DP Biology – A4.2

Conservation of biodiversity

- What is driving the sixth mass extinction?
- What can conservationists do to reduce the loss of biodiversity?

SL statements A4.2.1–8. Textbook pp. 156–180.
Image: tropical forest in Thailand. Vyacheslav Argenberg, CC BY 4.0.



Objectives for each class

Class	Statements	By the end of the class, you can...
1	A4.2.1–3	Describe biodiversity at three levels, compare it with the past, and use case studies of human-caused extinction
2	A4.2.4–6	Explain causes of ecosystem loss, evaluate evidence of a crisis, and outline its main causes
3	A4.2.7–8	Compare approaches to conservation, and explain how the EDGE programme chooses species

Biodiversity at three levels

A4.2.1

Level	What it means
Ecosystem diversity	The range of habitats or ecosystems in an area
Species diversity	The variety of species per unit area, and how abundant each is
Genetic diversity	The range of genetic material within a species or population

Richness and evenness

Richness is the number of species in an area. **Evenness** is how similar their numbers are. Two habitats can have the same richness, yet the one where a single species dominates has lower diversity. Why might this matter if a disease attacked the dominant species?

Measuring diversity: Simpson's reciprocal index

$D = N(N - 1) / \text{sum of } n(n - 1)$

N is the total number of organisms, and n is the number of each species.

Species	Habitat X	Habitat Y
A	10	37
B	10	1
C	10	1
D	10	1

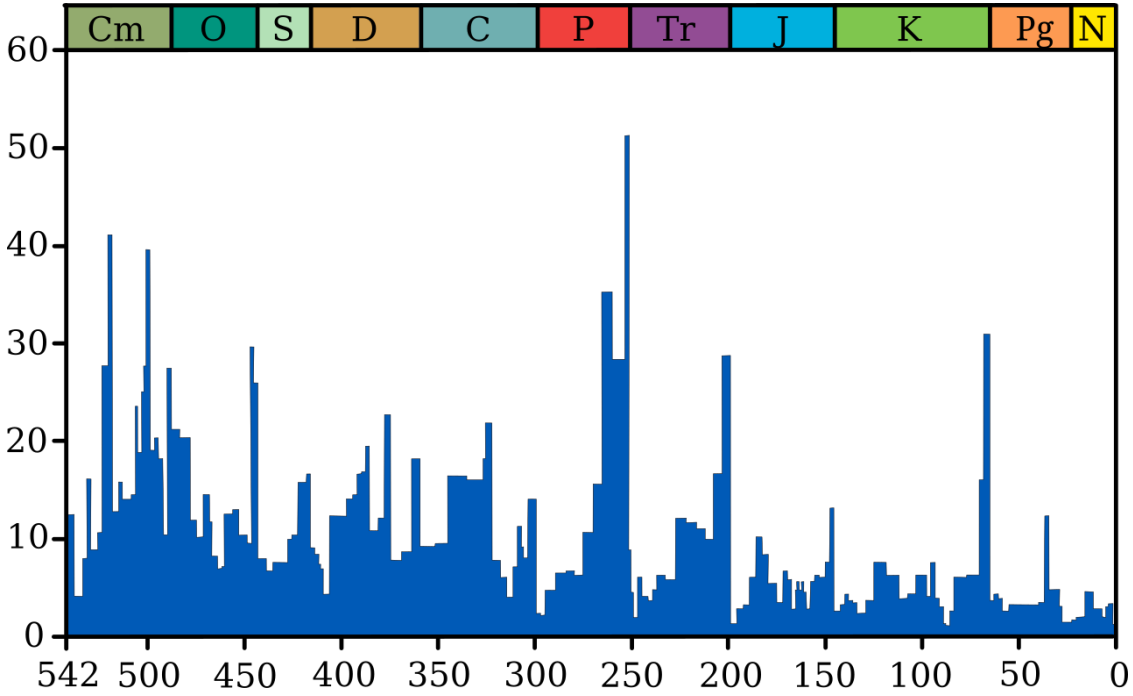
- Sample sessile species using random quadrats
- A higher value means higher diversity
- It allows two communities, or one community at two times, to be compared

Activity

Calculate D for habitats X and Y. They have the same richness: explain why their values differ, and what the values may tell you about human impact.

How does today compare with the past?

A4.2.2



Extinction intensity over time. CC BY-SA 3.0.

- Millions of species have been named, and many more are undiscovered
- Fossils suggest that there are more species alive now than at any time in the past
- There have been five mass extinctions, and diversity recovered after each one

Caution

Fossil records are incomplete, since most organisms never fossilize, so past levels are estimates. High total diversity today does not mean that all is well, as extinction rates are now very high.

Case study: moa in New Zealand

A4.2.3



Haast's eagle attacking moa. John Megahan, CC BY 2.5.

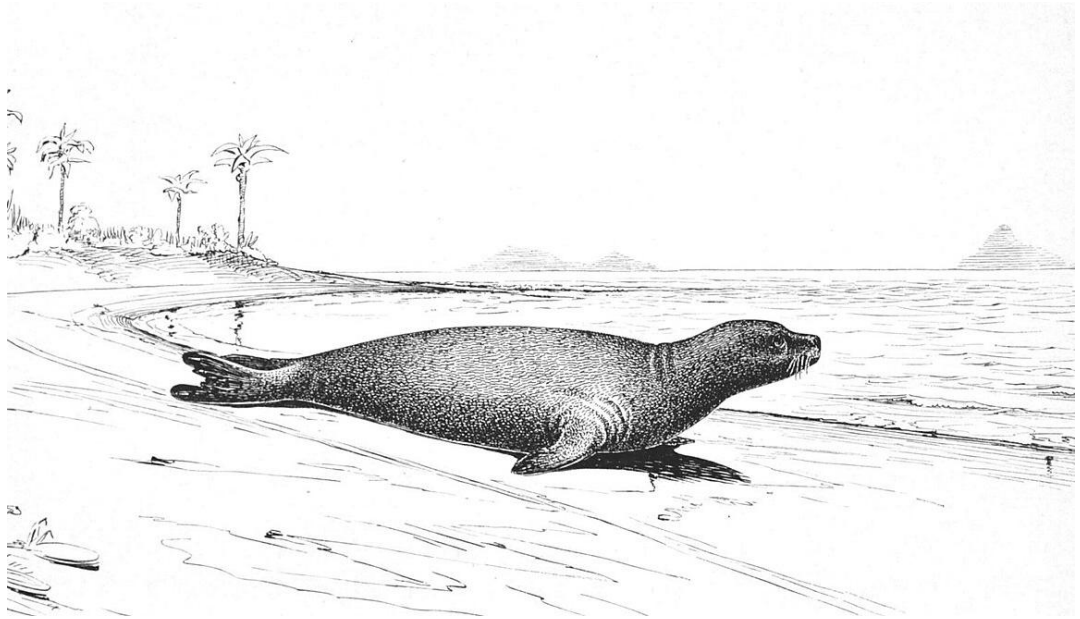
- Flightless birds found only in New Zealand
- Nine species; the North Island giant moa stood up to about 3 m tall
- Evolved with few mammal predators
- Maori arrived around 1280, hunted moa and burnt forest to clear land
- Giant moa had gone by about 1500; Haast's eagle, which preyed on them, died out too

Key idea

Over-hunting and loss of habitat together caused this extinction. Species that evolved without such predators are especially at risk, and their loss affects others in the food web.

Case study: the Caribbean monk seal

A4.2.3



Caribbean monk seal. Public domain.

- Widely hunted for oil and meat
- Showed little fear of people
- Last confirmed sighting in 1952
- Declared extinct in 2008

Knock-on effects

Its loss changed the food web of the Caribbean, including the numbers of fish that it had fed on.

Local example

Partridge numbers in Switzerland fell after farmland changed. Find a local case, and identify its causes.

Causes of ecosystem loss

- Land cleared for farming
- Logging and over-exploitation
- Mining and smelting
- Dams, and draining or diverting water
- Fertilizers leaching into water
- Pollution
- Climate change



Example: the Aral Sea

This was once the world's fourth largest lake. Rivers feeding it were diverted to irrigate cotton, and it has shrunk dramatically. It became far saltier, native fish died out and the fishing industry collapsed. Image: 1989 and 2014, NASA, public domain.

Case study: mixed dipterocarp forest

A4.2.4



Tropical forest in Thailand. V. Argenberg, CC BY 4.0.

- Tall rainforest trees of South East Asia, including Borneo
- Extremely high diversity of trees, and many animals that depend on them
- Cleared for timber and for plantations such as oil palm
- Fragments of forest are too small for some species
- Loss of forest also releases stored carbon

Research

Find out how forest loss has affected one named animal in Borneo. What would have to change to slow the loss?

Local case study: ecosystems in Switzerland

A4.2.4



Peat moss in a bog. NC Wetlands, CC0.

Ecosystem	Why it has declined	Why it matters
Moorland and peat bog	Drained for farming; peat cut	Habitat; stores carbon
River floodplain	Rivers straightened; dams	Flood control; varied habitat

Evidence

Your class slides give a decline of almost 90% for Swiss moors.

Research

Choose a local ecosystem near you. Describe its causes of loss, and the consequences for species and for people.

Evidence of a biodiversity crisis

A4.2.5

- Reports from **IPBES**, an international scientific panel, estimate that about a million species are threatened with extinction
- Evidence comes from surveys of population size, species range, richness and evenness, and how far ecosystems are degraded
- Reliable evidence comes from a wide range of habitats and taxonomic groups

Citizen science

Many people can collect data. Examples from your slides include burying tea bags to measure decomposition, spotting the invasive beetle Popillia japonica, and recording flowering times in an app.

Evaluate

What are the strengths and weaknesses of data from citizen scientists, compared with data from expert surveys? Think about the amount of data, geographical spread and reliability.

Causes of the current crisis

A4.2.6

The overarching cause

A growing human population needs more land, food and resources.

Cause	Example
Hunting and over-exploitation	North Sea cod; moa
Urbanization	Land lost to buildings and roads
Deforestation and clearing land	Land cleared for agriculture and grazing
Pollution	Pesticides and plastics in food chains
Invasive species	Species that spread after being carried to new places

Why several approaches are needed

A4.2.7

	In situ	Ex situ
Meaning	Within natural habitats	Outside natural habitats
Examples	Nature reserves, rewilding, reclaiming degraded land	Zoos, botanic gardens, seed banks, frozen storage
Strength	Protects whole ecosystems and natural behaviour	Can save critically rare species
Weakness	Needs land and enforcement	Small gene pools; behaviour can be lost

Key idea

No single approach is enough, as different species and habitats need different measures.

Conservation near us: Switzerland

A4.2.7



Swiss National Park. H. Krapf, CC BY-SA 3.0.

In situ	Ex situ
Swiss National Park, founded 1914	Agroscope Gene Bank of crop varieties
UNESCO Biosphere Entlebuch	Zoo Basel breeding programmes
Regional nature parks	Botanical gardens and the Aubonne arboretum



Reintroduction

The European bison survived only in captivity. Animals bred in zoos have been returned to the wild in parts of Europe, and there is a trial herd in Switzerland. Image: Michael Gabler, CC BY 3.0.

The EDGE of Existence programme



Tree pangolin. Charles J. Sharp, CC BY-SA 4.0.

- **Evolutionarily Distinct**: few close relatives, so much unique evolutionary history would be lost
- **Globally Endangered**: at high risk of extinction
- Conservation money is limited, so this helps to set priorities

Discussion

Look up your country in the EDGE database. Should distinct species that few people have heard of receive money before well-known species such as tigers? Consider what each option would protect.

Check that you can explain

1. Ecosystem, species and genetic diversity
2. Richness, evenness and Simpson's reciprocal index
3. How today compares with the past
4. Case studies of extinction and ecosystem loss
5. Evidence for a crisis and its causes
6. In situ and ex situ conservation
7. How the EDGE programme chooses species

Exit activity: 5 minutes

On your own and without notes. Hand this in as you leave.

1. Distinguish between richness and evenness.
2. State three causes of today's biodiversity crisis.
3. Explain why the EDGE programme might choose a species that has few close relatives.

Image credits

Virgin tropical forest in southern Thailand, Khlong Phanom, Surat Thani.jpg – Vyacheslav Argenberg – CC BY 4.0

Extinction intensity.svg – Author not stated – CC BY-SA 3.0

Giant Haasts eagle attacking New Zealand moa.jpg – John Megahan – CC BY 2.5

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AralSea1989 2014.jpg – NASA. Collage by Producercunningham. – Public domain

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Bison bonasus (Linnaeus 1758).jpg – Michael Gäbler – CC BY 3.0

Tree pangolin (Phataginus tricuspis) Nyamebe Bepo 5.jpg – Charles J. Sharp – CC BY-SA 4.0

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