.
→ Average tempt. varies from 0° (sometime - degree tempt.) to 50°C
→ Tempt. variation occur due to season, altitude, latitude, slope; topography, etc.
→ Tempt. variation can also occur in vast range ~~also~~ i.e. from 100°C to more than 100°C in hot thermal spring or hot thermal vent.
→ Due to tempt. variation mango plant can't grow in temperate countries

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→ Germany and Canada.
Snow leopard never found in Kerala forest.
→ Tuna fish are rarely catch in tropical latitude ocean.
→ On the basis of temperature, organism is of two types.

[1] Eurythermal / Warm blooded & Homeostasis:-
Animal that can tolerate large range of tempt. variation.
exp:- Birde, mammals, etc.

[2] Stenothermal or Poikilo thermal or cold Blooded
Organism that can't tolerate large range of tempt. variation.
exp:- Pisces, amphibians.

* On the basis of temperature, there are five Rules :-
Organism that can't tolerate large/range of tempt. variation.

[1] Bergmann's Rule.
Birds and mammalians that occur in colder region generally have larger body size while in warmer reason birds and mammalians have smaller body size.

[2] Allen's Rule
Mammalians that occur in colder region have small extremites. (Snout, nose, ear, limbs). compared to warmer region.

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[8] Allen's Rule Groger's Rule
Fishes occur in colder region have more developed vertebrates.

[4] Jordon Rule :-
Animals that occur in warmer region are generally dark in colour compare to colder region.

[5] Ranche's Rule :-
~~Fishes~~ Birds that occur in colder region have narrow wings.

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* Water :-
It is the most important abiotic factor after temperature.
→ In water, amount of salt also found.
→ Amount of salt concentration in water is measured as salinity.
→ Salinity defines parts per thousand (ppt)

Source of Water	Salinity
Inland water	5
Sea water	30-35
Hyper saline lagoon (Gulf)	More than 100

→ On the basis of salinity animals is of two types.

[1] Euryhaline
→ Animal that can tolerate large range of salinity.
→ ex:- Fish, human.

[2] Stenohaline
Organism that can't tolerate large range of salinity.
ex:- Leech, worm, Annelid.

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* Light :-

→ Light is an electromagnetic radiation.

→ It is measured by photo meter or Luxmeter

→ Sun is the ultimate source of light.
Through sun, total light radiated on earth i.e. total incident Radiation.

TIR

- Less than 50% ⇓ (390 – 720) (400 – 700) nm PAR → [Photosynthetic Active Radiation]
- More than 50%

83%	12%	5%
Absorbed light	Reflected	Transmitted

⇓

0.2 – 3%
chemical energy

GPP :- Gross Primary Production
NPP :- Net Primary Production.

TIR →	GPP →	NPP
	1 to 5%	0.8 to 4%

PAR →	GPP →	NPP
	2 to 10%	1.6 to 8%

* Albido effect :-

Decrease in temperature of earth atmosphere due to reflection of light.

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* Solar constant :-
Before entering in earth's atmosphere, solar radiation contains a constant rate of energy is 2 cal-cm/min.

* Soil :-
It is also called adaphic factor.
Study of soil is called pedology or Edaphology.
→ On earth, uppermost layer is called soil.
→ Process of formation of soil is called pedogenesis.
→ Soil formation process is very slow process.
→ To form one inch of soil, it took 500 to 1000 years.
→ In soil, various material of soil other than water.

component	%
• Minerals	45 %
• Air	25 %
• Water	25 %
• Organic matter (Dead & decay)	5 %

* Soil - Water
→ In soil, water is also present and it is measured by Tensiometer.
→ Total water available in earth's crust is called Hollard.
Hollard is of two type.

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Hollard

Crashard	Echard
ex:- Capillary water available form of water for plant.	Hygroscopic water, Gravitational water combined water.

* Capillary water

→ This water is available form of water for plant.

→ Water present between ~~mier~~ soil layer in the form of micropore.

* Hygroscopic water

Water present in the form of thin layer of moisture on soil particle is called Hygroscopic water.

These water is strongly combined with soil particle through cohesive and adhesive force of attraction and it is unavailable form of water for plant.

* Gravitational

Water that move down or percolate between soil particle and get accumulated below the soil.

It is unavailable form of ~~water~~ hydroxide of water for plant.

* Combined water :-

Water present ~~formed~~ in the form of hydroxide of Fe, Al, Si, is called combined water.

It is unavailable form of water for plane.

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ex:- Some of the vertebrates
Evolutionary biologist believed that successful survival of mammalians on earth is due to ability to maintain thermo-regulation.

* Conformers :- 99% animal.
Conformers can't maintain their constant body temperature.

* Stressful external condition occur :-
To overcome from stressful condition we have to follow.

[1] Migrate
[2] Acclimatisation
[3] Escape in time → Hibernation / → Aestivation
[4] Suspend
[5] Diapause

[1] Migrate :-
Migration occur when some organism move from one place to another place to overcome odd or harmful or stressful condition.

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Migration having 3 different mode:-

[i] Short distance Migration :-
ex :- Caribul (Rain deer); Whale

[ii] Long distance migration :-
ex :- Arctic term [perform cer-cum polar breeding].

[iii] Periodic distance migration :-
ex :- Locusta (Gregarious paste) (Grasshoppers)

[2] Acclematisation :-
Slow physical physiological change due to slow changing environment.
ex :- Sweating, increasing the rate of breathing. increase RBC ; decrease O_2 binding affinity of haemoglobin at high altitude.

[3] Escape in time :-
(i) Hibernation
It means winter sleep.
ex :- Lizard, reptiles ; bears, etc.
(ii) Aestivation :-
It means summer sleep.
exp :- Amphibians ; Snails, fish, etc.

[4] Suspend :-
Some organism like bacteria, fungi and lower plants form a thick wall covering on their body surface which protect them from unfavourable condition.

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* Opuntia :- Opuntia have no leaf since they reduce and converted into spines and the photosynthe-tic activities occur by flatened stem.

[5] Diapause :-
Some organism suspend their development in adverse condition to avoid stresseful condition.
ex :- Seed dormancy, zooplankton, etc.

* Adaptation :-
→ Any attributes of an organism which help in survival and reproduce in their habitat is called adaptation.
→ It may be morphological, physiological and behaviourlogical.
→ ex :- Kangaroo rate (found in North America desert) is capable of requiring of its all water requirement through its internal fat oxidation in which water is a by-product.
→ It also has capability to concentrate its urine due to which minimum water remove out as a urine.
→ Many desert plant have thick cuticles of their leaves surfaces and have their stomata arranged in deep pits to minimise their water loss through transpiration process they also follow due to which their stomata open in night.
→ Archaebacteria ~~AB~~ bacteria can survive in hot thermal wind or hot thermal spring where tempt. exceeded more than 100°c and they survive due to special enzymes present in Archaebacteria ~~AB~~ that prevent

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* Allen's Rule :- In polar sea seals have a thick layer of fat i.e. called blubber below their skin that act as an insulator and reduce loss of body temperature. Adaptation for altitude sickness person is increased heart beat ; increase in RBC count & decrease in O_2 binding capacity of haemoglobin.

from de-maturation and high tempt.

→ In desert, lizard and other reptiles show behavioural adaptation through sun bath.

→ Many fishes thrive in Atlantic water where most of the time tempt. below 0°C but fish can survive in those water due to antifreezing enzymes present in it.

→ Lots of fish survive in deep ocean where pressure is 100 times greater than normal atmospheric pressure but after all many fish and other fish can survive due to presence of Gills.

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* Population :-

It is a group of individual with same species in a particular area & particular time.

* Population attributes.

[1] Birth and Death Rate
[2] Sex Ratio
[3] Population age Pyramids
[4] Population density.

[1] Birth and Death Rate

A population has birth rate and death rate but for individual it may be only birth or death.

→ Birth rate & death rate calculated on per capita.

$$\boxed{\text{Birth Rate} = \frac{\Delta N}{N \Delta t}}$$

N = Population density.
ΔN = Change in population density
Δt = change in time.

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Q In a pond 20 lotus plant last year and through reproduction 8 new plants where added, taking current population 28. calculate the birth rate?

$\Delta N = 8$

$N = 20.$

$$B.R = \frac{\Delta N}{N \Delta t} = \frac{8}{20 \times 1} = \frac{4}{10} = 0.4.$$

$$\boxed{\text{Death Rate} = \frac{\Delta N}{N \Delta t}}$$

If 4 individuals in a laboratory population 40 fruitflies dead during a specified time interval say a week. The death rate in the population during that period is how much?

$$D.R = \frac{4}{40 \times 1} = \frac{4}{40} = 0.1.$$

[2] * Sex Ratio :-

It is calculation of how much female population ~~is~~ existing for existing male population on 1000 population.

Q If in a population of 1000 female is 550 and male 450 so find out the ratio?

$$\text{Sex ratio} = \frac{\cancel{550}^{11}}{\cancel{450}_{9}} = 11:9$$

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[3] Population age Pyramids.

In a population in unit time how much type of population are existing.

Individual composed three group on the basis of age.

[1] Pre - Reproductive :- Infants

[2] Reproductive :- Sexually mature.

[3] Post - Reproductive :- Old individuals.

[4] Population density & popula

It is represented by N.

It has various attributes like

[a] Total Number

[b] Biomass or Percent Cover

[c] Relative Density.

[d] Indirect Count.

→ Total Number is most appropriate measurement of population density.

→ If population density is very use so we use percent cover or biomass for particular area.

→ Relative density = $\frac{\text{Total no. of individual of species}}{\text{Total no. of all species}} \times 100$

→ Without actual counting or seeing them, on the basis of estimation if population density measure.

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Population interaction.

→ It is the interaction between two different species on the basis of profit and loss.

→ Six different types of interaction.

	Interaction	Species 1	Species 2
+ve population interaction	[1] Mutualism	+	+
	[2] Protocooperation	+	+
	[3] Commensalism	+	0
	Competition	−	−
	Predation	+	−
−ve population interaction	Parasitism	+	−
	Amensalism	−	0

Mutualism.

→ It is obligatory relationship between both the species that is both are benefitted & completely dependent on each other for growth & survival.

→ They show co-evolution & co-extinction.

→ In it, physical contact is present between both the species.

→ exp :- Lichen :- Algae & fungi relationship.

Micorhiza :- fungi & root of higher plant.

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Plant-pollinator :- (i) Rhizobium & leguminous plant.

(ii) Yucca plant & pronema insect

(iii) fig and wasp insect

Protocooperation

In this interaction both the partners are benefitted but can live separately.
They do not show co-evolution & co-extinction

exp :- Sea anemone and Hermit Crab.
Tick bird & Rhinoceros.
Crocodile & Bird.

Commensalism

In this interaction, in which one species benefitted and other is neither harm or benefitted.

exp
- Orchid plant grow as epiphytes on mango plant.
- Pilot fish & shark.
- Sucker fish & shark.
- Clone fish & sea anemone.
- Whale & Barnicle

Cattle egret bird & egret.

Note If in a ~~opt~~ question having option & protocooperation is not given then choose the option commensalism.

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Competition

→ A/c to Darwin, if competition between two species happen then it is struggle for existence & survival of the fittest in nature.

→ exp The Abingdon tortoise in Galapagos Islands became extinct within a decade after goats were introduced on the island. ~~then result~~

Predation :-

In this, one species is predator that catch and kill the another species. (prey) for food.

→ All herbivores are ~~predators~~ prey that catched, killed and eaten.

→ Carnivores :- lion, leopard, etc.

Insectivores :- Dr Nepanthis

In parasitism, smaller species depend on larger species (host) for food & shelter.

True parasite depend on host for food & shelter.

Parasite never kills the host.

It is of two types.

Ectoparasite	Endo
Present on body surface.	~~Per~~ Present inside the body of host.
exp. Leech on cattle. Ticks on dog.	exp. Tainiwali, plasmodium, Entamoba.

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Musquito is not a true parasite.
It depends on sap & other thing but to incubate their eggs depends on mammalian blood.

Type of paral parasitism

[1] Hyperparasitism
Parasite on parasite.
exp Bacteriophage on bacteria
Plasmodium on mosquito.
Brood parasitism (not a true parasitism)
exp cuckoo & crow.
Rafflesia :- total root parasite.
Cuscutta :- total stem parasite.

[2] Hemi-parasite :-
exp Viscum and loranthus

Santalum :- partial root parasite.

* Ammensalism
In this, one species is harmed and other species is unaffected.
Some fungi secretes antibiotics which kill the bacteria.

Population growth measured upon density

It has four attributes.
[1] Natality :- Birth Rate } Intransic growth
[2] Mortality :- Death Rate } (Natural growth)
[3] Imigration :- incoming of same species individual in existing population
[4] Emigration :- Outgoing of same species individual from existing population

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→ Imigration and Emigration are extransic or special circumstances growth.

Population density

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

N_t :- Population density at time t.
N_{t+1} :- " " " " t+1.
B :- Birth Rate
I :-
D
E

→ To explore population growth, we have two type of growth model.

[1] Exponential / Geometrical / J-shaped Growth.

[2] Logistic Growth. / Sigmoid Growth / Pearl

[1] Exponential Growth :-

It occurs when resource is unlimited

Population density (N)

at particular time, $N = B - D \times N$

Unit Calculation = differentiation method

$\Rightarrow \frac{dN}{dt} = (B-D)N$

$\Rightarrow \cancel{\frac{dN}{dt}}$ If $(B-D) = r$

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

r = intransic population growth.

Integral form.

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

N_t :- Population density after time t

N_0 :- " " " " 0

r :- intrinsic rate of Natural increase

e :- the base of natural log.

* Logistic Growth :-

If resources is limited

It is also called sigmoid growth or Verhulst - Pearl Logistic Growth.

$$N = (B-D) \times N$$

$$\frac{dN}{dt} = (B-D) \times N$$

If $(B-D) = r$

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

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

K = Carrying capacity.

N = Population density

r = intrinsic rate of natural increase.

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