CAIE Biology A-level

Topic 18: Biodiversity and classification

Notes

Biodiversity is the **variety of living organisms**, over time the variety of life on Earth has become more extensive but now it is being **threatened by human activity** such as deforestation. Biodiversity can be measured in terms of:

- **Species richness** is the **number of different species in a community** and can be measured by simply counting the number of species present via methods such as **random sampling.**

- **Genetic diversity** is a measure of the **genetic variation** found in a particular species, in other words it is the **number of alleles in a gene pool**. It can be determined by calculating **the heterozygosity index (H),** the higher the heterozygosity index (H), the more genetically diverse the species.
  H= number of heterozygotes / number of individuals in the population

Biodiversity can also be measured using the **index of diversity (D)** which can be calculated as following:

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

D = Diversity index
N = total number of organisms
n = total number of organisms of each species
Σ = the sum of

Endemism is the state of a species being **unique to a particular geographic location** such as an island and are not found anywhere else.

Methods of measuring the distribution or abundance of organisms within an area

Frame quadrat
A sampling technique using a square frame which is divided into equal sections like a grid. To measure species abundance you can count the abundance of each species in each section of the frame. This quadrat can be used along a transect.

Line transect
A sampling technique which consists of making a line on the ground between 2 points within the sampled area. The species touching the transect at regular intervals are recorded to determine the abundance and distribution of organisms in an ecosystem.

Belt transect
A sampling technique which consists of making **2 parallel lines** on the ground between 2 points within the sampled area. Quadrats are placed at intervals, and the species within/touching the quadrat are recorded to determine the abundance and distribution of organisms in an ecosystem.

Mark release and recapture

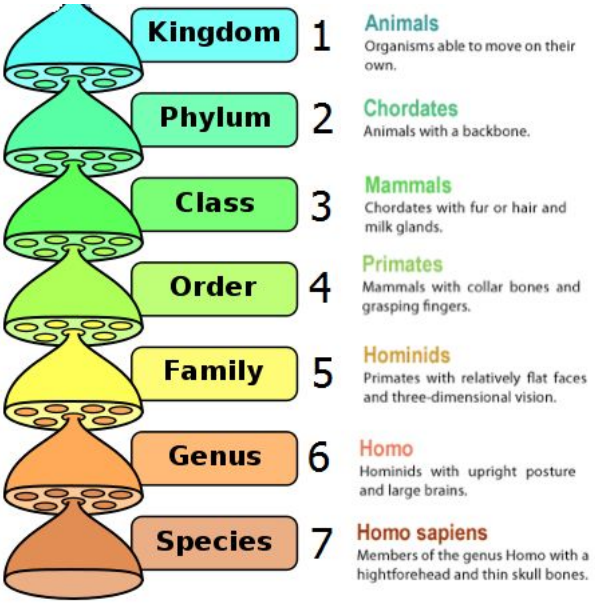
A method of **estimating the population size o**f motile organisms. It involves capturing a sample of the population, marking them and releasing them. At a later date, another sample is captured and the number of marked individuals recorded.

The population size can be estimated using the Lincoln index

$$N = (n1 \ x \ n2) / m2$$

- N = estimated population size
- n1 = number of captured individuals in 1st sample
- n2 = total number of individuals in 2nd sample (unmarked & marked individuals)
- m2 = number of marked individuals in 2nd sample

Species and taxonomy



Classification is the process of **naming and organising organisms into groups based on their characteristics.** Organisms can be grouped into one of the five kingdoms: **animals, plants, fungi, prokaryotes and protoctista**.

*Figure SEQ Figure * ARABIC 1 Wikipedia*

They can then be grouped further into **phylum, class, order, family, genus and species**. Each species is named according to the **binomial system**, the first part of the name is the genus and the second part of the name is the species.

The 5 kingdoms

1. **Animals**
   - Multicellular
   - Presence of a nucleus and other membrane bound organelles
   - No cell wall
   - No chloroplasts
   - Are able to move - with the help of contractile proteins, flagella or cilia
   - They are heterotrophic feeders hence nutrients are acquired by ingestion
   - They store food in the form of glycogen

2. **Plants**

- Multicellular
- Presence of a nucleus and other membrane bound organelles
- Contain a cellulose cell wall
- Contain chloroplasts as well as chlorophyll
- Mostly unable to move
- Autotrophic feeders - acquire food via photosynthesis
- Store food in the form of starch

3. **Protoctista**
   - Mostly **unicellular**
   - Presence of a nucleus and other membrane bound organelles
   - Some contain chloroplasts
   - Some can move due to the presence of cilia or flagella
   - **Autotrophic feeders** - acquire food via photosynthesis
   - Some can be **heterotrophic feeders**
   - Some can be both **autotrophic and heterotrophic feeders**
   - Some may be **parasitic**

4. **Fungi**
   - Can be **multicellular** or **unicellular**
   - Presence of a nucleus and other membrane bound organelles
   - Contain a **chitin** cell wall
   - Contain no chloroplasts or chlorophyll
   - Cannot move
   - Most of them have a body or a **mycelium** composed of thread-like hyphae
   - **Saprophytic feeders** - acquire nutrients from dead or decaying matter
   - Some can be **parasitic**
   - Mostly store food in the form of **glycogen**

5. **Prokaryotes**
   - Mostly **unicellular**
   - Divided into two domains: *Bacteria* and *Archaea*
   - Lack an envelope-enclosed nucleus, mitochondria or any other eukaryotic membrane-bound organelles
   - They can **move through liquids or over moist surfaces** by swimming, swarming, gliding, twitching or floating.
   - To aid movement, they may have **flagella** that spin, **pili** that pull or **Mycoplasma 'legs'** that walk.
   - They can store food in the form of **lipid molecules** or **glycogen granules**

The analysis of molecular differences in different organisms to determine the extent of their revolutionary relatedness is known as **molecular phylogeny**. The data obtained by molecular phylogeny has been accepted by scientists and this gave rise to new taxonomic groupings – all organisms can be separated into one of the **three domains: Bacteria, Archaea and Eukarya.**

Archaea and bacteria are both **prokaryotes** with a few differences in between them.

- One difference is in the lipid cell membranes. The lipids in the membranes of archaea consist of fatty acids linked to glycerol by **ether bonds** whereas the lipid of bacterial membranes consist of fatty acids linked to glycerol by **ester bonds**.
- Their cell wall compositions are also different. Bacterial cell walls are composed of **peptidoglycan** whereas archaean cell walls are not.

Archaea often live in extreme conditions as they have strong membranes that are able to stand high temperatures and low pHs. Eukarya includes the plant, animal, fungi and protista kingdoms.

Viruses are not included in the three domains as they are **non-living** and are not classed as cells. In taxonomy, they are instead classified by the disease which the virus causes and the type and structure of their nucleic acid.

The scientific community evaluates the data in the following ways:

- The findings are published in **scientific journals** and presented at scientific **conferences**.
- Scientists then study the evidence in a process called **peer review**
- Scientists start **collecting evidence** to either **support or reject the suggestion**

Conservation

- There are many threats to biodiversity in **aquatic** and **terrestrial** ecosystems. The threats include **loss of habitat** and **environment degradation**, **climate change**, excessive use of **fertilisers** which leads to **pollution**, **overexploitation** and **unsustainable use of resources** as well as invasion of **alien species.**
  Alien species might outcompete the native organisms or introduce diseases therefore they need to be controlled.

- There are many **ecological, aesthetic, social and commercial** reasons to maintain biodiversity. For instance, microorganisms are a source of useful products such as antibiotics.

- **Zoos** use various methods to **conserve endangered species and their genetic diversity,** some of the methods used include: **captive breeding programmes** in which endangered species are carefully bred to increase genetic diversity and population size and **reintroduction programmes** which aim to release animals bred in captivity into their natural habitat as well as to restore lost habitats.

- **Seed banks** store a large number of seeds in order to **conserve genetic diversity** and prevent plant species from going **extinct**. Storing seeds instead of plants means that a **large variety of species can be conserved,** it's also cheaper than storing whole

plants as it takes up **less space.** The seeds are stored in **cool, dry conditions** as this maximises the amount of time they can be stored for and they are **periodically tested for viability.**

- Other means of conserving endangered mammals include **assisted reproduction** in the form of **IVF, embryo transfer and surrogacy.**

- **Culling and contraceptive methods** are used to prevent overpopulation of protected and non-protected species.

- Non-governmental organisations such as **World Wide Fund for Nature (WWF)** and **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)** play an important role in local and global conservation. For instance, WWF funds conservation projects and publicises environmental issues whereas CITES controls the trade of endangered species and their products.

- The **international union for the conservation of nature (IUCN)** is a conservation agreement which helps create agreements between nations. They work together to conserve endangered animals. They play an important role in global conservation.

- **Degraded habitats** can be restored on a small scale by **planting new trees** on land that is no longer needed for food production and on a large scale by **replanting forests.**