

UNIT 3

Topic 1: Describing Biodiversity

1 Biodiversity

1.1 Recognise that biodiversity includes the diversity of species and ecosystems

Ecosystem: system of organisms interacting with one another and with their non-living surroundings.

Biodiversity: the variety of all life forms, the genes that they contain and the ecosystems of which they are a part of. It includes all of the species present in the world, all of the ecosystems to which those species belong and all of the interactions between those species.

Types of biodiversity:

- Genetic diversity: the number of different alleles possessed by a species.
- Species diversity: the number of different species present in a particular ecosystem.
- Ecosystem diversity: the number of biomes in the world and the variation in those biomes.

Diversity is essential. E.g. more diverse ecosystems are more stable and can withstand sudden changes.

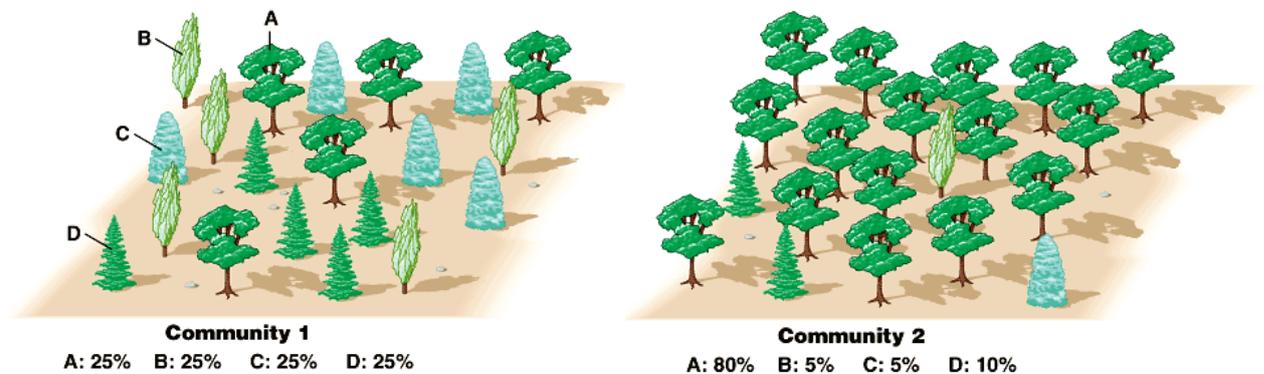
1.2 Determine diversity of species using measures such as species richness, evenness (relative species abundance), percentage cover, percentage frequency and Simpson's diversity index

1. **Species richness:** abundance or total number of species in an ecosystem.
 - Calculated via a tally of the number of species within a particular area.
 - It does not take into account the number of individuals of each species, how they are distributed in the area or how important they are in maintaining the ecosystem.
 - o E.g. species richness may be high but 95% of organisms could come from only one species.

2. *Species evenness or relative species abundance*: number of individuals of a particular species in relation to the total number of individuals of all species in an area.

$$\text{relative species abundance} = \frac{\text{number of organisms of one species}}{\text{total number of organisms}} \times 100$$

- Shows whether there are significant numbers of individuals of many different species.
 - o E.g. both community 1 and 2 have the same species richness but community 1 has a greater species evenness.



3. *Percentage cover*: measurement of the proportion of an area covered by an organism.

$$\text{percentage cover} = \frac{\text{area covered by one species}}{\text{total area sampled}} \times 100$$

4. *Percentage frequency*: percentage of quadrats in which a particular species occurs.

$$\text{percentage frequency} = \frac{\text{no. quadrats with one species}}{\text{no. quadrats sampled}} \times 100$$

5. *Simpson's diversity index*: a tool to measure diversity in a population on a scale of 0 to 1. A score close to 1 indicates a high diversity.

$$SDI = 1 - \left(\frac{\sum n(n - 1)}{N(N - 1)} \right)$$

Where:

- N = total number of organisms of all species
- n = number of organisms of one species

Example calculation

Species	n	$n - 1$	$n(n - 1)$
A	32	31	992
B	24	23	552
C	15	14	210
Total	$N = 71$		$\sum n(n - 1) = 1754$

$$\begin{aligned}
 SDI &= 1 - \left(\frac{\sum n(n - 1)}{N(N - 1)} \right) \\
 &= 1 - \frac{1754}{71(71 - 1)} \\
 &= 0.65
 \end{aligned}$$

1.3 Use species diversity indices, species interactions (predation, competition, symbiosis, disease) and abiotic factors (climate, substrate, size/depth of area) to compare ecosystems across spatial and temporal scales

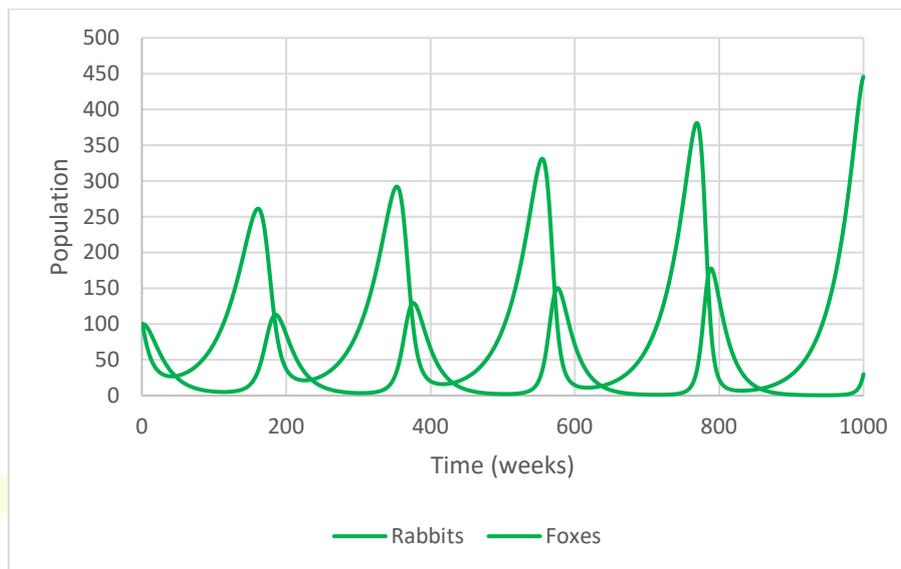
Species Interactions

Species interactions affect ecosystems by changing population sizes and the resources available.

1. *Predator-prey*

A predator is an organism that eats another organism. The prey is the organism which the predator eats. Prey (e.g. rabbits) populations must be higher than predator (e.g. foxes)

populations to provide sufficient nutrients. If the prey population decreases, the predator population will decrease as it is deprived of its food source.



2. Competition

Organisms compete for the same resource, such as food, water, shelter, sunlight or mates. Consequently, a carrying capacity is reached, which is the maximum size of the population that can be supported indefinitely on the available resources and services of that ecosystem.

3. Symbiosis

A close association between two different organisms, in which at least one of the organisms benefits from the association.

- Mutualism: both organisms benefit
- Commensalism: one organism benefits, the other is not harmed
- Parasitism: one organism (parasite) feeds off another organism (host). The parasite benefits the host is harmed.

4. Disease

A disease is any condition that impairs the normal functioning of an organism. Diseases can be infectious or non-infectious. Infectious diseases spread faster within denser populations and can reduce population numbers significantly.

1.4 Explain how environmental factors limit the distribution and abundance of species in an ecosystem.

Ecosystem Components

1. *Biotic Factors*: living organisms
2. *Abiotic Factors*: non-living factors
 - Temperature
 - Sunlight
 - Soil or water pH
 - Soil structure
 - Salinity
 - Humidity
 - Wind strength
 - Water availability
 - Pressure (e.g. underwater)

Limiting Factors

Any factor that prevents a population from growing larger. These can be:

- Density-dependent factors
 - o These factors increase as the population increases in size. It includes all of the species interactions listed.
- Density-independent factors
 - o These factors are present regardless of the population's size and are abiotic factors that limit the distribution and abundance of species in an ecosystem.