

## - SPECIES -

- ⇒ A group of organisms with similar morphology and physiology, which can breed together to produce fertile offspring and are reproductively isolated from other species.
- share living space w/ others to form communities ⇒ group of species that interact w/ each other & w/ environment.

## - ECOSYSTEMS -

- ⇒ relatively self-contained, interacting community of organisms & the environment in which they live & interact.
- Habitat ⇒ place where a species lives within an ecosystem.
- Niche ⇒ role of an organism in an ecosystem.
  - ↳ where is the organism, how it obtains energy, how it interacts w/ physical environment & other species.

## - BIODIVERSITY -

- ⇒ degree of variation of life forms in an ecosystem.
- 3 levels
  - ecosystem diversity
    - ↳ variation in ecosystems / habitats
  - species diversity
    - ↳ number & abundance of diff species
  - genetic diversity
    - ↳ genetic variation within each species

## - COLLECTING ORGANISMS & SPECIES LISTS -

- find distribution & abundance.

## - SPECIES DIVERSITY -

- depends on species richness + evenness of abundance of species.
- species richness ⇒ number of species
- ecosystems w/ ↑ species diversity = more stable
- tropics are important centres for biodiversity
  - ∴ ↑ light intensity, warm.

## - GENETIC DIVERSITY -


- ⇒ diversity of alleles within genes in genome of single species.
  - ↳ complete set of genes.

- assessed by finding what proportion of genes have diff alleles, & how many alleles per gene.
- genetic differences: between pop of same species ∴ pop may be adapted slightly differently in diff parts.
- genetic differences within pop also.
- diversity important in providing pop w/ ability to changes in biotic/abiotic factors.
- Genetic diversity exists:
  - between cultivated/domesticated
  - between pop
  - within pop.

## - RANDOM SAMPLING -

- used when area looks reasonably uniform / no clear pattern of distribution.

## - RANDOM SAMPLING W/ QUADRATS -

- ↳ square frame that marks off an area of ground/water to identify diff species / measure abundance.
- samples taken randomly to avoid bias.
- mark out area w/ tape, generate random coordinates.
- To measure species frequency, ⇒ chance of species being found in any quadrat
  - $\frac{\text{total number of organisms}}{\text{total number of quadrats}} \times 100\%$
  - Eg. 22 daisies from 50 quadrats,  $\frac{22}{50} \times 100 = 44\%$
- To measure species density, ⇒ how many individuals per unit area
  - $\frac{\text{total number of organisms}}{\text{total area of quadrats}} = x \text{ m}^{-2}$
- If impossible to count, use % cover.
  - use 100cm x 100cm quadrat divided into 100 smaller squares. 
  - decide % area occupied.
  - or use Braun-Blanquet Cover scale. Eg. 6-25% = 2

## - ESTIMATING NO. OF MOBILE ANIMALS -

- mark-release-recapture.
  - proportion of marked to unmarked = proportion of marked to total.
  - marked = 247  
Second sample = 259  
marked in 2nd sample = 16
- $$\therefore \text{pop} = \frac{247 \times 259}{16} = 3998$$
- or use ratio method.


## - SIMPSON'S INDEX OF DIVERSITY -

- $D = 1 - \left( \sum \left( \frac{n}{N} \right)^2 \right)$  n = total no. of particular species  
N = total no. of all species.
- 0 = ↓ species diversity, 1 = ↑ species diversity.
- Advantage: do not need to identify any of the organisms to the level of species. Can use phenotypic name.
- Depends on number & abundance.
- Compared communities & organisms should be similar.

## - SYSTEMATIC SAMPLING -

- used with environmental gradient
- Line transect - organisms found @ regular points along the line noted
- Belt transect - abundance of organisms within quadrats placed at regular points along line noted.

## - PEARSON'S LINEAR CORRELATION -

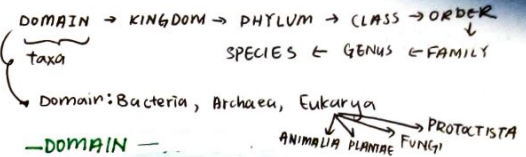
- test for linear correlation.
- both variables quantitative.
- normal dist 
- no outliers.
- if r is -ve, then -ve correlation.

## - SPEARMAN'S RANK CORRELATION -

- no need linear / normal dist, outlier ok.
- rank values from small to large.
- if have tied values, give mean → 5.5 for both.
- $r_s = 1 - \left( \frac{6 \times \sum D^2}{n^3 - n} \right)$  n = no. of pairs  
D = diff in ranks
- $r_s \rightarrow +1$  ∴ +ve correlation
- $r_s \rightarrow -1$  ∴ -ve correlation.

## - CLASSIFICATION -

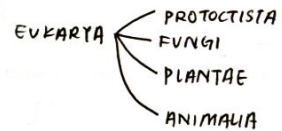
- Taxonomy → study & practice of classification, which involves placing organisms into taxa.



## - DOMAIN -



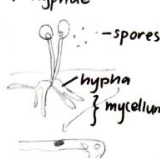

## - EUKARYA KINGDOMS -



## - COMPARISON OF DOMAINS -

BACTERIA	ARCHAEA	EUKARYA
× nucleus × m.b. organelles	× nucleus × m.b. organelles	✓ nucleus ✓ m.b. organelles
DNA = circular 'chromosome' ○ × histone proteins	DNA = circular 'chromosome' ⊗ ✓ histone proteins	DNA = linear chromosomes ✓ histone proteins
✓ plasmids	✓ plasmids	× plasmids.
70S ribosomes	70S ribosomes	80S in cytosol, 70S in mito/chloro
✓ cell wall (peptidoglycans)	✓ cell wall (× peptidoglycan)	cell wall in plants only
binary fission.	binary fission	mitosis.
single cell / small group of cells	single cell, small group of cells	unicellular, colonial, multicellular
		Circular DNA in chloro & mito
		Asexual / sexual

**COMPARISON OF EUKARYA KINGDOMS**

PROTOCTISTA	FUNGI	PLANTAE	ANIMALIA
single-celled / small group of cells	unicellular / made of hyphae - spores 	multicellular, differentiated cells	multicellular, specialised cells. Cells differentiated to form tissues & organs.
(no cell wall) animal like = protozoan plant like = algae (cellulose cell wall)	✓ cell wall (chitin) eg. 	✓ cell wall (cellulose)	x cell wall
(depends...)	x chlorophyll heterotrophic nutrition	✓ chlorophyll autotrophic nutrition	x chlorophyll heterotrophic nutrition
	Spores		
	x cilia / flagella	may have flagella	may have cilia / flagella
	✓ vacuoles	✓ vacuoles	✓ small temporary vacuoles.

**VIRUSES**

- do not show feeding, respiration, growth & excretion
- classified based on
  - type of nucleic acid (DNA / RNA)
  - nucleic acid single / double stranded (in virus both can be single / double)
  - type of disease they cause.

**THREATS TO BIODIVERSITY**

- loss of habitat / degradation of environment
- climate change
- pollution by waste products
- overexploitation of resources
- introduction of alien species.

**HABITAT LOSS**

- land clearing for agriculture housing etc.
- either lose habitat completely / habitat fragmentation
- deforestation = land degradation ∴ soil erosion.

**OVEREXPLOITATION**

- eg. fishing.
- predatory fish ↓ ∴ fish for small fish ∴ no food for birds
- eg. logging.
- loss of single species causes chain reaction.

**POLLUTION**

- chemicals cannot be metabolised / excreted.
- entanglement
- eutrophication
- air pollution → acid rain → destroy vegetation.

**CLIMATE CHANGE**

- organisms migrate north / south ∴ competition.
- temp ↑ = coral bleaching = die ∴ protects coastlines.
- rise in sea levels
- natural catastrophes ↑

**MORAL & ETHICAL REASONS**

- we have no right to drive species to extinction.

**ASTHETIC REASONS**

- wildlife → tourism → source of income

**ECOLOGICAL REASONS**

- ecosystem diversity ↑, less likely unbalanced
- drugs come from plants / animals
- eg. Antibiotics, chinese / Indian medicines
- extinction of any species have a knock on effect on other species.

**SOCIAL & COMMERCIAL REASONS**

- wild plants provide genetic resources to ↑ genetic diversity of crops.
- microorganisms → eg. Taq polymerase.

**OTHER SERVICES**

- forests absorb CO<sub>2</sub>
- organic waste broken down by microorganisms.
- transpiration of plants → water cycle.
- recycling of elements.

**CONSERVATION**

- management of the Earth's resources to provide for the needs of humans at a sustainable level, while ensuring resources are neither over-exploited / destroyed.

## - NATIONAL PARKS -

- limit public access & controls activities
- provides jobs (tourism) \* at suitable level
- financial reward for cooperation
- some species may still have to be removed & placed somewhere safer. (eg. zoo)

## - ZOOS -

- provide health care
- provide fund raising for conservation projects
- " research
- " education
- captive breeding
- provide enough food.

- problems:
- refuse to breed in captivity
  - die in wild before breeding (no skills)
  - ∴ low genetic diversity
  - ∴ not possible to create suitable habitat

## - ASSISTED REPRODUCTION -

- ARTIFICIAL INSEMINATION
  - semen collected & injected into female's reproductive system using catheter
  - during ovulation / use hormone treatment
  - if multiple embryos, → embryo transfer.
  - ↳ recipient females → surrogate mothers.
- IVF IN VITRO FERTILISATION
  - oocytes collected by inserting needle into ovaries
  - Secondary oocytes placed in culture medium
  - semen added → fertilisation
  - transferred to surrogate mothers.
- frozen sperm, egg & embryos kept in 'frozen zoos'.

## - BOTANIC GARDENS -

- protect endangered species
- research methods of reproduction & growth
- research conservation methods
- reintroduce species to habitats
- educate public.
- SEED BANS
  - repositories for seeds of rare species
  - protect biodiversity.

## - CONTROLLING ALIEN SPECIES -

- Invasive alien species (IAS)
  - ↳ organisms that have spread from one ecosystem to another where they are not naturally present.
- introduced as a result of human activities, eg. food source, ornamental plant, biological control
- cause competition for food etc, compete w/ others w/ same niche.
- ∴ carefully consider biological control
- ∴ cargo must be checked by customs.
- plants block sunlight / compete for space.

## - INTERNATIONAL CONSERVATION ORGANISATIONS -

- CITES
  - list species in CITES appendix, control trading
  - if trade becomes illegal, price ↑ ∴ more people trade.
  - if announced in advanced, species becomes illegal, trade ↑

# Biodiversity

## - PREVENTING OVERPOPULATION -

- CULLING ⇒ killing of some organism in a population
- used when pop grows larger than can be supported by available resources
- support:
  - If culling not done, disease ↑, food not enough
  - harm to other species, eg elephants destroy trees, deer prevent regrowth
- against:
  - ppl don't understand it
  - must be done humanely
  - selectively (not killing mothers with young)
  - difficulty in deciding when culling must be done
- BIRTH CONTROL
  - vasectomy
  - chemical contraceptives
    - ↳ vaccine stimulates immune response that produce antibodies.
    - ↳ antibodies attach to glycoproteins around eggs ∴ no fertilisation.

- WWF
  - funds conservation projects
  - publicises environmental issues
  - Campaigns to save ecosystems.

## - RESTORING DEGRADED HABITATS -

- replanting eg. farmer can plant trees where land not used.
- replant mangroves.
- repair due to human & natural disasters.
- counteract 'habitat fragmentation'
- plants make up most of the community of any terrestrial ecosystem. ∴ replant.
  - ↳ reproductive success, ↓ genetic exchange & diversity
  - ↳ area appearance of new species (they can adapt) ∴ competition