

A2 BIOLOGY 9700

Crash Course

ZUHA FATIMA

CLASSIFICATION, BIODIVERSITY AND CONSERVATION

COMPLETE NOTES



0331 - 2863334



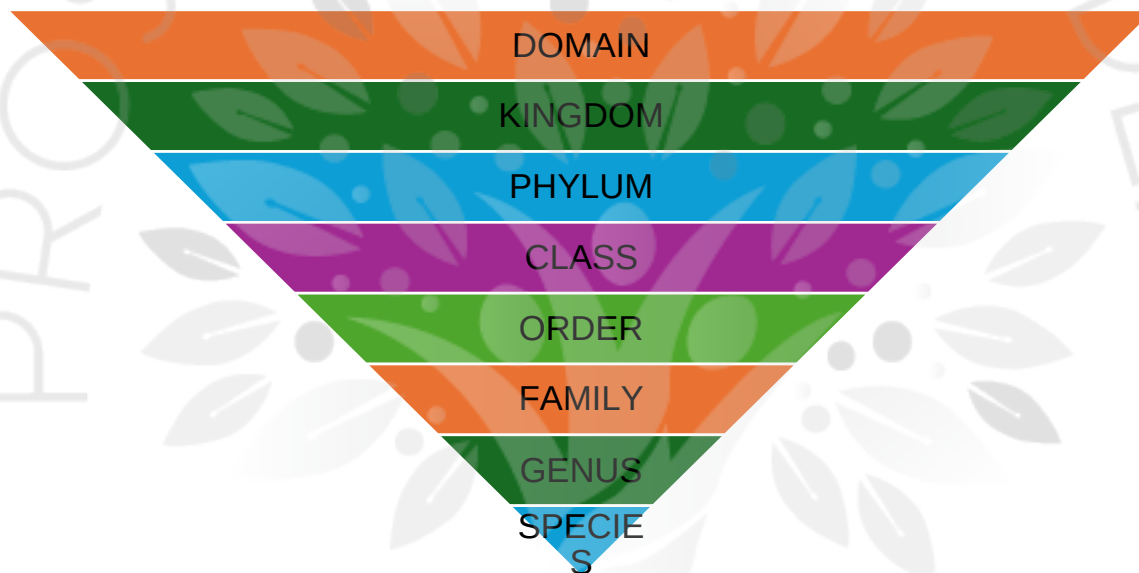
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Unit #17 - BIODIVERSITY, CLASSIFICATION & CONSERVATION

Classification: The process of arranging organisms into different groups. Classifying organisms makes it easier to understand them and their key features.

Taxonomy: is the study and practice of classification which involves placing organisms in a series of taxonomic groups and determining relationship b/w organisms.



- ❖ The domain is at the top of the hierarchical system. As we move from domains to species:
"The morphological and physiological similarities between the organisms increase."
- ❖ The number of organisms in each taxon decreases.
- ❖ All the living organisms are currently classified into:
3 domains
 - Archaea (prokaryotic)
 - Bacteria (prokaryotic)
 - Eukarya (eukaryotic)

5 Kingdoms

- Prokaryotes
- Protoctista
- Fungi
- Animalia
- Plantae

ARCHAE: - Prokaryotic organisms which survive in extremes of environment.

3 categories: -

1. **Thermophiles:** survive in extremely hot climates like hot springs & volcanoes.
2. **Halophiles:** survive in extremely salty env. Such as Dead Sea.
3. **Methanogens:** responsible for producing CH₄ by reducing carbon,

BACTERIA: Prokaryotic organisms which are distinct from archaea and have typical prokaryotic features.

Why are archaea classified into a different domain when compared to bacteria?

- Archaea have a cell wall which is not made of peptidoglycan.
- The **circular DNA** of archaea is **attached with histone proteins**.
- The 70s ribosomes in Archaea are larger than bacterial ribosomes but smaller than eukaryotic 80s ribosomes. These ribosomes have a greater similarity to eukaryotic ribosomes.
- The protein synthesis machinery of Archaea has more similarity to eukaryotes. For example: transcription in Archaea and the tRNAs used in translation are similar to that in eukaryotes.

EUKARYA: Characteristic Features:

- Cells with a true nucleus and membrane bound organelles.
- DNA in the nucleus is arranged as linear chromosomes with histone proteins.
- Ribosomes (80s) in the cytoplasm are larger than prokaryotes. Chloroplast and mitochondria have 70s ribosomes, like those in prokaryotes.
- Chloroplasts and mitochondrial DNA are circular as in prokaryotes.

- There is a great diversity of forms: there are unicellular, colonial, and multicellular organisms.
- Cell division is by mitosis.
- Different ways of reproduction
- May reproduce sexually and/or asexually.

❖ **KINGDOMS** —> Prokaryotes, Protocista, fungi, Plantae, Animalia

i. **PROKARYOTES:**

- 1) **Cellular organization:** Unicellular
- 2) **Cellular features:**
 - No true nucleus
 - No membrane bound organelles
 - Circular DNA
 - NOT bound to histones
 - 70s ribosomes.
- 3) **Bacteria:** Peptidoglycan cell wall
- 4) **Mode of nutrition:** Autotrophic or heterotrophic
- 5) **Division:** Divide via binary fission
- 6) **motility:** motile or immotile
- 7) **Examples:**
 - Cyanobacteria
 - Archaeobacteria
 - Streptococcus
 - Staphylococcus.

ii. **PROTOCTISTA:** - Organisms that are eukaryotic and CANNOT be classified as part of fungal, animalia or plant kingdom.

- 1) **Cellular organization:** Unicellular or multicellular
- 2) **Cellular features:**
 - true nucleus
 - membrane bound organelles
 - 80s ribosomes
 - Linear DNA bound to histones
- 3) **Cell wall:** may or may not have a cell wall.
- 4) **Mode of nutrition:** autotrophic or heterotrophic
- 5) **Division:** mitosis/meiosis
- 6) **Examples:**
 - algae (plant like)
 - protozoa (animal)
 - Slimy molds (Fungi-like)

7) **Motility:** may or may not be motile.

iii. FUNGI:

- 1) **Cellular organization:** multicellular except yeast (unicellular)
- 2) **Cellular features:** eukaryotic
- 3) **Cell wall:** made up of chitin.
- 4) Fungi are made up of thread-like structures □ **Hyphae**; network of hyphae □ **Mycelium**
- 5) **Mode of nutrition:** Heterotrophic
- 6) **Motility:** Immotile
- 7) **Division:** Reproduce via spore □ mushrooms, yeast.
- 8) **Mode of digestion:** they have an extracellular mode of digestion. They secrete digestive enzymes into external medium and absorb digestive food material.

iv. PLANTAE:

- 1) **Cellular Organization:** multicellular organisms differentiated into tissues and organ system(s)
- 2) **cellular feature:** eukaryotic
- 3) **cell wall:** made of cellulose.
- 4) **Mode of nutrition:** autotrophic (cells contain chloroplast)
- 5) **Motility:** immotile
- 6) **Division:** asexual/sexual reproduction

v. ANIMALIA:

multicellular organisms differentiated into tissues and organ systems.

- 1) **Cell features:** eukaryotic
- 2) **Cell wall:** absent
- 3) **Motility:** motile
- 4) **Mode of Nutrition:** Heterotrophic
- 5) **Division:** Sexual reproduction
- 6) **Examples:** mammals, fish, corals etc.

❖ **VIRUSES:** - are particles that are made up of proteins and nucleic acids.

➤ **There are different ways of classifying viruses, some of which include:**

- naked and enveloped virus
- DNA & RNA Virus

- **Structure of a naked virus includes:**
 - a protein coat made up of small protein sub-units called capsomeres.
 - This protein coat is known as capsid.
- **Nucleic Acids**
 - **SS DNA:** e.g., canine parvovirus.
 - **DS DNA:** e.g., varicella zoster virus
 - **SS RNA:** e.g., morbillivirus
 - **DS RNA:** e.g., HIV
- **Viruses are considered as non-living because:**
 - devoid of protoplasm
 - lack metabolism.
 - do NOT respire.
- A virus can only survive within the host cell by taking over the protein machinery of the host cell.

ENDANGERMENT & EXTINCTION

- ❖ Species are said to be **endangered** if their numbers are so low that they cannot be maintained by normal rates of reproduction and are in danger of becoming extinct.
- ❖ Species are said to be **critically endangered** if their number falls **below 10%** of their original population.
- ❖ Species are said to be **extinct** if there are no organisms in the artificial or natural habitats.

Reasons For Endangerment of Species:

(1) Habitat Loss: Human activities such as deforestation and reclamation of land are few examples of habitat loss.

(2) Climatic Changes: Changes such as global warming and natural disasters are responsible for affecting a large no. of different species. For example: melting Arctic sheets and coral reefs are affected due to rise in ocean temperature.

(3) Pollution: It has significantly contributed to reduction in numbers of a diverse group of species. Pollution may be classified into:

- ☒ **air pollution:** Involves emission of oxides of nitrogen, oxides of sulfur & CO². These harmful emissions contribute to acid rain & global warming.
- ☒ **Industrial and Domestic pollution:** involves the release of harmful chemicals into the atmosphere such as PCBs (Polychlorinated biphenyls). PCBs are responsible for reducing fertility and weakening the immune system in certain birds and mammals.
- ☒ **Marine Pollution:** It involves disposal of non- biodegradable plastic into nearby rivers and lakes. These plastic bags are mistaken as jellyfish by turtles that ingest them.

(4) Overexploitation and unsustainable use of resources: It includes overfishing and cutting of valuable trees which lead to endangerment.

(5) Food shortages: It may be due to disruption in the food chain & food web

(6) Disease: For e.g viral infections

(7) Tourism

(8) Reduction in breeding sites of organisms

(9) Invasion of alien species involves introduction of an organism into an ecosystem where it was originally absent. These alien species are responsible for pushing the native organisms to endangerment or extinction.

ENDANGERMENT OF AFRICAN ELEPHANTS:

- ❖ African elephants have declined from 5-10 million to half a million over the last century. The reasons for endangerment of African Elephants include:
 - Habitat lost due to deforestation. African elephants survive in Savannah habitats.
 - Deforestation due to land requirements for housing, growth of escape, and grazing of livestock.
 - Hunting for their ivory tusk and bush meat. Some are killed because they were considered pests.

- Poaching - Illegal hunting of African Elephants. Poaching involves the use of automated weapons and airplanes to hunt larger elephants. Killing of these animals disrupts the social structure of younger animals (can also affect their fertility rates).

ENDANGERMENT OF CORAL REEFS:

- ❖ Coral reefs make up one of the largest marine ecosystems. Corals are animals that use CaCO_3 from the sea to grow their skeleton.
- ❖ Symbiotic algae grow within the polyps of coral reefs where they provide nutrition to the corals in exchange for mineral ions. These algae are also responsible for providing colour for the colour.
- ❖ Coral reefs provide a habitat to a significant proportion of fish species.
- ❖ Reasons for endangerment include:
 - Acid rain which lowers the pH of lakes and rivers. The drop in pH damages the CaCO_3 skeleton.
 - Global warming results in a rise in the temperature of the ocean which, in turn, causes the algae to leave the polyps. This causes the whitening of the corals—> "coral bleaching."
 - Tourism
 - Overfishing
 - Reclamation of land.

ENDANGERMENT OF POLAR BEARS:

- ❖ The reasons for the endangerment of polar bears include:
 - Reduction in the Arctic ice sheets due to global warming
 - Reduced availability of food due to endangerment of seals.
 - Diseases
 - Polar bears must travel long distances in search of food.

ENDANGERMENT OF WHITE-BACKED VULTURES:

- ❖ The carcasses these vultures fed on were treated with a painkiller (Diclofenac) that caused kidney damage in vultures.

What is biodiversity?

Biodiversity can be defined as the degree of variation of life forms in an ecosystem.

NEED TO MAINTAIN DIVERSITY:

- (1) Ecological reasons
- (2) Human reasons
- (3) Commercial reasons / Social reasons
- (4) Aesthetic and Socio-economic reasons

❖ Ecological Reasons:

- Biodiversity needs to be maintained to ensure stability of an ecosystem. All the organisms in an ecosystem interact in many ways - if one of the organisms disappears it can affect the whole community. The maintenance of biodiversity ensures that the gene pool of various species within an ecosystem is conserved.

❖ Human Reasons:

- To provide possible medicines.
- For use in agriculture either as potential food supplies or to be crossed with existing agricultural species to improve features such as yield and disease resistance.
- To encourage tourism in some countries.
- From an ethical point of view, if human activity has been largely responsible for decline in biodiversity, it is an obligation upon humans to control this rate of decline.
- It is equally important to try and maintain the current levels of biodiversity for future generations.
- Some people worship nature. Thus, conservation of species for religious reasons.

❖ Commercial Reasons:

- Many crops are threatened by climate change and habitat destruction.
- These plants do not have as much genetic diversity as their wild relatives because it has been lost by selective breeding.
- Crossing crop plants of different varieties may produce hybrids that are resistant to diseases and climatic changes. These crop plants have a better yield and therefore will have great commercial value.
- Certain micro-organisms are a source of useful products such as enzymes and anti-biotics.

❖ Aesthetic/Socioeconomic:

- Many people gain pleasure from studying/ appreciating nature; provide inspiration to artists/ photographers etc.
- Wildlife □ source of income as eco-tourism has increased. This form of tourism provides employment and contributes to the economy of the nation.

Defining the term "Specie(s)"

(1) **Biological Species Concept (gold standard)**: a group of organisms with similar features and the ability to interbreed to produce fertile offsprings.

(2) **Morphological species Concept (Most common and practical)**: a group of organisms with similar physical (anatomical) features.

(3) **Ecological Species Concept (most vague)**: a group of organisms with similar features which occupy the same habitat in a given time.

Conservation of Animal Species

- Zoos
- National Parks
- Assisted Reproduction Techniques (ARTs)

- ❖ **Zoos**: provide a source where endangered species of animals can be captivated and bred. This is known as **captive breeding**.
 - carried out to increase their numbers.
 - They are protected from predators and diseases.
 - Captivated animals are fed well in captivity.

Advantages of Captive Breeding:

- It is possible to monitor the health of the mother and fetus during pregnancy.
- The sperm & oocytes can be collected and stored in sperm banks and frozen zoos.
- Frozen sperms and oocytes (cryopreservation – a process that freezes biological materials) can be used for “Assisted reproductive techniques” (ARTs).
- Animals can be transferred to other countries where environmental conditions are more conducive for breeding.
- It allows the keeping of breeding records and the generic similarity between captivated organisms.
- Animals are well fed and protected from predators and diseases.

Challenges Of Captive Breeding:

Although some species of animals may breed successfully in captivity others may find it difficult to breed in artificial habitat. The reasons for this may include:

- They are no longer living in their natural habitat.
- They may have stress and behavioral changes which may arise due to the change in environment.
- Female organisms may have disruption in their menstrual cycle due to the stress in captivity.
- Organisms may not prefer the chosen mate for breeding.

Problems associated with releasing captive breed animals:

- Reduced availability of food in the wild.
- Increased susceptibility to diseases.
- They are at risk of predation by another animal.

- At times, animals find it difficult to move around in their natural habitat once they have been bred in captivity for a long time.

- ❖ **National Parks:** Many countries have designated areas often with legislation to ensure protection of endangered species and maintain important habitats.

How do they work?

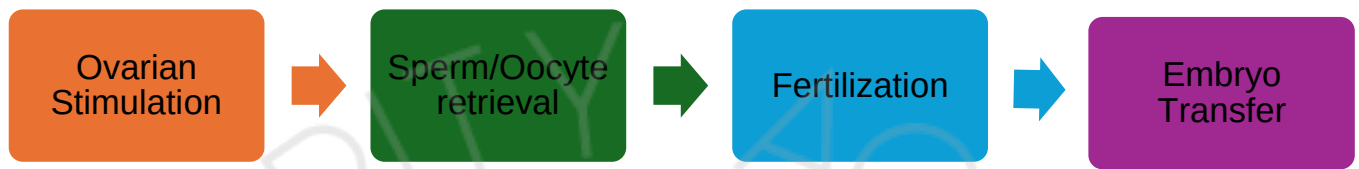
- patrolling of parks by wardens, rangers, and volunteers
- restricted human access - foot paths maintained to avoid interference with habitat.
- Apart from conventional farming, agricultural activities are controlled.
- Visitor centres can be established to educate the general public.
- 24 hours of surveillance of nests / breeding sites.

- ❖ **ASSISTED REPRODUCTIVE TECHNIQUES:** include methods to assist fertility in organisms with reduced fertility or increase the number of organisms. Methods include:

- 1) Artificial Insemination
- 2) In Vitro Fertilisation (IVF)
- 3) Intra-cytoplasmic sperm injections (ICSI)
- 4) Surrogacy

Artificial Insemination: Involves the transfer of sperms using a catheter into the uterus of a female. Fertilisation therefore occurs in-utero leading to the formation of the zygote. Occasionally, the embryo formed following mitotic division of the zygote is flushed out and transferred into the uterus of another organism -> surrogacy.

In Vitro Fertilization: refers to the fertilization in a glass tube outside the female reproductive tract.



(1) Ovarian Stimulation:

- Treatment normally starts on the third day of menstruation.
- Involves administration of hormones which will have action similar to FSH.
- Stimulate the development of multiple follicles in ovaries → Superovulation.
- 10 days of injections are usually necessary.

(2) Oocyte retrieval:

- Development of follicles is monitored by serum oestrogen levels.
- When the development of follicles is judged to be adequate, the hormone Human Chorionic Gonadotropin (HCG) is given.
- HCG has a similar effect as LH.
- Ovulation is expected to be about 42 hours after injection.
- A needle is used to remove the oocytes directly from the female organism.

(3) Fertilization:

- The oocytes are stripped of any surrounding cells and are incubated with sperms for about 18 hours.
- Where sperm counts are low, it is also possible to inject sperm directly into the oocyte.
- The fertilized egg is now placed in a special growth medium and left for 48 hours.
- It reaches the 6-8 cell stage in 48 hours.

(4) Embryo Transfer:

- Embryos which are growing successfully are transferred to the patient's uterus through a thin plastic catheter.

- Often multiple embryos are transferred to improve the chances of implantation and pregnancy.
- During the next weeks, the woman is administered progesterone, which helps the uterine lining to thicken and be suitable for implantation.
- ❖ **Intra-Cytoplasmic Sperm Injection (ICSI):** is a technique which involves fusion of a visibly healthy sperm (shape and motility) with an oocyte to form a zygote outside the female reproductive tract.
- ❖ **SUROGACY:** At times, the health of the female organism which donates the oocyte is not good enough to bear a normal pregnancy. In such cases, the embryos are usually transferred to the uterus of an unrelated female organism. This is surrogacy. It is advantageous because it helps in the conservation of endangered female organisms which cannot bear normal pregnancy.

Conservation of plant species:

Botanic gardens: enable conservation of plant species by growing them from seeds, cuttings, tissue cultures and cloning.

Tissue culture involves growth of a tissue sample in an agar medium under sterile conditions. Tissue samples develop into tiny plantlets. Plantlets are planted into soil.

- Botanic gardens are to research methods of reproduction and growth so that species cultivated in botanic gardens can be grown in appropriate conditions to be propagated.
- Research conservation methods so plants can be introduced to new habitats if their original habitat has been destroyed.
- Reintroducing plants to the habitats where they have become extinct.
- Educating the public regarding the ecological and economic value of plant species.

Seed Banks: are an effective way of conserving the gene pool of organisms of different species.

A seed bank is a collection of plant seeds (that are endangered/extinct) in conditions that are not suitable for germination. These conditions include an atmosphere low in moisture and O_2 and low temperature.

Biodiversity can be assessed at **3** different levels:

1. **Species diversity**
 - ☒ species richness
 - ☒ species evenness
2. **Genetic diversity**
 - ☒ Habitat
3. **Ecosystem diversity**

Species diversity ↑, species richness ↑, species evenness ↑, stable ecosystem ↑

Generic diversity ↑, the ability to adapt to changes ↑, chances of survival ↑

- ❖ **Ecosystem** is a relatively self-contained interacting community of living organisms and the environment in which they live and with which they interact.
- ❖ **Habitat** refers to the place where an organism lives.
- ❖ **Niche** refers to the functional role of an organism in an ecosystem.
- ❖ **Population** is a group of organisms of the same species Occupying a given area at a given time.
- ❖ **Species** is a group of organisms that have similar physiological and morphological features which can interbreed to produce fertile offspring. All the organisms of the same species are reproductively isolated.
- ❖ **Community** refers to all the organisms of different populations occupying a given area at a given time.
- ❖ **Biotic** ☐ living factors
- ❖ **Abiotic** ☐ non-living factors
- ❖ **Species Diversity** refers to the different types of species (richness) and the relative abundance of species within an ecosystem.

- ❖ **Species richness** refers to the different types of species within an ecosystem.
- ❖ **Species evenness** refers to the relative abundance of species within an ecosystem.



Sampling

- ❖ The process of taking samples to determine species frequency, distribution, density, abundance and/or percentage cover within an ecosystem.
- ❖ Some ecosystems are very complex with large numbers of different species of different sizes. For the sake of logistics, **sampling** is often used to estimate the **distribution** and **abundance** of species.
- ❖ There are two ways to sample organisms
 - Random
 - Systematic

(1) Random (unbiased) Sampling:

- ❖ **Random sampling** is carried out if the **physical conditions** within an ecosystem are **uniform** and for there is no clear pattern of distribution of organisms.
- ❖ In random sampling the positions of the **sampling points** are completely random or **due to chance**. This method is beneficial because it means **there will be no bias** on the part of the person that is carrying out the sampling that may affect the results
- ❖ Random sampling is carried out using the following procedure:
 - 1) Mark off an area of the ecosystem using a measuring tape.
 - 2) Determine the size and the no. of quadrats to be used e.g. 25 quadrats each with an area of 1m².
 - 3) Place the quadrats randomly at the coordinates generated by a mobile app or a random number generator.
 - 4) Collect the organisms within each quadrat using nets/traps/pooter.

5) Identify the organisms using dichotomous keys (each question has two responses **yes** or **no**).

6) Determine the species frequency/density/abundance/percentage cover.

$$\text{Species Frequency} = \frac{\text{No of quadrats with the species}}{\text{total no of quadrats}} \times 100$$

$$\text{Species Density: } \frac{\text{Total no. of organisms in all quadrats}}{\text{total area of all quadrats}}$$

Score	% cover
+	<1%
1	1-4%
2	5-25%
3	26-50%
4	51-75%
5	>75%

used for
immotile
specific

☒ percentage cover is
grassland or other
species which grow in a
manner **Braun - Blanquet**
scale is used to quantify
percentage cover

5) Mark off a **separate** area within the same ecosystem and repeat sampling using the same number and size of the quadrats (increases reliability)

6) Safety precautions:

- Stay with the group to avoid getting lost.
- Wear protective clothing & gloves to avoid allergies.
- Wear mask to avoid inhalation of pollen.

(2) Systemic Sampling

- ❖ Systemic sampling is carried out in physical conditions (such as rainfall, soil pH, soil water within an ecosystem **change**).
- ❖ Systemic sampling is carried out using the following procedure:

- 1) Randomly select a starting point and lay down the measuring tape/rope to create a transect along which sampling will be carried out.
- 2) Sampling organisms along the line are known as a **transect**.

3) Transect is of two types

☒ **Line Transect**

☒ **Belt Transect**

- 4) **Line transect** involves sampling organisms along a line at regular intervals. At **equal distances** along the tape **record the identity of the organisms that touch the line**. The organisms sampled are represented **qualitatively** using diagrams
- 5) **Belt Transect** involves sampling organisms along a line by placing quadrats at regular intervals. The results obtained are **quantitative** and represented using bar charts or kite diagram.
- 6) Organisms are collected via traps/nets/pooter and identified using dichotomous keys.
- 7) Determine species frequency/density/ distribution.
- 8) Select a different starting point and repeat transect to ensure reliability.
- 9) Safely precautions:
 - a) Stay with the group to avoid getting lost
 - b) Wear protective clothing & gloves to avoid allergies.
 - c) Wear mask to avoid inhalation of pollen

Differences b/w line and belt Transect:

Line Transect	Belt Transect
Refers to sampling organisms at regular intervals along a line	Refers to sampling organisms at regular intervals along a line by placing quadrats
Offers qualitative data	Offers quantitative data
Data of a line transect is represented using a diagram	Data of a belt transect is represented using a kite diagram or bar chart

Estimating Population Size (No) of Mobile Organisms “mark-release- recapture method”

- The population size of mobile organisms can be determined using the mark-release-recapture method.
- The method involves the following steps:
 - 1) Collect a sample of organisms using nets or traps and mark them with a non-toxic paint in such a way that it doesn't harm the organisms.
 - 2) Count the organisms (n_1)
 - 3) Release the organisms and allow sufficient time to mix with their population.
 - 4) Recapture a second sample of organisms and count them (n_2).
 - 5) Count how many of the recaptured organisms are marked (nm).
- 6) Population size can therefore be determined using the expression:

$$N = \frac{n_1 \times n_2}{nm} \text{ Lincoln's Index}$$

- Assumptions for the validity of this method:
 - 1) Paint does not affect mobility of organisms
 - 2) Paint does not affect the survival of organisms
 - 3) No migration of organisms.

Q. The number of Voles collected in a particular ecosystem were 247. All these voles were marked with non-Toxic paint and released. (n_1)

A second sample was collected the next day. The total no of voles caught in the second sample were 259. (n_2)
(nm) Sixteen of these voles were marked. Estimate the population size.

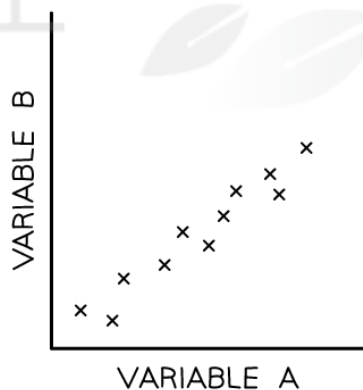
Ans: $N = \frac{247 \times 259}{16}$

$$N = 3998$$

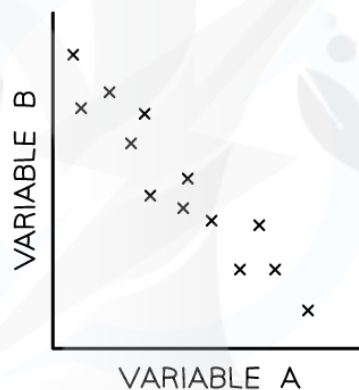
Correlation

- Sometimes **correlation** between two variables can appear in the data
 - Correlation** is an association or relationship between variables
 - There is a clear distinction between **correlation** and **causation**: a correlation does not necessarily imply a causative relationship
 - Causation** occurs when one variable has an influence on, or is influenced by, another.
- The apparent correlation between variables can be analysed using **scatter graphs** and different **statistical tests**

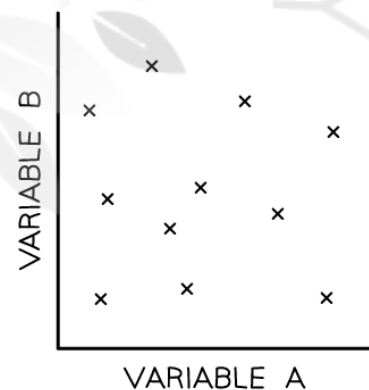
POSITIVE CORRELATION



NEGATIVE CORRELATION



NO CORRELATION



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- The correlation coefficient (r) indicates the **strength of the relationship** between variables. The correlation coefficient (r) lies between **-1.0 to +1.0**.
- Correlation can be **positive or negative**
 - Positive correlation**: as variable A increases, variable B increases
 - Negative correlation**: as variable A increases, variable B decreases
- If there is **no correlation** between variables the **correlation coefficient will be 0**

Pearson's Linear Correlation coefficient (r)

- The data must:
 - Be **quantitative**, e.g., the number of individuals has been counted and a numerical value recorded
 - Scatter graph should show a **linear relationship**
 - That data is from a population that is **normally distributed**
 - Data is **continuous**
 - At least 5 pairs of data points

Pearson's linear correlation (r)

$$r = \frac{\sum xy - n\bar{x}\bar{y}}{(n-1)s_x s_y}$$

Key to symbols:

x, y = observations

$\bar{x}, \bar{y}$ = means

n = sample size (number of observations)

s = sample standard deviation

Null hypothesis would be “there is no significant correlation between the two variables”

If the correlation coefficient r is close to 1.0 or -1.0 then it can be stated that there is a **strong linear correlation** between the two variables and the **null hypothesis can be rejected**.

Spearman's Rank correlation (r_s)

The data is:

- Not normally distributed
- The data is ordinal or is converted to ordinal scale by ranking
- The scatter graph is non linear
- At least 5 pairs of data points

Spearman's rank correlation (r_s)

$$r_s = 1 - \left(\frac{6 \times \sum D^2}{n^3 - n} \right)$$

Key to symbols:

D = difference in rank between each pair of measurements

n = number of pairs of items in the sample

Null hypothesis would be “there is no significant correlation between the two variables”

After calculating r_s value, compare it to the critical value at $p=0.5$ against the number of readings you took. (If there were 10 paired observations then $n=10$)

Accept or reject the null hypothesis according to the critical value.

Simpson's Index of diversity (D)

- Species diversity looks at the **number of different species** in an area but also the **evenness** of abundance across the different species.
- These values are also known as species richness and species evenness.
- An index of diversity is a numerical value that considers both species richness and species evenness.
- **Simpson's index of diversity (D)** is one type of index that can be calculated

Simpson's index of diversity (D)

$$D = 1 - \left(\sum \left(\frac{n}{N} \right)^2 \right)$$

Key to symbols:

- n = number of individuals of each type present in the sample (types may be species and/or higher taxa such as genera, families, etc.)
- N = the total number of all individuals of all types present in the sample

The value of D shall be between 0 to 1;

value closer to 1 suggests:

- high diversity
- The habitat has many species and/or even distribution among them.
- It is likely stable, resilient, and supports a complex ecosystem.
- Less vulnerable to disturbances or disease.

value close to 0 suggests

- low diversity.
- The habitat has few dominant species or very uneven distribution.
- It may be stressed, degraded, or less stable.
- More vulnerable to environmental changes.

CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora)

- CITES is an international agreement between governments. Its main role is to ensure that international trade in wild animals and plants does not threaten their survival.
- **Regulates international trade** of species listed in its appendices through a permit system.
- **Categorizes species** into three appendices based on their level of endangerment:

Appendix I: Species threatened with extinction – trade is generally prohibited.

Appendix II: Species not necessarily threatened but may become so – trade is controlled.

Appendix III: Species protected in at least one country – trade requires cooperation.

- Monitors and controls trade to prevent illegal exploitation.
- Provides data and reports to track the global trade of species.
- Works with customs and enforcement authorities to reduce illegal wildlife trade.

IUCN (International Union for Conservation of Nature)

- **Maintains the IUCN Red List** – the world's most comprehensive inventory of the global conservation status of plant and animal species. The IUCN Red List is a **global database** that assesses the **extinction risk** of species of animals, plants, and fungi.
- **Identify species at risk of extinction.**
- **Track changes** in biodiversity over time.
- **Guide conservation actions** and policy decisions.

- **Raise awareness** about threatened species and ecosystems.

