ORGANISM AND POPULATION

Ramdeo Mishra → Father of Indian Ecology
Ecology term/defined by → Ernst Haekal
Father of mordern ecology → Odum.

Autecology → Deals with study of organisms/species
Synecology → Study of diff. species and its interaction

Ecology → Study of interactions among organisms, between organisms and its physical (abiotic) factors.
4 levels → Organisms, Population, community, biomes

Organism and It's Environment

At organismic level → Organisms get adapted to their environment for their survival and reproduction

Rotation of earth about it's axis brings change in environment, leading to different seasons. This leads to formation of biomes desert, rainforest and tundra.

Tropical forest → Max. Precipitation. 25-30°C, 300-400cm
Temperate forest → 5-20°C, 5-200cm
Coniferous forest → Polar regions - 0°C - 10°C
Arctic and Alpine tundra → Perma Frost
Desert → Cold desert → Gobi desert, Spiti
↳ Hot Desert → Sahara, Thar.
Grassland → 0°-25°C, 50-80cm
Major Biomes of India → Tropical rain forest, Deciduous forest, desert, Sea Coast.
→ Extreme and Harsh habitats → Scorching Rajasthan desert, thermal spring, perma frost...
→ Intestine → parasite Tania Solium.

→ Factors

Abiotic Factors	Biotic Factors
Temp, Water, Light, Soil	pathogen, parasite, predatory, competitory

Organisms → Natural selection, adaptations..

Niche → Distinct functional role in ecological system.

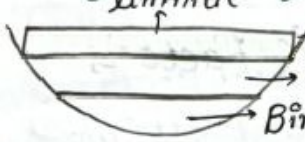
Major Abiotic Factors

① Temperature → Most imp. ecologically relevant environmental factor
→ Subzero level - polar areas.
→ high altitudes → >50°C in tropical desert
→ Thermal Springs / deep sea hydrothermal Vents → 100°C
→ Mango trees → Cannot grow in Canada, Germany
→ Snow leopards → not in Kerala.
→ Tuna fish → Uptill tropical latitudes
→ Eurythermal → Tolerate wide range of temp. (Warm Blooded)
→ Stenothermal → Narrow range of temp.
Hibernation (Winter sleep) ↔ Aestivation (Summer sleep) (Cold blooded)

② Water → Another most imp. factor influencing life of Organism.
→ productivity / distribution of plants are heavily dependent on water.
→ Aquatic animals → (Chemical composition, pH) very imp of water.
→ Salt conc. (Salinity in parts per thousand)
↳ <5 in inland water ★
→ 30-35 in sea ★ ★
→ >100 - HyperSaline Lagoons ★
→ Euryhaline - Tolerant wide range of Salinity (Salmon Fish)
→ Stenohaline - Narrow range of Salinity (Shark)

③ Light → Sunlight = Source of energy for photosynthesis.
→ Heliophytes - Sun plant.
Schiophytes - Shady plant → Stratification, Low light Condition
→ Plants depend → Sunlight = photoperiodic requirement for flowering.
→ Animals → foraging, Reproductive, migratory activities

→ Light & Temp → Sun is source of both.
→ Deep > 500m in Oceans → Souce of energy is Hydrothermal Vent.
→ Stratification of Lake

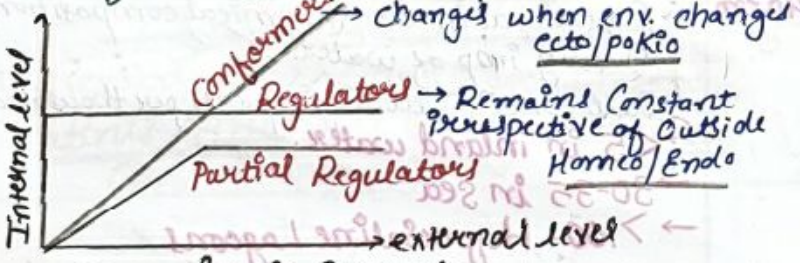


→ UV component → Harmful (Skin Cancer)
→ Green < Brown < Red → Deepest water algae

④ **Soil** → Nature, Composition differs place to place.
→ Depends upon Climate, weathering process, soil development method.
→ Characteristics of Soil → Soil Composition, grain size, aggregation → percolation and water holding capacity
→ pH, mineral composition, topography.
→ Aquatic → Sediment - characteristics determine type of Benthic Animals ★
→ Black / Clayey soil → Water Retain Max
→ Loamy Soil → 〃 — moderate ✓
→ Sandy Soil → 〃 — lowest ✓

Responses to Abiotic Factors

Homeostatis → Stable internal Environment
↳ energetically expensive process



Organismic Response

① **Regulate** → Maintain Homeostatis, constant body temperature, osmotic conc.
→ Thermoregulation, Osmoregulation
→ Birds, Mammals, few lower Vertebrate, invertebrate species
→ Success of Mammals → Homeostatis
→ We maintain (37°C) temp. → Sweat, Shiver..

② **Conform** → 99% of animals and all plants.
→ Body temp. changes with environment
→ Thermoregulation is energetically expensive process
→ Heat loss / Heat Gain → function of Surface area ★
→ Small animals → larger surface area relative to their volume, they tend to lose body heat very fast.
→ Small animals - rarely found in polar region
→ Bergamin's Rule ★ - Small animal - tropics, Large animals - Polar (Birds)

③ **Partial Regulators** → Regulate over limited range, beyond they conform

④ **Migrate** → Move away temporarily from stressful habitat to more hostable area and return when stressful period is over. ★
→ Keolado National Park (Bharatpur) in Rajasthan host thousand of migratory birds coming from Siberia and other extreamely cold northern regions ★

⑤ **Suspend** → Bacteria, fungi, lower plants → thick walled spores, which germinate on getting suitable temperature ★
Animals - If unable to migrate, avoid stress by escaping in time.
Hibernation → Polar Bear
Aestivation → Snails and fish
Diapause → Stage of Suspended development (Zooplanktons in lakes and ponds) ★

Adaptations

physiological adjustments →
→ Any attribute of organism
→ morphological
→ physiological
→ behavioural
} able of surviving and reproducing.

→ Many adaptations → evolved over a long time → Genetically fixed

→ Kangaroo Rat (North American desert)
↳ water requirement through internal fat oxidation
→ Concentrate urine, long loop of Henle

→ Desert plant (thick Cuticle) - Opuntia on leaf surfaces and have stomata deep pits (Sunken) - Norsum to minimize water loss. ★

→ Special photosynthetic way - CAM → (Stomata closed during day time)
→ Opuntia - No leaves, (Spines).. Flattened Stems.

→ Allen's Rule - Mammals from Colder climates generally have shorter ears and limbs to minimise heat loss

→ Polar Seas - Seals have thick layer of fat (blubber)

→ physiological Adaptations. →
(>3500m Rohtang Pass near Manali & Leh
→ altitude sickness. (Nausea, Fatigue, heatit palpitations)
→ Low atmospheric pressure ↓↓ → O_2 ↓↓
↓
High RBC Count ↑↑ (acclimitization)

→ Many fish thrive in Antarctic water (temp < 0) → anti freeze proteins ★
→ Marine Invertebrates and fishes → depth of Ocean → pressure > 100 times.
↳ Biochemical adaptations ★
→ Behavioral responses = Desert Lizard Bask in sun, absorb heat.. Move to shade.. according to temp.
→ Burrowing into Soil.. ★

Populations →

→ Population Attributes

→ Group of similar individuals living in geographical area, sharing similar resources, and capable of interbreeding.

→ Population Ecology - links ecology to population genetics and evolution

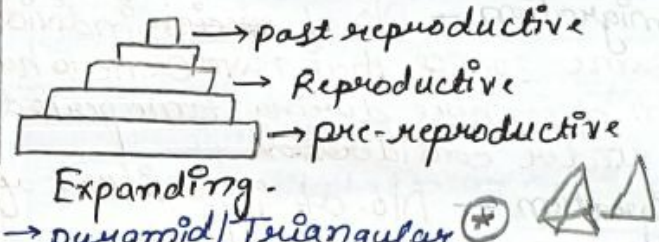
→ Population have certain attributes, which individual Organism

→ Birth Rate = $\frac{\text{No. of Birth}}{\text{Total Birth}}$ ★

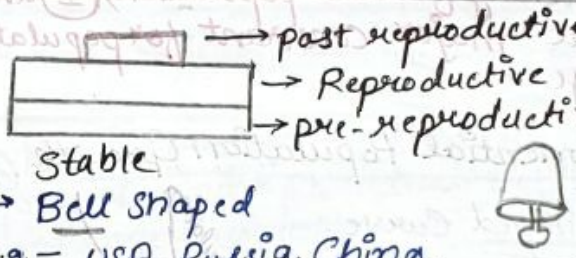
→ Death Rate = $\frac{\text{No. of Death}}{\text{Total Death}}$ ★

→ Sex Ratio = e.g. 60% males, 40% females

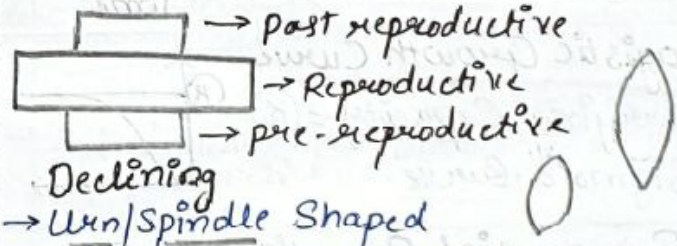
→ Population Pyramid / age pyramid
→ Pre Reproductive age (0-12)
→ Reproductive (12-50)
→ Post reproductive (50-70)



Expanding.
→ pyramid / Triangular ★
e.g. - India, Pakistan, Bangladesh



Stable
→ Bell shaped
e.g. - USA, Russia, China.



Declining
→ Urn / Spindle Shaped
e.g. - Germany, France, Japan

Population Density → population size.

↳ Denoted by N.
↳ no. of individuals inhabiting a particular niche. ★

→ If population ↑↑ → Relative density is measured instead of absolute density.

→ Tiger Census - Pugmarks and fecal pellets
→ % of biomass

→ Population Growth

$N_{t+1} = N_t + [(B-D) + (I-E)]$ ★

B = No. of Birth (+)
D = No. of Death (-)
I → Immigration ← (+)
E → Emigration → (-)

Natality → No. of Birth during given period in population that are added to Initial density.

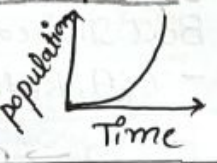
Mortality → No. of Death in population

Immigration — No of individuals of same species that have came to habitat from else-where during time period under consideration

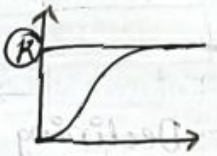
Emigration — No. of individuals of population, who left habitat.

For a newly formed population, (I) and (E) are the major constraint for population change. ★

→ Exponential Population Growth ★
→ J-shaped Curve.
→ Resources Unlimited



→ Logistic Growth Curve
→ Carrying Capacity = (K)
→ Sigmoid Curve



① Exponential Growth →

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

$(b-d) = r$

$\frac{dN}{dt} = rN$ → intrinsic rate of natural increase.

→ Norway rat (r) = 0.015
→ flour beetle = 0.12
→ Human population (India) = 0.0205 (1981)

$N_t = N_0 e^{rt}$

N_t ← density at time t
N_0 ← density at time 0
e ↓ base of natural log ★
r ← intrinsic rate of natural increase
t ← time

② Logistic Growth

↳ Competition b/w individuals for limited resources
→ Fittest will survive and reproduce
→ Limit: Nature's carrying capacity (K) for species in that habitat.
→ Asympott $N = K$ ★
→ Verhulst-Pearl Logistic Growth

$\frac{dN}{dt} = rN\left[\frac{K-N}{K}\right]$; $K_i = N$; K → Carrying Capacity

Life History Variation

→ Darwinian fitness
↓
High r Value → Max. reproductive fitness

→ Breed Once in Lifetime → Pacific Salmon fish, Bamboo

→ Breed many times → Most birds and mammals

→ Large no. of small size offspring Oysters, pelagic fishes
→ Small no. of large-sized offspring → Birds, Mammals

Population Interactions (8 marks)

↳ Natural Habitat → Many organisms living together, and they communite and interact.
→ Interspecific → Interactions b/w two different species

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

↳ population Interactions

→ Protocorporation (+,+) Non Obligatory Mutulism - Obligatory

→ Predation, parasitism and Commensalism share common Characteristic - Interacting species live closely together

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(1) **Predation** :→ (+, -)

↳ Nature's way of transferring to higher trophic level fixed by plants.

→ predator and prey → tiger and deer, Sparrow eating any seed

→ Act as conduits for energy transfer.

→ Keep prey population under Control.

→ Exotic species grow exponentially in absence of prey (Prickly pear Cactus) → Australia 1920's → caused havoc.

→ Cactus feeding predator (Cactoblastis) ↳ Moth

→ Helps to maintain Species Diversity.

e.g.- American Pacific Coast → Starfish Pisaster is imp. predator.

→ Pisaster → Remove → 10 species extint in Year, because of inter-specific competition

→ predator - Too efficient → Overexploit prey. ↓ prey may extint, ∴ predators in nature are prudent

→ Defenses developed by prey →

(1) Cryptically Coloured (Camouflaged) (Species of Insects and frogs)

(2) Poisonous

(3) Highly distasteful (Monarch butterfly) because of its special chemical.

→ Butterfly → acquires chemical in caterpillar stage by feeding on poisonous weed

→ 25% - Insects → phytophagous (feeding on plant sap and other parts of plant).

(4) plants evolved astonishing Variety.

(5) (Acacia, Cactus) → Thorns → (Morfological)

(6) plants → Chemicals → Herbivorous Sick

(7) Weed Calotropis grows in abondoned fields

(8) Plant producer → Highly poisonous → Cardiac glycosides (+)

(9) Nicotine, Caffeine, Quinine, Strychnine, Opium → defense against Grazers and Browsers

(10) Mimicry → (1) Batesian Mimicry ↳ Harmless species mimics harmful one

(2) Mullerian Mimicry → 2 Harmful species share common feature

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(2) **Competition** :→ (-, -)

Darwin → struggle for existence. → Survival of fittest in nature

Interspecific competition is potent force in organic evolution.

↓

Competition Occurs → Closely related species compete for same limiting resources

Not ultimately True!!

Firstly

↓

Totally unrelated species compete for same resources

↓

Shallow South american lakes

↓

Visiting flamingoes and resident fishes compete for

↓

Zooplankton in lake

Secondly

↓

Unlimited sources leads to interference competition

↓

feeding efficiency of one species might be reduced due to interfering and inhibitory presence of other species

Competition — process in which, fitness of 1 species (measured in terms of its 'r' — intrinsic rate) is lower than presence of other species

Gause's Competitive Exclusion Principle

↳ 2 closely related species cannot co-exist indefinately and the competivity inferior will be eliminated eventually.

→ Co-existence > Competitive exclusion

ex- Arbingdon tortoise in Galapagos Islands became extint within decade after goats were introduced

Competive Release — Species distribution restricted to small area, because of superior species.

Competing Species remove → Species expand
↳ Connels elegant field →
Rocky Sea Coats of Scotland, larger and competitively superior barnacle Balanus dominates and excludes smaller barnacle Chathamalus. ★ Bada → chamon

→ Mac Arthur ↔ 5 closely related species of warbles living on same tree.
↳ Co-exist. (diff feeding, foraging pattern) ★

Parasitism :— (+, −)

Parasites evolved → host-specific (can parasite only single species of host) in such a way that both co-evolve.

Host ↓ Rejecting/Resisting parasite ← evolve mechanism to counteract and neutralise.

Ectoparasite — Tick, Leech, Lice ✓
Endoparasite → Roundworm, Ecoli
Holoparasite → Complete parasite
↳ Total root parasite - Rafflesia ✓
Total stem parasite - Cuscutta ✓
Hemiparasite → Loranthus, Viscum, Mistletoe
Hyperparasite → Bacteriophage.

Parasite → loss of unnecessary sense organs, presence of adhesive organs or suckers.
→ Life cycles of parasites → Complex, 2,3 host.
→ Human Liver fluke (a trematode parasite) depends on 2 intermediate hosts (snail & fish) to complete life cycle ★
→ Malaria → Mosquito (Vector) ★
→ Many marine fish infested with, ectoparasitic copepods ✓
→ Brood parasitism - Koel, Kauwa (Crow) ★ Ka anda (egg)
↓ Same breeding time - Coevolution

Commensalism :→ (+, 0)

→ Orchid growing epiphyte on mango branch.
→ Cattle egret and grazing cattle

→ Sea anemone that has stinging tentacles and the clown fish that lives among them.
→ Sea anemone and Hermit Crab → Protocorporation ✓
→ Crocodile bird and Crocodile

Mutualism :— (+, +)

→ Lichens with fungus and photosynthetic algae/Cynobacteria.
↳ mycorrhizae association between fungi and roots of higher plants.
→ plant, animal relationship.
↳ Co-evolution ★
e.g. — fig trees and wasp.
Fig → Place of egg laying, Food, larval growth → seed.
Wasp → Pollination.
e.g. — Orchids. ✓
Mediterranean Orchid Ophrys employs 'sexual deceit'
1 petal of flower → Resembles like female bee in size, colour, markings.
Intercourse ← Male ↺ (pseudocopulates) → Coevolve.

NEET SLAYER