DP IB Environmental Systems & Societies (ESS): HL

Your notes

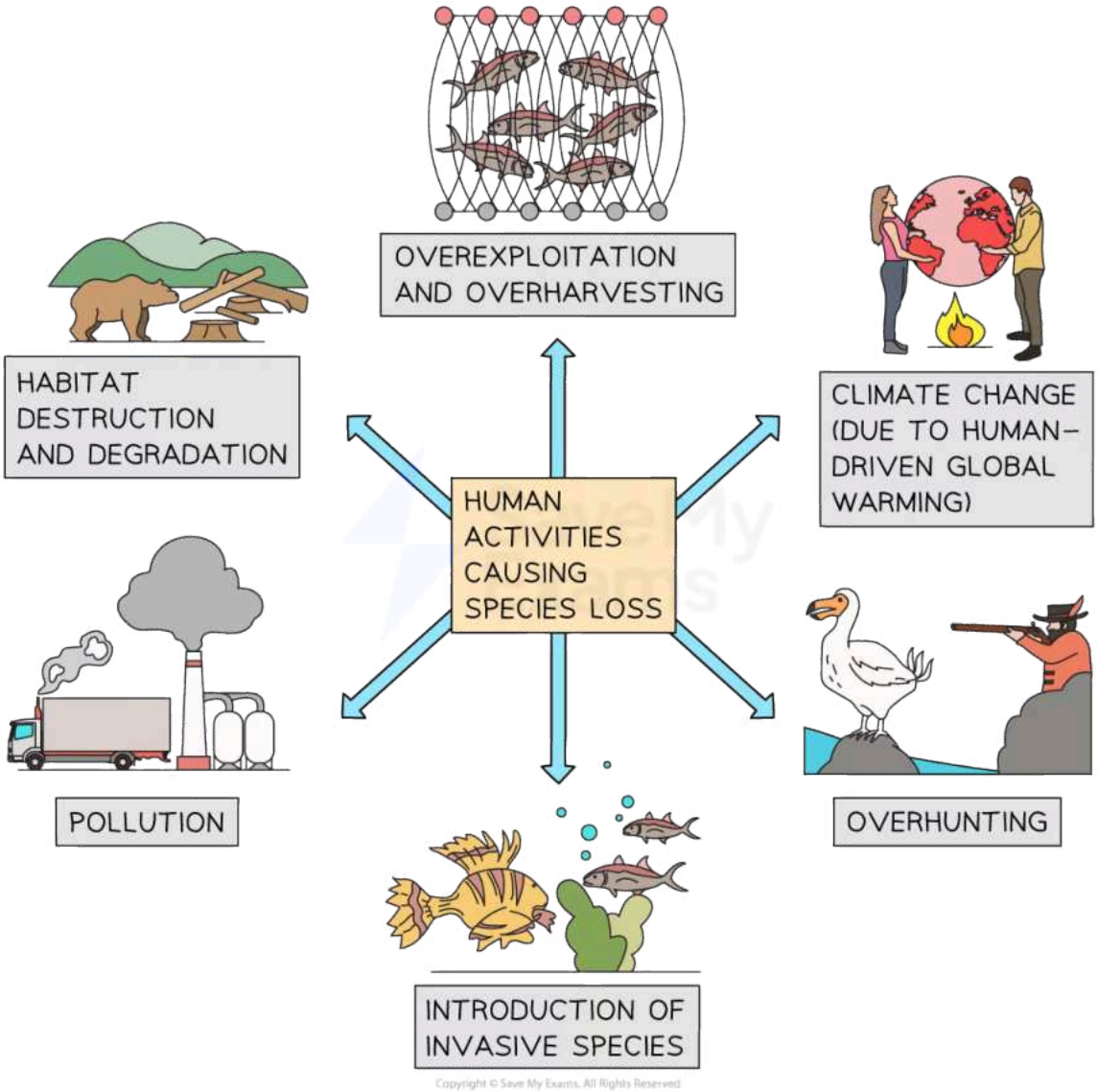
3.2 Human Impact on Biodiversity

Contents

Your notes

Threats to Biodiversity

- Biodiversity is crucial for ecosystem stability, resilience and functioning
  - However, biodiversity is being negatively affected by both **direct** and **indirect** human influences



Human activities that lead to a loss of biodiversity

Direct threats


Your notes

- **Overharvesting**:
  - Harvesting of species at a rate faster than their natural reproduction, leading to **population decline**
    - For example, overfishing of Atlantic cod in the North Sea, leading to **population collapse**
    - Many tropical rainforests are also under threat from overexploitation
    - They have major ecological and economic value
    - The trees are being cut down and harvested at a rate much faster than reforestation takes place
  - Continued overexploitation of a species can drive it to become **extinct**
- **Poaching**:
  - Illegal hunting or capturing of wildlife, often for **trade** or **consumption**
    - For example, poaching of African elephants for their tusks, leading to a decline in elephant populations
  - If too many individuals within a species are killed then the population will become so small that it is no longer able to survive and the species may go extinct
- **Illegal pet trade**:
  - Trafficking of live animals for the exotic pet market

Indirect threats

- **Habitat loss**:
  - Destruction or fragmentation of natural habitats due to human activities such as **deforestation**, **urbanisation**, or **agricultural expansion**
    - For example, clearing of rainforests in the Amazon for cattle ranching
  - Causes of aquatic habitat loss include: destructive fishing techniques, dredging of wetlands, damage from ships, tourism and pollution
  - Causes of terrestrial habitat loss include: inland dams, deforestation, desertification, agriculture and pollution
  - When a species' habitat is destroyed or degraded, they no longer have the support systems and resources they need to survive
- **Climate change**:


Your notes

- The change in global climate patterns due to greenhouse gas emissions, leading to habitat disruption, shifts in species distributions and increased frequency of extreme weather events
    - For example, melting of polar ice caps, threatening species like polar bears
- **Pollution**:
    - Introduction of harmful substances or contaminants into the environment, including air, water and soil pollution
        - For example, plastic pollution in oceans, endangering marine species
- **Invasive alien species**:
    - Non-native species introduced into an ecosystem that **disrupt native species** and ecosystems
        - For example, Japanese knotweed in the UK, which outcompetes native plants and causes damage to buildings
    - When humans travel between countries and continents, they often exchange (either intentionally or unintentionally) animal and plant species between their home country and the foreign country
        - These non-native species can be highly problematic as they often have no natural competitors, predators or pathogens that help limit population growth
        - Without these natural population checks, non-native species can massively increase in number
        - The large numbers of non-native species can negatively affect the native species through factors such as competition and disease

Case Study

Grey Squirrel Invasion in the UK

- **Alien species**:
    - Grey squirrels (*Sciurus carolinensis*) were introduced to the UK from North America in the 19th century
    - Originally brought over as ornamental additions to estates, they have since become a major invasive species
- **Impact**:
    - Grey squirrels outcompete native red squirrels (*Sciurus vulgaris*) for resources such as food and habitat
    - They also carry the squirrelpox virus, which is fatal to red squirrels but does not affect grey squirrels
- **Management strategies**:

- **Culling programs**: some areas have introduced culling programs to reduce grey squirrel populations, aiming to protect red squirrels and restore native biodiversity
- **Forest management**: habitat management practices such as selective tree planting and creating corridors for red squirrels help to create more favourable conditions for the native species, as they are more arboreal than grey squirrels
- **Research and monitoring**: continual research and monitoring of squirrel populations and their impacts can help to develop effective management strategies over time


Your notes

Combined impacts

- Most ecosystems face **multiple** human impacts **simultaneously**
  - This leads to **cumulative effects**
  - This is when negative effects are amplified when different threats act together, reducing ecosystem resilience
    - For example, in a coral reef ecosystem, overfishing by human populations weakens the resilience of the coral reef to coral bleaching caused by climate change, making ecosystem collapse more likely

Examiner Tips and Tricks

Make sure you understand the difference between direct and indirect threats to biodiversity. It would be a good idea to learn at least one specific example of each threat to illustrate its impact.

It is possible to investigate the impact of human activity on biodiversity in an ecosystem using **transect surveys**.

For example, you could study the change in species diversity along a transect laid perpendicular to a site of human interference (i.e. to determine how species diversity changes as you **move away** from the site where human-disturbance has occurred).

Or you could randomly sample within transects **before** and **after** the human activity.


Your notes

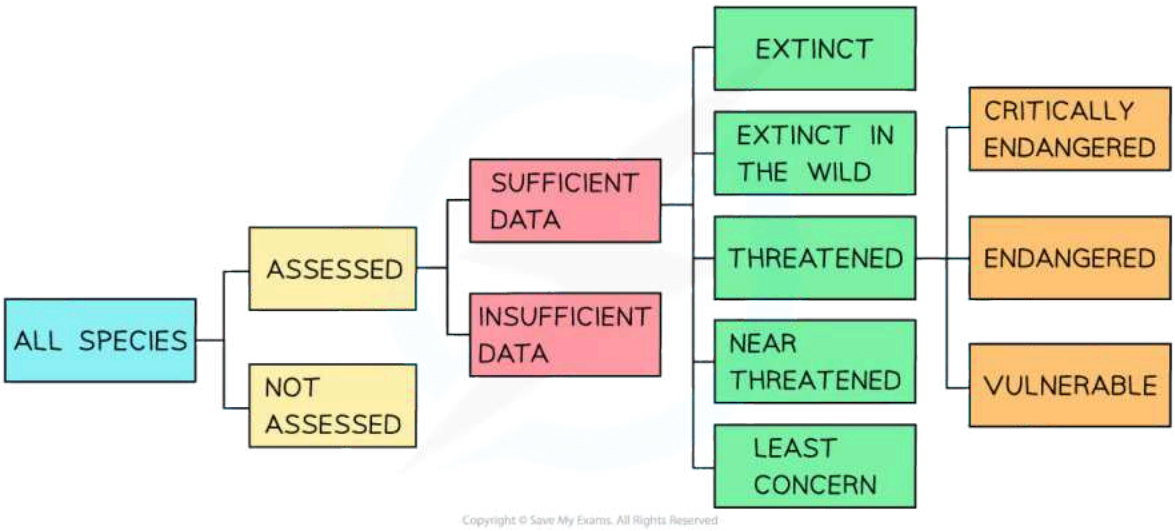
Assessing Conservation Status

- International cooperation is essential if conservation is to be successful
  - There are several agreements and authorities that exist within and between countries with the aim of protecting and conserving species worldwide

IUCN

- The International Union for the Conservation of Nature (IUCN) is the **global authority** on the status of the natural world and the measures needed to safeguard it
- One of the duties that the IUCN carries out is **assessing** the **conservation status** of animal and plant species around the world:
  - Scientists use **data** and **modelling** to estimate the category each species should be in
- Factors used to determine the conservation status of a population include:
  - Population size (smaller populations are usually at a greater risk of extinction)
  - Rate of increase or decrease of the population
  - Degree of specialisation
  - Distribution (geographic range)
  - Reproductive potential and behaviour (breeding potential)
  - Geographic range
  - Degree of endemicity (i.e. if the species is only found in a single specific area)
  - Degree of habitat fragmentation
  - Quality of habitat
  - Trophic level (animals in higher trophic levels are usually at a greater risk of extinction)
  - Known threats

Your notes

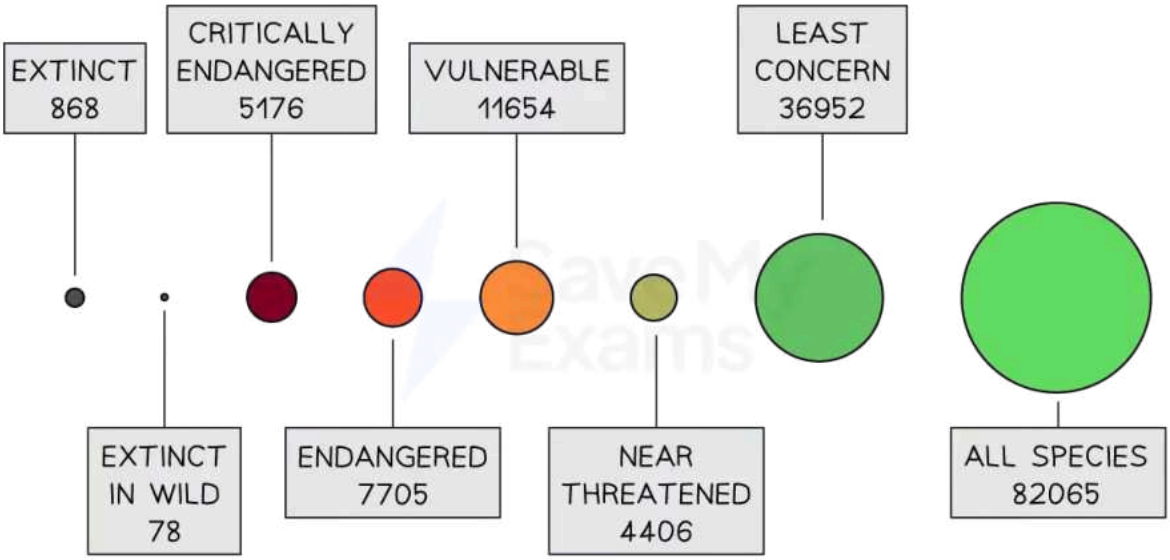


The IUCN classification system of species - scientists are continually updating and reviewing the conservation status of species

- The IUCN has their own **classification system**:
  - There are several different categories and levels that a species can fall into depending on its population numbers and the threats and risks to those populations
  - Species that have been assessed are categorised by the IUCN as:
    - LC = least concern
    - NT = near threatened
    - VU = vulnerable
    - EN = endangered
    - CR = critically endangered
    - EW = extinct in the wild
    - EX = extinct
  - Species can also be classed as DD (data deficient) when there is not enough data on which to base a category choice, or as NE (not evaluated)
- Animals that are on the **IUCN Red List of Threatened Species™** can be seen online as this list is made public
- Giving a global conservation status highlights how vulnerable certain species are

- This helps governments, NGOs and individuals to select appropriate conservation priorities and management strategies

Your notes



The IUCN categorises species on the basis of their risk of extinction; this 2016 data can be represented visually to give an immediate picture of the level of risk being faced by many species

- Although the data shown above is from 2016, the number of species assessed is **increasing** every year and in 2023, this figure reached almost double the amount from 2016, with just under 160 000 species assessed
  - However, this means that extinction risk has still only been evaluated for **less than 5% of the world's described species**


Your notes

Extinct, Critically Endangered & Improving Species

Extinct species

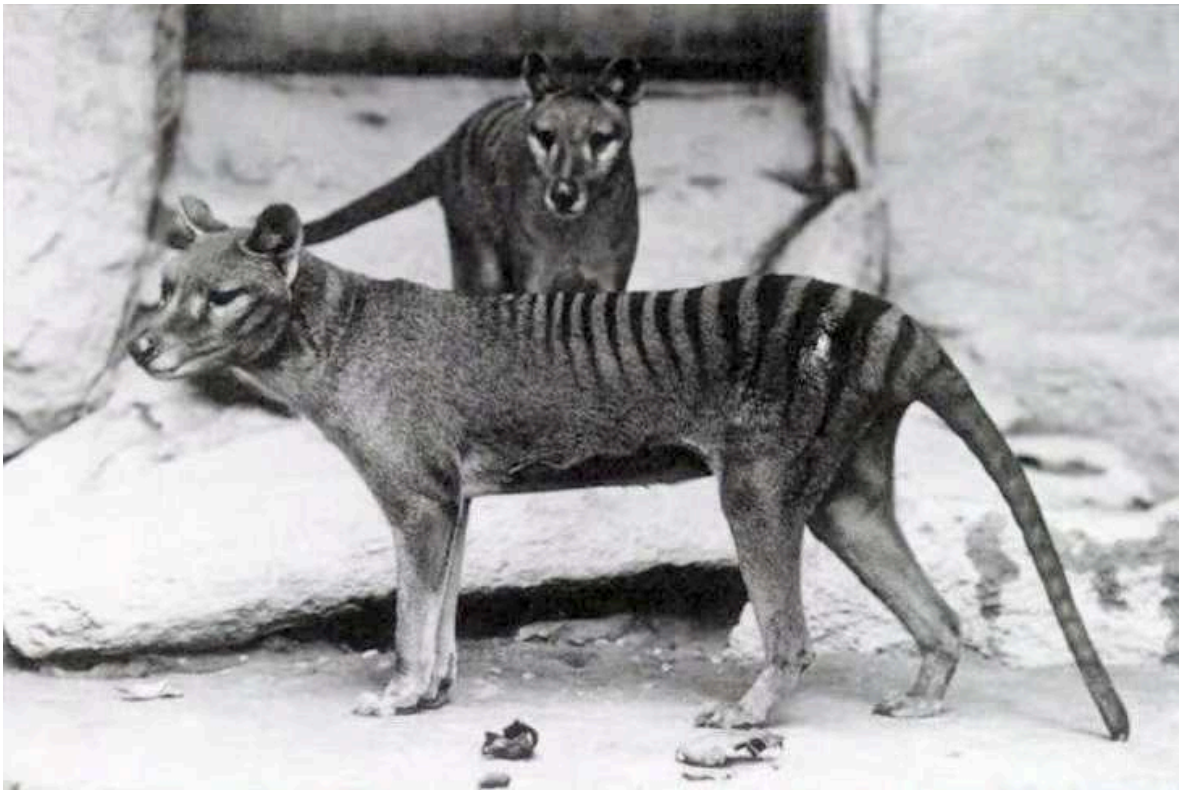
- **Passenger Pigeon** (*Ectopistes migratorius*):
  - The Passenger pigeon was once one of the most abundant bird species in North America, numbering in the billions of individuals
  - However, due to overhunting and habitat destruction, the passenger pigeon went extinct in the early 20th century
  - The hunting of these birds for meat, as well as the destruction of their forest habitats, led to a sharp decline in their numbers
  - By the late 1800s, the species was in serious decline, and despite some attempts at conservation, it went extinct in 1914

Your notes

Mounted male passenger pigeon, Field Museum of Natural History (James St. John, Wikimedia Commons, CC BY-SA 4.0 DEED)

- **Tasmanian Tiger** (*Thylacinus cynocephalus*):
  - The Thylacine, also known as the Tasmanian Tiger or Tasmanian Wolf, was a carnivorous marsupial that once inhabited the Australian island of Tasmania
  - Human activity such as hunting, habitat loss and disease transmission by introduced species caused their population to decline
  - The last known Tasmanian tiger died in captivity in 1936, marking the extinction of the species

Your notes



A female Thylacine and her juvenile offspring (male) in the National Zoo in Washington, D.C., c. 1903 (Baker; E.J. Keller, Wikimedia Commons, CC BY-SA 4.0 DEED)

Critically endangered species

Sumatran Orangutan (*Pongo abelii*):

- The Sumatran orangutan is one of three species of orangutan and is found only on the Indonesian island of Sumatra
- Habitat destruction and fragmentation due to logging, conversion of forests to agriculture, and infrastructure development have been the primary causes of its decline
- In addition, illegal hunting and capture of orangutans for the pet trade have also contributed to their decline
- The Sumatran orangutan is now critically endangered, with only around 14 000 individuals remaining in the wild

Your notes

Close-up of an adult male Sumatran orangutan, Tierpark Hagenbeck, Hamburg (Aiwok, Wikimedia Commons, CC BY-SA 4.0 DEED)

- **Black rhinoceros** (*Diceros bicornis*):
  - The black rhinoceros is a large mammal native to Africa and is critically endangered due to poaching for their horns, habitat loss, and civil unrest in the countries of their range
  - Their population has declined by over 90% since the 1960s, and there are currently only around 3 000 mature individuals remaining in the wild
  - Conservation efforts such as anti-poaching patrols, habitat restoration and captive breeding programs are underway to try to save this species from extinction

Your notes

Black rhinoceros female, with an oxpecker and scratches on skin, in Nairobi National Park, Kenya (Zammerman, Wikimedia Commons, CC BY-SA 4.0 DEED)

Improving species

Southern white rhinoceros (*Ceratotherium simum*):

- The Southern white rhinoceros was once on the brink of extinction due to poaching for their horns, with only a handful of individuals surviving in the wild in South Africa in the early 20th century
- However, conservation efforts including increased law enforcement, habitat protection, and captive breeding programs have helped their population recover to over 18 000 individuals today
- While they are still threatened by poaching and habitat loss, the Southern white rhinoceros' conservation status has greatly improved thanks to human intervention

Your notes

A southern white rhino mother with calf in Namibia (Zigomar, Wikimedia Commons, CC BY-SA 4.0 DEED)

- **Bald eagle** (*Haliaeetus leucocephalus*):
  - The bald eagle is a bird of prey native to North America and was once on the brink of extinction due to habitat destruction, hunting, and pesticide use, which caused eggshell thinning and reproductive failure
  - Conservation efforts such as habitat protection, captive breeding programs, and the banning of harmful pesticides like DDT have helped their population recover from less than 500 pairs in the 1960s to over 10 000 pairs today
  - The bald eagle's conservation status has greatly improved thanks to human intervention

Your notes

Bald eagle about to fly in Kachemak Bay, Alaska (Andy Morffew, Wikimedia Commons, CC BY-SA 4.0 DEED)

Examiner Tips and Tricks

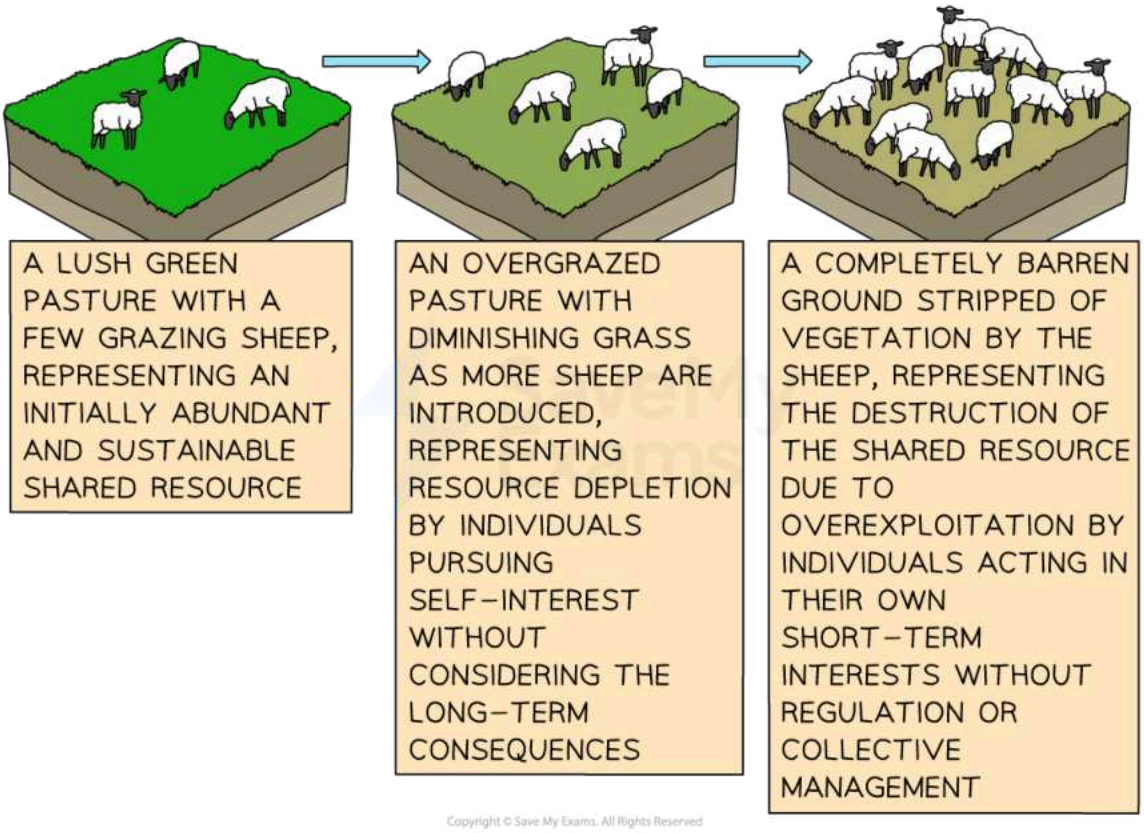
In preparation for your exams, you should learn at least one example, in detail, of an extinct species, a critically endangered species, or an improving species. You do not need to use the examples given here.

For the three different named species, consider the factors that contributed to their decline and the impacts of their decline or extinction on ecosystems and societies. Consider the conservation strategies that were used, and whether they were successful or not.

Your notes

Tragedy of the Commons

- The tragedy of the commons describes the **overuse** and **depletion** of a **shared resource**
  - It occurs when individuals act in their own self-interest rather than considering the common good
  - It leads to the **degradation** of the resource, making it **unavailable** for future use



A non-human example demonstrating the tragedy of the commons

Implications for sustainability

- **Overexploitation**:
  - Many natural resources are used faster than they can be replenished

- This is resulting in **resource depletion** and could eventually lead to the **collapse** of certain ecosystems


Your notes

- **Impact on biodiversity**:
  - Result in the loss of **habitats** and **species**
  - It can also lead to reduced **genetic diversity**
    - These factors can weaken ecosystem resilience, threatening biodiversity

Case Study

Overfishing of Fish Stocks on the Grand Banks

- **Location**:
  - Grand Banks, off the coast of Newfoundland, Canada
- **Natural resource affected**:
  - Cod fish
- **Problem**:
  - Intensive fishing by local and international fleets
  - Advanced fishing technologies and no effective regulation
- **Consequences**:
  - Dramatic decline in cod populations
  - Economic collapse of the fishing industry in the region
  - Long-term ecological damage
- **Current situation**:
  - Strict regulations and moratoriums on cod fishing
  - Slow recovery of cod stocks but these are still a long way below historical levels

- The tragedy of the commons does not only apply to situations where a natural resource is overharvested
  - It also applies to the **contamination** and **degradation** of **ecosystems** by humans

Case Study

Plastic Pollution in Ocean Gyres

- **Location**:

- Various ocean gyres, including the North Pacific Gyre, home to the Great Pacific Garbage Patch

- **Natural resource affected**:
  - Marine environment and marine biodiversity
- **Problem**:
  - Accumulation of plastic debris from land-based and marine sources
  - Plastics are non-biodegradable and persist for hundreds of years
- **Consequences**:
  - Marine animals ingest plastics, leading to injury and death
  - Plastics break down into microplastics, entering the food chain
  - Damage to marine ecosystems and decline in marine biodiversity
- **Current situation**:
  - Efforts to reduce plastic use and increase recycling
  - International agreements and clean-up initiatives


Your notes

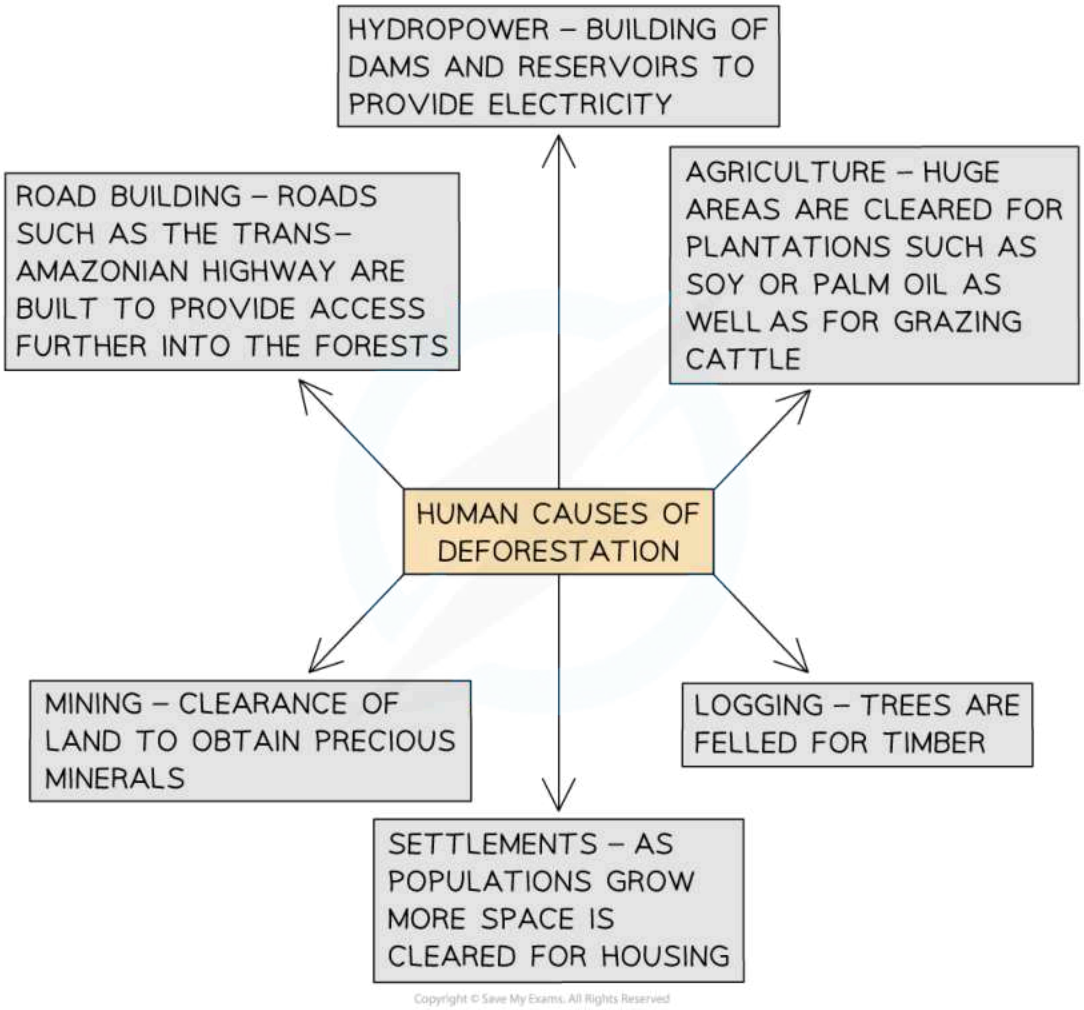
Your notes

Threats to Biodiversity Hotspots

Habitat destruction

- **Habitat destruction** is the most significant threat to biodiversity hotspots
  - **Deforestation** in **tropical rainforests** is a major cause of habitat loss
    - For example, in the Amazon Rainforest, large areas are cleared for cattle ranching and soybean farming, threatening species like the **jaguar** and **giant river otter**
  - Deforestation is due to human activities, including:
    - Agriculture, particularly large-scale **slash and burn**
    - Mining
    - Hydroelectric power
    - Logging
    - Road building and settlements
    - Wildfires: although they are typically natural, people can intentionally start wildfires, and human-induced climate change is associated with their increasing frequency and severity

Your notes



Human causes of deforestation

- These activities lead to the **fragmentation** of habitats
  - Fragmentation makes it harder for species to **survive** and **reproduce**

Challenges of conservation in biodiversity hotspots

Biodiversity distribution

- Biodiversity is not evenly distributed across the globe
- Many biodiversity hotspots are located in **developing countries**, particularly around the **tropics**
- These regions often face challenges like:

- **Poverty**
- **Political instability**
- **Rapid population growth**

- These challenges make conservation efforts more difficult
- Conservation strategies may conflict with **economic development**, as people in these regions rely on natural resources for their livelihoods
  - For example, in **Indonesia**, efforts to conserve tropical forests have to balance the needs of local communities that depend on farming and palm oil production

Lack of funding and resources

- Developing countries often have **limited funding** for conservation
  - This makes it harder for them to implement effective strategies to protect biodiversity hotspots
- International organisations and governments sometimes provide support
  - However, these efforts are often not enough to prevent habitat loss or species decline

Examiner Tips and Tricks

Be ready to explain the difficulties of conserving biodiversity in hotspots, especially in developing countries where there may be conflicts between environmental and economic needs.

Your notes

Key Biodiversity Areas (HL)

Your notes

Key Biodiversity Areas (KBAs)

What are key biodiversity areas?

- Key biodiversity areas (KBAs) are places identified as **globally important** for the **conservation of biodiversity**
  - These areas are crucial for the survival of species and ecosystems, particularly those at risk of extinction or collapse
  - KBAs are often prioritised for conservation efforts because of their significant role in maintaining **global biodiversity**
  - The concept of KBAs helps guide policymakers, scientists, and conservationists in protecting the **most critical areas** for biodiversity

Criteria for identifying KBAs

- KBAs are identified based on specific scientific criteria, which ensure that they contribute significantly to the **global persistence of biodiversity**
- These criteria include:
  1. **Threatened species**: the area holds species that are listed as vulnerable, endangered, or critically endangered on the **IUCN Red List**
     - E.g. areas with populations of animals like the **Sumatran tiger** or **Javan rhinoceros** are considered KBAs due to their species' risk of extinction
  2. **Threatened ecosystems**: the area contains ecosystems or habitats at risk of **collapse**, meaning the system may stop functioning if not protected
     - E.g. coral reefs in the **Coral Triangle** are at high risk due to climate change and overfishing, and they are considered KBAs for their ecosystem value
  3. **Restricted-range species**: the area contains species that have a limited geographical range
     - E.g. Madagascar is home to many **endemic species** that exist only in specific parts of the island, making it a KBA for species like **lemurs**
  4. **Significant population sizes and biological processes**: the area is crucial for supporting large populations of species during important life stages, such as **breeding**, **migration**, or **feeding**
     - E.g. the **East African Rift Valley** is a critical stopover for millions of migratory birds, including species like the **lesser flamingo**, which rely on the area for feeding during migration

5. **Ecological integrity**: the area remains **ecologically intact** and largely unaffected by **industrial human influence**, supporting natural ecological processes
    - E.g. **Canada's Boreal Forest** is a KBA because it remains one of the world's last **undisturbed** forests, supporting numerous species while regulating climate and water systems

Your notes

Examples of key biodiversity areas

1. Atlantic Forest, Brazil

- **Importance**: The Atlantic Forest is one of the most biologically diverse regions in the world, home to thousands of plant and animal species, many of which are found nowhere else
- **Biodiversity value**: The forest is a critical habitat for endangered species such as the **golden lion tamarin** and the **black-fronted piping guan**
- **Threats**: Deforestation for agriculture and urban development has reduced the forest to a fraction of its original size, threatening its rich biodiversity

Golden lion tamarin (Leontopithecus rosalia). Photo by Bart van Dorp (CC BY-SA 4.0).

Your notes

Black-fronted piping guan (Pipile jacutinga). Photo by Mvshreeram (CC BY-SA 4.0).

2. Western Ghats, India

- **Importance**: The Western Ghats mountain range is a global biodiversity hotspot, supporting a wide variety of ecosystems and species
- **Biodiversity value**: It is home to endemic species like the **Nilgiri tahr** and **Lion-tailed macaque**
- **Threats**: Hydroelectric projects, deforestation, and agricultural expansion threaten the unique species and habitats in this region

Nilgiri tahr (Nilgiritragus hylocrius) male (left) and female (right). Photo by A. J. T. Johnsingh (CC BY-SA 4.0).

Your notes

Your notes

Lion-tailed macaque (Macaca silenus). Photo by _paVan_ (CC BY-SA 4.0).

3. Sundarbans, Bangladesh and India

- **Importance**: The Sundarbans is the largest mangrove forest in the world and a critical area for global biodiversity
- **Biodiversity value**: It supports endangered species such as the **Bengal tiger** and various species of **river dolphins**
- **Threats**: Rising sea levels, pollution, and habitat destruction threaten this delicate ecosystem, which provides crucial services such as carbon sequestration and coastal protection

Conflicts between exploitation, sustainable development, and conservation in KBAs

- **Exploitation**:
  - Many key biodiversity areas (KBAs) are rich in natural resources, making them targets for industries like agriculture, mining, and logging
  - This leads to habitat destruction and biodiversity loss

- **Sustainable development**:
  - There is a growing push for development that meets human needs without depleting natural resources or damaging ecosystems
  - However, balancing economic growth with environmental protection can be challenging in areas rich in biodiversity
- **Conservation**:
  - Conservation efforts in KBAs aim to protect species and ecosystems at risk of collapse or extinction
  - This often conflicts with exploitation, as resource extraction can degrade or destroy critical habitats


Your notes

Palm oil plantations in Malaysia and Indonesia

- Palm oil is one of the most widely used vegetable oils in the world, found in many food and cosmetic products
- The demand for palm oil has led to the rapid expansion of plantations in tropical countries like Malaysia and Indonesia
- **Conflict**:
  - Palm oil plantations often expand into key biodiversity areas, such as the tropical rainforests of **Borneo** and **Sumatra**
  - This leads to large-scale deforestation and habitat destruction
  - These areas are home to critically endangered species like the **Sumatran orangutan** and **Bornean pygmy elephant**, which face severe threats due to the loss of their habitat
- **Consequences for biodiversity and climate**:
  - The expansion of palm oil plantations destroys forests that are key habitats for many species, disrupts ecosystems, and contributes to climate change by releasing carbon stored in trees and soil
- **Efforts for sustainable development**:
  - Some companies and conservation groups are working to establish **sustainable palm oil** production that does not destroy forests
  - The **Roundtable on Sustainable Palm Oil (RSPO)** has set standards for palm oil producers to reduce deforestation and protect biodiversity
- **Challenges**:
  - Despite these efforts, the demand for palm oil remains high, and illegal deforestation continues

- This makes it very difficult to fully protect KBAs in these countries from exploitation

Mature oil palm plantation in Malaysia

Your notes

Your notes

Traditional Indigenous Approaches to Land Management

- Traditional Indigenous land management refers to the methods used by Indigenous communities to care for and sustain the natural environment over generations
  - These methods often focus on long-term sustainability, ensuring the land remains productive and healthy for future generations
  - Indigenous practices maintain balance in the ecosystems in which they occur and include:
    - Rotational farming
    - Controlled burning
    - Sustainable fishing and hunting
  - These methods are often based on a deep connection to the land and a holistic understanding of ecosystems

Sustainability in Indigenous land management

- Indigenous approaches to land management are often viewed as **more sustainable** than many modern, industrial practices
  - **Rotational farming**:
    - Some Indigenous groups, like the **Kayapo** in the **Amazon**, use shifting agriculture to allow soil to regenerate between planting cycles, preventing nutrient depletion
  - **Controlled burning**:
    - **Indigenous Australians** have used fire-stick farming (controlled burning) to manage forests, prevent large wildfires, and promote the growth of certain plants and animals
    - This promotes biodiversity and reduces the risk of catastrophic wildfires
- These methods focus on working with nature rather than over-exploiting it, helping preserve biodiversity and ecosystem balance

Challenges to Indigenous land management

- Despite the sustainability of traditional Indigenous methods, they face significant challenges:

External threats

- **Population growth and economic development**:
  - As populations grow and economies develop, there is greater pressure on Indigenous lands for resources, agriculture, and infrastructure development
  - E.g. **deforestation** in the **Amazon** threatens Indigenous farming and hunting practices as large areas of forest are cleared for cattle ranching or soy production
- **Climate change**:
  - Climate change is disrupting traditional weather patterns and natural cycles that Indigenous practices rely on
  - E.g. in the **Ecuadorian Amazon**, Indigenous communities have historically used river flooding during the rainy season to increase the effectiveness of their fishing practices
  - However, due to climate change, **flooding is now more extreme**, submerging farms and affecting the growth of vital crops, leading to food insecurity in these communities
- **Government policies and lack of support**:
  - Many governments do not recognise Indigenous land rights or they prioritise economic development over traditional land management
  - E.g. in parts of **Canada**, government-sanctioned logging and mining on Indigenous lands have caused degradation of ecosystems essential to Indigenous hunting, fishing, and spiritual practices

Internal threats

- **Aspiration for economic development**:
  - As Indigenous societies become more integrated into the global economy, there can be pressure to adopt **modern development models** that may not align with sustainable practices
  - E.g. younger generations within some Indigenous communities may prefer industrial agriculture or other economically profitable but less sustainable forms of land use, leading to overuse of natural resources
- **Erosion of traditional knowledge**:
  - The spread of modern education systems and cultural influences can lead to a loss of traditional ecological knowledge
  - This is making it harder for Indigenous communities to maintain their sustainable practices over generations

Your notes

Examiner Tips and Tricks

Be clear on the differences between traditional Indigenous methods and modern land management. Focus on how Indigenous methods often prioritise sustainability.

Exam questions may ask about how both **outside pressures** (like deforestation) and **internal changes** (like economic aspirations) affect Indigenous approaches to land management, so make sure you are prepared for this!


Your notes

Your notes

Conservation & Environmental Justice

What is environmental justice?

- Environmental justice refers to the **fair treatment and involvement** of all people, regardless of race, income, or geography, in **environmental policies and practices**
- It seeks to ensure that no group bears an unfair share of environmental harms or is excluded from the benefits of environmental protection
- In the context of conservation, environmental justice aims to protect **both biodiversity and the rights of local and Indigenous communities**

Conservation and biodiversity loss

- Conservation efforts are essential for reducing biodiversity loss
- Areas most affected by biodiversity loss are often in **developing countries**, many of which have **significant Indigenous and low-income populations**
  - These areas, such as tropical rainforests and savannahs, are rich in biodiversity but also face intense pressure from deforestation, mining, and agriculture

Links between environmental justice and conservation

Conflicts between conservation and Indigenous rights

- Conservation efforts need to balance **protecting ecosystems** with ensuring the rights and livelihoods of **local and Indigenous communities** are protected
- Many conservation programmes have historically focused on protecting land and biodiversity by creating **protected areas** like national parks
- However, this has sometimes led to **forced relocations** of local and Indigenous peoples, violating their rights
  - For example, the creation of **Serengeti National Park** in Tanzania led to the **relocation of the Maasai people**, who had traditionally lived there and relied on the land for grazing their cattle
  - This displacement has caused long-term challenges for the Maasai, including:
    - Loss of livelihood
    - Poverty

- Cultural disruption and cultural disconnection from their land

- Environmental justice argues that Indigenous and local communities should be **partners in conservation**, not obstacles
  - Forced relocation undermines the traditional stewardship of land that Indigenous peoples have practiced for generations
  - In many cases, these communities were sustainably managing the land before being removed for conservation purposes
  - Indigenous peoples often have **deep knowledge** of their environments, which can be invaluable for sustainable conservation strategies
    - For example, in certain parts of the Amazon, some Indigenous groups work with conservation organisations to manage their lands sustainably, combining traditional practices with modern conservation techniques


Your notes

Lack of legal support

- Many Indigenous communities lack **legal recognition** of their land rights
- This makes it easier for governments and corporations to seize land for conservation or development
  - For example, in **Botswana**, the **San people** were removed from their ancestral lands in the **Central Kalahari Game Reserve**
  - This was despite living there for thousands of years
  - They were relocated without proper compensation or support
- Without legal rights, Indigenous and marginalised communities have little ability to defend their land when governments or organisations prioritise conservation projects over their livelihoods

Examiner Tips and Tricks

Be prepared to discuss how conservation can sometimes harm Indigenous communities if their rights are not respected. Familiarise yourself with at least one example like the Maasai, the San people, or the Adivasi.

Remember that environmental justice seeks to ensure that conservation efforts do not **disproportionately affect vulnerable communities**. This is an important concept in environmental sciences.

Loss of Biosphere Integrity (HL)


Your notes

Loss of Biosphere Integrity

What is biosphere integrity?

- Biosphere integrity refers to the **health** and **stability** of the Earth's **biodiversity**, including it **ecosystems**, **habitats**, **species**, and **genetic diversity**
  - It is one of the nine planetary boundaries
  - These are thresholds that define a **safe operating space** for **humanity**
  - Crossing these boundaries increases the risk of environmental change that could **destabilise the Earth system**
- The **loss of biosphere integrity** shows that human activities have caused a rapid decline in biodiversity, pushing species extinction rates **beyond the natural threshold**
  - Scientists believe this boundary has already been **crossed**
  - This means that species extinctions are happening at a significantly faster rate than in the past
- Species extinction is occurring **100** to **1000** times faster than the background extinction rate
  - Often called the **sixth mass extinction,** and is driven by human activities such as deforestation, pollution, climate change, and habitat destruction

Your notes

Vertebrate species extinction rates since 1500

- When species are lost, it doesn't just affect individual ecosystems
  - It can also destabilise the whole Earth system, leading to widespread changes that affect the climate, air, water, and food resources

Tipping points in the Earth system

- Tipping points are **critical thresholds** where small changes in the environment can lead to drastic and irreversible consequences

- The loss of key species or ecosystems can create feedback loops that push the Earth system into a **new**, **less stable state**

- If the loss of biodiversity continues, it could lead to widespread **ecosystem collapse**
  - For example, the **disappearance of pollinators** like bees could disrupt global food production
    - This will also impact wild flower populations globally
  - **Forest degradation** can reduce carbon storage, accelerating climate change by releasing more carbon dioxide into the atmosphere
    - Large-scale deforestation could push the Amazon past a tipping point where it no longer functions as a rainforest
  - The **loss of phytoplankton** due to **warming oceans** and **ocean acidification** could lead to a major disruption of the marine food chain
    - This could eventually lead to collapse in marine biodiversity and significantly impact the ocean's ability to sequester carbon, affecting global climate systems
  - Climate change is causing the **melting of Arctic sea ice**
    - This loss of habitat is threatening species like polar bears
    - The resulting sea-level rise is also leading to the destruction of previously biodiverse coastal habitats
    - The loss of ice reduces Earth's ability to reflect sunlight, causing even more heat to be absorbed
- There is concern that the loss of species and ecosystems could reach a point where the entire Earth system begins to change in **unpredictable** ways, possibly affecting many factors, including:
  - Climate stability
  - Food security
  - Freshwater availability

Ecosystem services

- Ecosystem services are the **benefits that humans receive from nature**, including clean air, water, food, and climate regulation
  - The loss of biosphere integrity threatens these services, making it harder for ecosystems to provide essential resources for expanding human populations

Examiner Tips and Tricks

Your notes

Try to memorise one or two clear examples of how biosphere integrity is being steadily eroded and how this could have **significant knock-on effects** (e.g. how loss of the Amazon rainforest or Arctic sea ice will have further negative consequences for climate and biodiversity).

Your notes