Edexcel A Geography GCSE

Ecosystems, Biodiversity & Management

Detailed Notes

Biomes

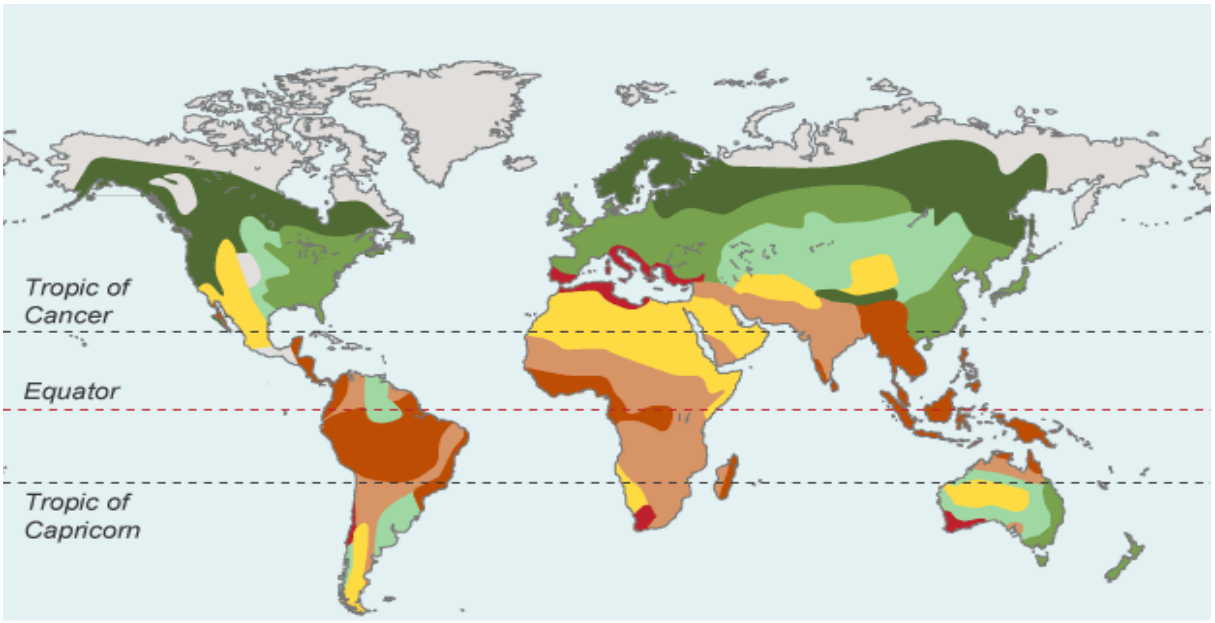
What is a Biome?

Biomes are global-scale ecosystems that exist throughout the world, categorised by **similar environmental characteristics** such as **climate, vegetation type and soil**. Biomes are important for the local environment and community and their interactions sustain life on Earth.

Biomes usually occur in **latitudinal belts**, meaning they are present across the world at **similar latitudes** (horizontally on a typical map).

Similar regional climates within these latitudinal patterns occur because of **atmospheric circulation**. However, there are **some variations** in biome distribution caused by other influences like **ocean currents, winds** and **land-sea temperature differences**.

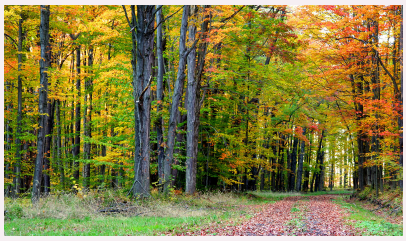
Global Distribution of Biomes

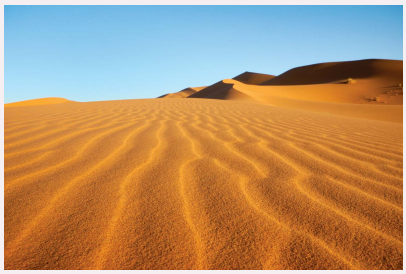


Biomes such as the polar and monsoon ones are not included in this map as they cover a smaller region of the Earth. The definition of a 'biome' differs because they are classified according to the **particular species that live there**; the **temperature**; **soil** type; **precipitation levels** and **amount of sunlight**.

Characteristics

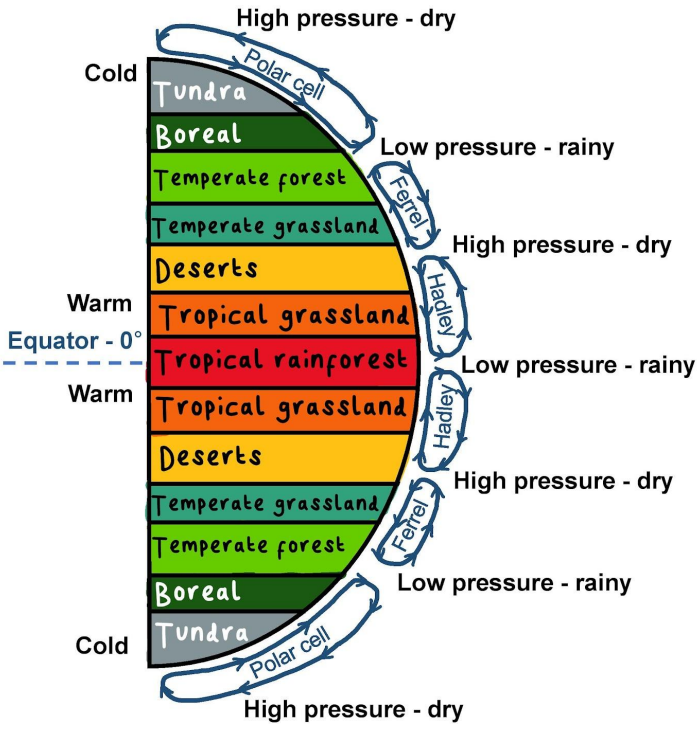
Global ecosystems have different **characteristics** that determine what kind of biome they are. These are outlined in the table below.

Ecosystem	Location	Characteristics
Tundra 	Located in the **far north**. Arctic circle to 60-70°N (e.g. Canada, Northern Russia, coastal Greenland). Not as prevalent in the **southern hemisphere** as there aren't as many land masses far south.	• Harsh, **cold winters** and extremely **short summers**. • **Treeless** ecosystem as it is too cold and not wet enough for trees. • **Precipitation** is extremely **low** (10-25cm/yr) • Short growing season, **nutrient poor soils** and lack of biodiversity. • Animals are usually **migratory** (i.e. they move further south in winter) • Soils are permanently frozen (**permafrost**).
Taiga **(coniferous forest/boreal)** 	Located at latitudes **below the tundra biome**, anywhere from 50-70°N (e.g. North America, Russia, Scandinavia).	• **Coniferous forest** (conifers) which are **drought resistant**, cone-bearing trees. • They retain their leaves all year round to **maximise photosynthesis**, especially during short summers. • Around 50 cm/yr of rainfall and a **longer growing season**, meaning there are more plants. • Small animals and migrating birds are present. Coniferous forests may also contain wolves, bears and moose.
Temperate deciduous forest 	Around 40-50°N and S of the equator, although this varies. Located in Eastern **USA**, **Europe** - including the UK - Eastern Australia.	• **Deciduous vegetation** (broad-leaf trees that shed their leaves in winter to retain moisture) • **Oak**, **maple**, and **beech** trees are common. • **Highly seasonal temperatures**: hot summers and cold winters. • **Moderate precipitation** - 75-150cm/yr. • Animals include deer, bear and small animals.
Temperate grassland	Located roughly 30-40°N	• Dominant vegetation is

(prairie, steppe, pampas) 	and S of the equator, away from coastal areas. E.g. Central Europe and Asia, Central USA, Central Australia, some parts of South America. Found in **Hungary**, **South Africa**, **Argentina** and the **USA**. Prairie = USA Steppe = Europe/Siberia Pampas = South America	**grasses** due to **periodic fires** and precipitation being too low to support trees. • **Low precipitation** (25-75cm/yr). • Animals include prairie dogs and originally bison, although these were overhunted in the past. • **Hot summers, cold winters**.
Desert 	Around 30°N and S of the equator. Present near the **Tropics of Cancer and Capricorn**. E.g. Northern Africa, Australia, Eastern USA, Middle-East, southern South America.	• **Precipitation** is extremely **low** - under 25cm/yr. • **Temperature fluctuates** from well above 20°C in the day to below 0°C at night. • Precipitation greatly limits **plant growth,** soil is very low in nutrients and high in salts. Mainly cacti and sagebrushes. • **Small animals** live in deserts, often **nocturnal** to regulate body temperature. • Deserts cover **one fifth** of the world's land surface.
Tropical rainforest 	Close to the **equator**. E.g. equatorial South America, South-East Asia.	• **Species rich ecosystem**, with over half of the world's species of plants and animals. • **Warm, moist climate** throughout the year with little variation, perfect for plant growth. Temperatures stay around 26°C. • Precipitation is **extremely high** (200-450cm/yr). • Very quick **nutrient cycle**, soils are nutrient poor but there is a thin layer of organic matter on the top of soils that makes plants **very productive**. • Animals include **many insects**, reptiles and amphibians.

Savanna (tropical grassland) 	Located between 15-30° N and S of the equator. Found mainly in **Central Africa**, **Central South America**, **southern India** and **northern Australia**.	• Temperature varies **little throughout the year**, staying in the **high 20°Cs**. • **Precipitation is very seasonal**, with distinct **wet and dry seasons**. Yearly precipitation is around 76-150cm/yr, though most of this falls in winter. • Tropical grassland dry seasons are characterised by **wildfires**, and the vegetation is **adapted to this**. • Wide expanses of grass means this ecosystem is often used for **animal grazing.** • Hoofed animals and **herds** are common in this ecosystem, as well as **large predators** like lions and leopards.
Mediterranean (chaparral or evergreen hardwood) 	Around 40-45°N of the equator. The Mediterranean biome exists around the Mediterranean Sea, around some areas of **South Africa** and **Western Australia** (Perth and Melbourne) and **California** in the USA.	• Mild, moist winters. Hot, dry summers (precipitation around 50cm/yr). • Frequent **wildfires**, with vegetation adapted to this. • Dense growth of **shrubs**, as well as fruit trees. • Diverse **wildlife** - animals include foxes, pumas, tortoises, lizards. • Characterised by **hot-dry summers and mild, rainy winters**. • Nearly all of the rainfall occurs in the winter and spring rainy Season.

The Influence of Climate on Biomes



The **distribution** and **characteristics** of biomes are affected by the **climate** (e.g. **precipitation, temperature and sunlight exposure**).

The climate has major influence over the **type of vegetation that can grow**, what **animals can survive** and what the **soils are like** in a particular biome.

Precipitation

Forest biomes are found in areas of **low pressure**; as these climates are rainy, they strongly support **tree growth**.

Grasslands and deserts are found in areas of **high pressure** as precipitation is too low for forested ecosystems.

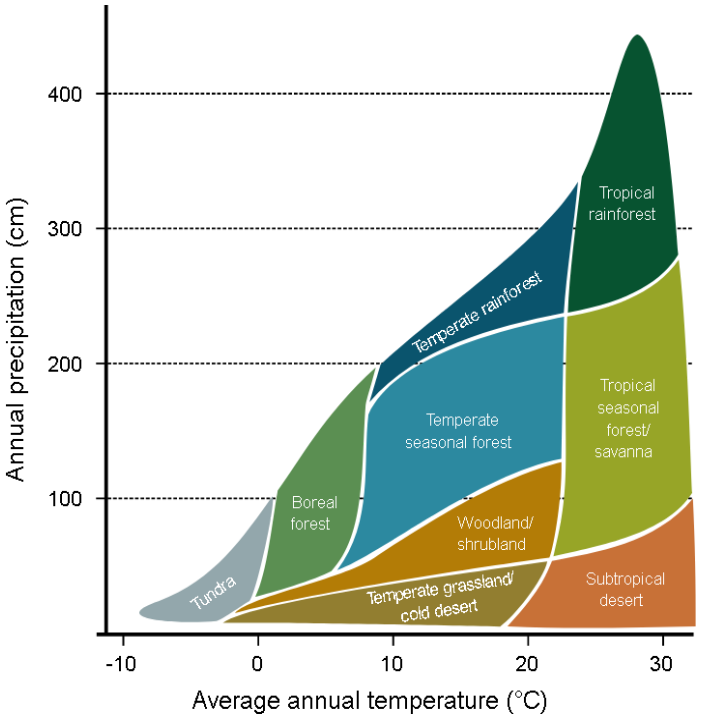
Temperature

As well as precipitation, **temperature** and **sunlight** has a huge influence on a **biome's characteristics**. The average **temperature** of an area is impacted by the **angle of the sun**.

Around the **equator**, the **sun shines directly onto the land**, making it very **warm**. This causes plants to be **more productive** (with enough rain), creating **tropical rainforest biomes**.

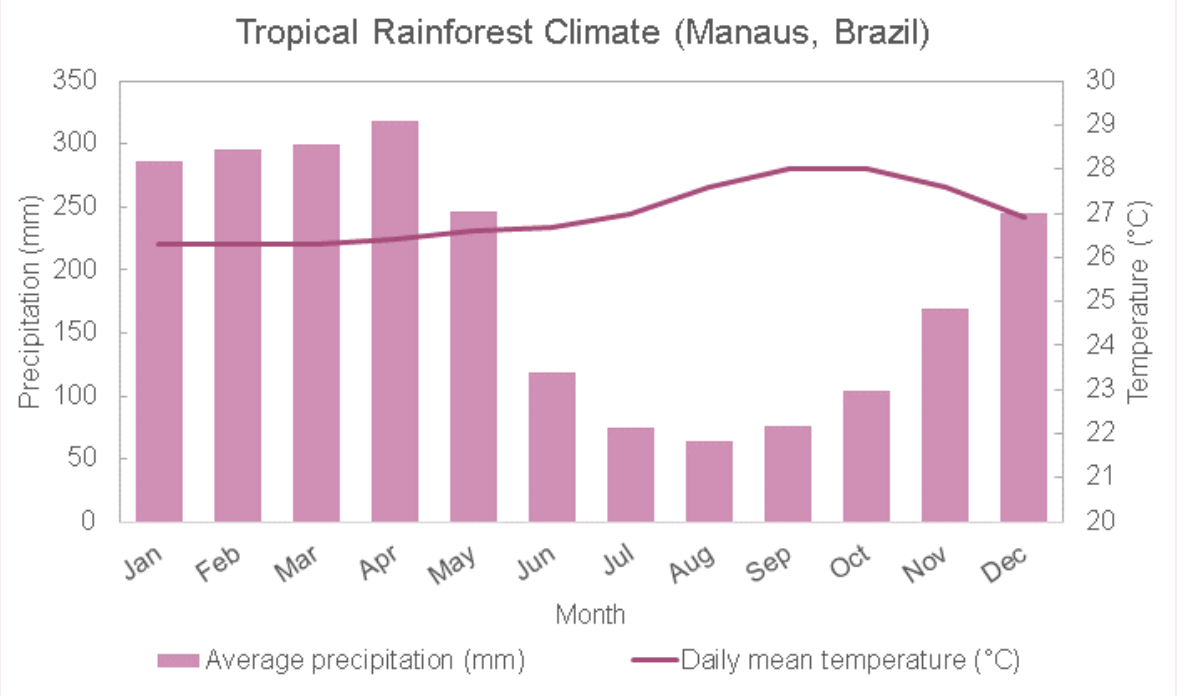
At **higher latitudes**, sunlight becomes **less intense** and **more seasonal**, influencing the type of vegetation that can grow. At the poles, the low temperatures, low precipitation and lack of light limit plant growth.

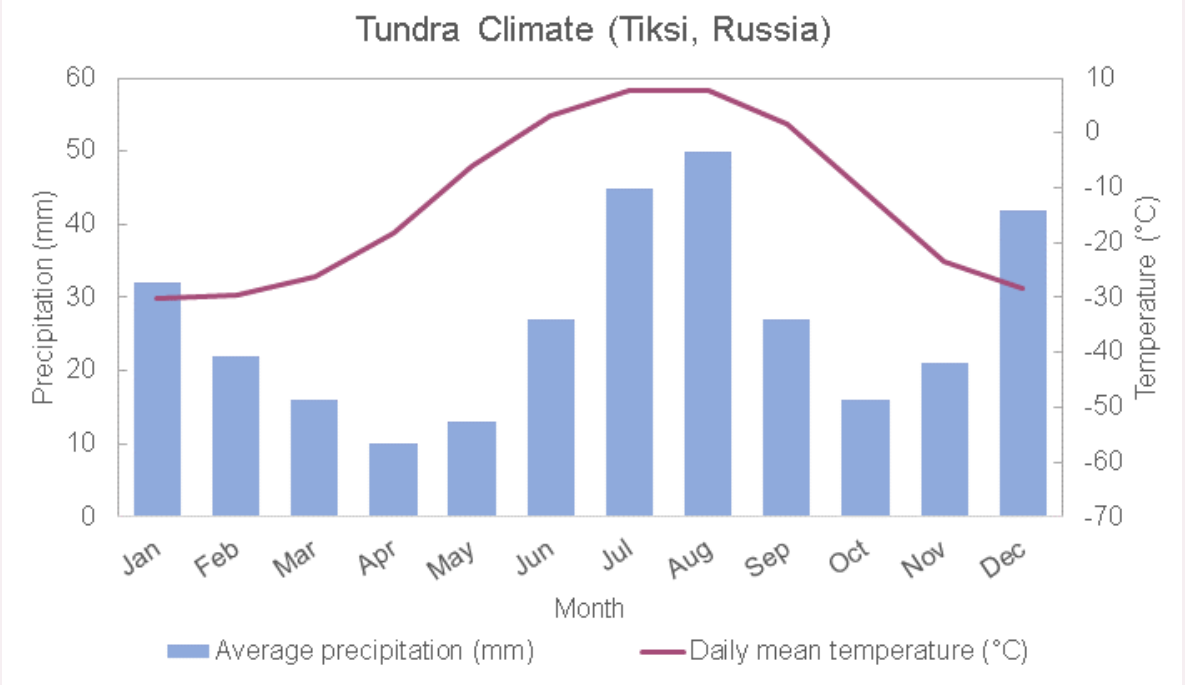
The relationship between **temperature, precipitation and biome type** can be seen in this graph, first created by Robert Whittaker. However, biomes may not always follow this trend as there are **local factors** that influence biome type (such as **topography** or the presence of **wildfires**).



Thinking Further: Comparing Biomes

Climate graphs are a helpful way to **compare different biomes** and visualise how the climate changes **seasonally**. The climate graphs below show two very different biomes: a **tundra** biome and a **tropical rainforest** biome. Compare the two climate graphs to see how these biomes differ and how they change over the seasons.





The Influence of Local Factors on Biomes

As well as the climate, **local factors** also have an influence on **biome distribution**. Local factors are **aspects of the surrounding environment** that cause the ecosystem to **behave differently to how we would expect** in that area given the climate. Local factors include:

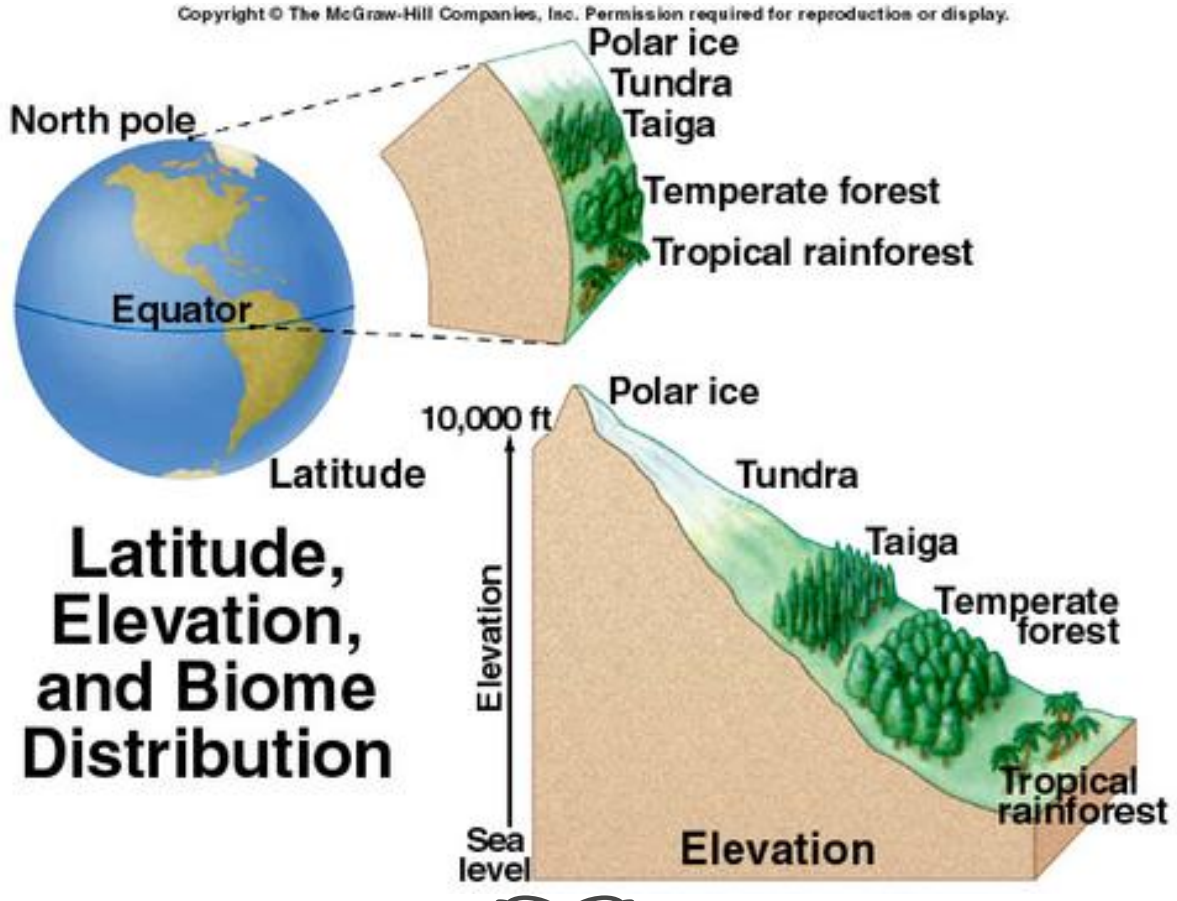
- Altitude
- Rock and soil type
- Drainage

Altitude

Altitude refers to the **height of the land**, measured by **height above sea level** (elevation). As **altitude increases** (e.g. on hills and mountains) **the local climate changes**, creating different biomes. Altitude has the following effects:

- The **temperature** gets **colder with increasing height**. For every 1000m change in height, temperature drops by around 6.5°C. At high latitudes, temperatures can reach below freezing, and stay this cold for weeks (or even months).
- **Precipitation usually increases with height**, which alters the vegetation and soil at different altitudes.

Altitudinal zonation refers to the pattern we see on hills and mountains where the ecosystem changes with increasing elevation. This can be seen in the diagram below, where the vegetation is split into different 'zones' of biomes depending on the elevation. **Patterns of altitude can sometimes mirror patterns of latitude**, which is also shown on the diagram below.



Rock and Soil Type

Rock and soil type can cause major differences in **vegetation and wildlife** in a particular area.

When **rocks** are broken down during **weathering**, **chemicals and nutrients** are released from rocks into soils. These chemicals influence a range of soil factors, such as **pH** and **fertility**, which dictates what type of plants can grow.

The plant to the right is a hydrangea, which grows blue in acidic soils and pink in alkaline soils!

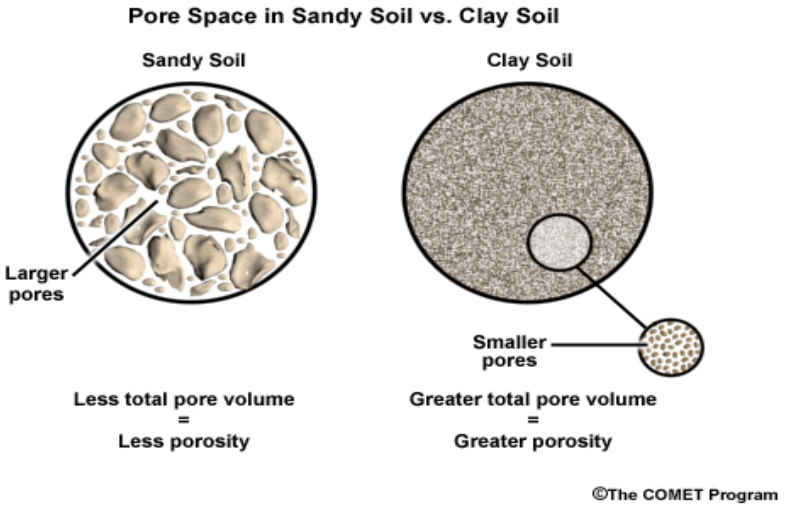
The **bedrock** of an area also influences **soil composition and grain size** (e.g. whether it is a sandy soil or a clay soil etc.), this then affects things like **rock permeability**, **vulnerability to erosion** and **drainage**. All of these aspects can influence biome type.

Drainage

Drainage refers to **how fast water enters and leaves soil**. **Well-drained soils** do not retain excess water, whereas **poorly drained soils** can be left **waterlogged** and **boggy**. Ecosystems adapt to different drainage types (e.g. willow trees are found in waterlogged, marshy areas).

Drainage is influenced by different local factors, such as:

- **Topography and relief** - some areas may receive more water due to the shape of the land, like in valleys.
- **Soil type** - more permeable soils like sandy soils are well-drained, whereas very porous soils (clays) retain water.
- **Amount of vegetation** - trees and plants **intercept and store water**, influencing how wet an area is.
- **Precipitation and temperature** - more precipitation obviously leads to wetter soils, and higher temperatures causes more evaporation.



Biotic and Abiotic Interactions

Within biomes, there are interactions between **biotic components** and **abiotic components**.

- **Biotic components** refer to **living organisms**, such as plants (flora) and animals (fauna).
- **Abiotic components** refer to the non-living **environmental factors** which have influence over the ecosystem such as climate (temperature, humidity and precipitation), light exposure, soil type, rock type, the atmosphere, water availability etc.

Biotic and **abiotic** components **interact with each other** within biomes:

- **Plants** (producers) take up carbon dioxide in the **atmosphere** during photosynthesis and convert it into energy (glucose). They use **energy from the sun** to do this. This energy is **passed through the food chain** into **animals** (primary consumers) when they eat **plants**, and then **carnivores** (secondary consumers) when they eat primary consumers.

Grass (producer) **Rabbit (consumer)** **Fox (consumer)**

- **Plants** give out oxygen during photosynthesis, which is released into the **atmosphere** and **taken up by animals**. **Animals** give out carbon dioxide during respiration, which goes into the **atmosphere** and is taken up by **plants**.
- When **animals and plants die**, they are broken down by **decomposers**. Decomposition releases nutrients into the **soil**, where they are taken back up by **plant roots**.

Dead animal matter **Decomposers** **Plants (producers)**

- **Water falls as precipitation** and is taken up by **plants and animals**. Water is also lost through urinating, respiration or when organic matter decays, where it is transferred **back into the atmosphere**.
- **Water** breaks up rocks through weathering, which releases chemicals into the **soil**. These chemicals are taken up by **plants** and used as nutrients to help them grow. They are then passed onto **animals** when they eat plants, and put back into the **soil** when they decompose.

The Biosphere as a Life-Support System

The **biosphere** is the living layer of Earth between the **atmosphere** (air) and the **lithosphere** (crust) where **all plants and animals are found**. Within the biosphere, we find all of the Earth's **biomes**.

The biosphere is essential for human life as it supports us by providing us with **resources**. These include:

Food and water: Meat, berries, crops, nuts etc.

Energy sources: Fossil fuels, timber (for burning).

Materials: Metal, rock, wood and other raw materials for building, medicine, or to **process into other things** (e.g. cotton for clothes).

Exploitation of the Biosphere

The biosphere is **delicately balanced**, and needs **time to recover** from the use of its **goods and services** (e.g. trees need to regrow, carbon dioxide needs to be absorbed, groundwater stores need to be replenished etc.).

However, **human activities** have been **exploiting** the goods and services at an **unsustainable rate**, meaning the biosphere **cannot recover and regenerate** in a timeframe that **keeps up with these levels of exploitation**. Continuing to exploit the biosphere may **throw off its balance**, potentially removing these goods and services forever.

The biosphere is being exploited by humans for **energy, water and mineral resources**:

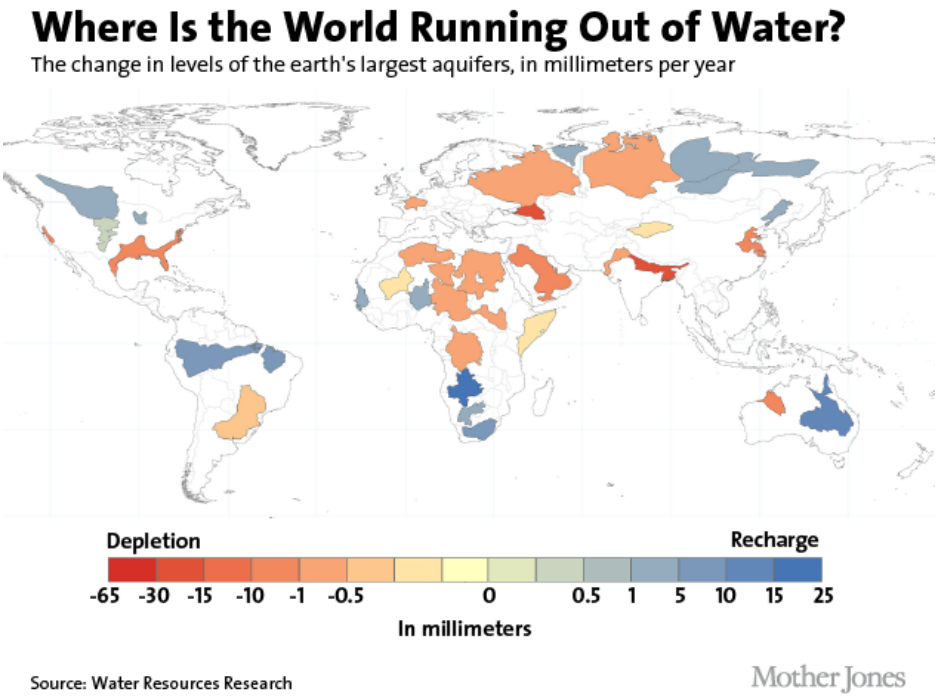
Energy

Within the biosphere, we find our energy supplies of **fossil fuels** (decomposed ancient **organic matter**). Fossil fuels are being extracted at an **unsustainable rate** to meet the energy demands of a growing population.

It takes **millions of years** to produce coal, oil and gas and it is being consumed at a much faster rate. Extraction creates **lasting environmental damage** (e.g. mines) and fossil fuel combustion releases **greenhouse gases** into the atmosphere, which is changing the **delicate balance of carbon** in the biosphere.

Water

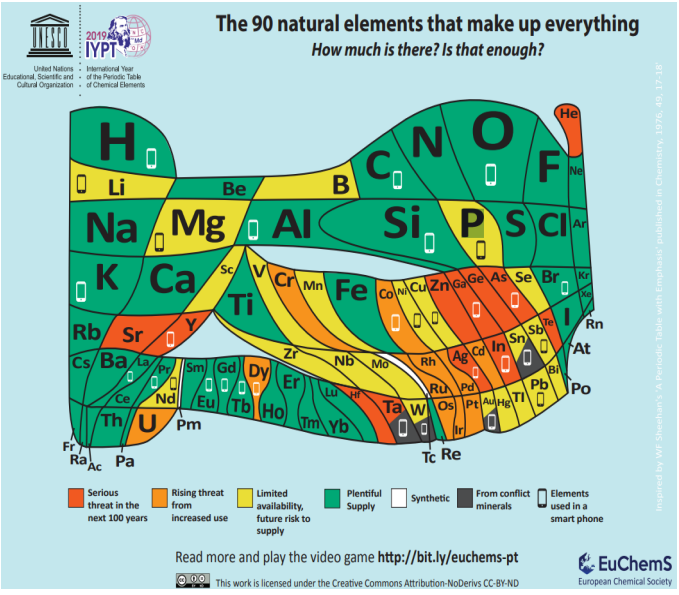
To provide **freshwater** for **drinking and hygiene**, the population requires **long lasting, clean** water. However, water resources are being depleted, which is altering the **hydrological (water) cycle**. Groundwater stores (**aquifers**) are being **depleted** at a faster rate than **replenishment**. This means there is an issue with **water security**, and many places may face water shortages.



Mineral Resources

Mineral resources are naturally occurring elements or compounds that humans use and benefit from. Some minerals can take **billions of years** to form, but are being depleted at a much faster rate for **commercial uses**, for example:

- **Consumer goods** like makeup, jewelry, phones, televisions, etc. require certain minerals to be produced
- **Construction** of buildings and infrastructure needs (e.g. metal, limestone)
- Many **medicines** are derived from minerals
- Some **fertilisers** are made of minerals (especially phosphorus). Crop yields and food supply must rise to support **population growth**, so these fertilisers are in higher demand.



The UK's Ecosystems

The UK is found in the **northern hemisphere** and so it is part of a **temperate biome**. The UK has **four main ecosystems**: moorlands, heaths, woodlands and wetlands.

Source: Tristan Campbell

Moorlands

- Found across the North of England and Scotland at **higher altitudes.**
- The soil tends to be **acidic** and **waterlogged**, making it difficult for vegetation to grow.
- Often used for hill farming and grouse (type of bird) shooting.
- 75% of Europe's moorlands are found in Europe, of which many of these sites are **under protection** (SSSI - Scientific Sites of Interest).

Some examples of vegetation & wildlife found across the Moorlands include:

Heather

Source: Deposit Photo

Grouse

Source: LGIU

Cowberry

Source: Summit Post

Source: BBC

Heaths

- Found in patches across the UK, both in the North and South.
- Headlands are often found near the **coast.**
- **Sandy, infertile acidic soils** and a lack of trees.
- Due to the sandy composition, the soil drains quickly and doesn't become waterlogged (unlike the moorlands).

Some examples of vegetation & wildlife found across the Heathlands include:

Orchid

Source: Pinterest

Hares

Source: Independent

Stonechat

Source: Wildlife in Sight

Source: Telegraph

Woodlands

- The **largest forests** in the UK include Galloway Forest, Kielder Forest and New Forest. They are **rich and diverse**, supporting more invertebrates than any other habitat.
- **High mineral** and **moisture soil content**
- **Seasonal variation** - the leaves will be lost and regrow on a yearly basis.
- Woodlands have a **fast nutrient cycle**, due to the moist conditions.

Some examples of vegetation & wildlife found across the Woodlands include:

Lichen
Source: UWM.edu

Ferns
Source: Explore the Wreckin

Woodland Butterfly
Source: Cheryl Harner

Source: Arcadis

Wetlands

- Found across the UK where water and dry land meet, and are home to many species.
- Soils have different levels of water content, therefore there is a mixture of normal and **pond vegetation**.
- Wetlands are an important part of the **water cycle**, with water filtering into the groundwater stores.
- Also important for the storage of **carbon**.

Some examples of vegetation & wildlife found across the Wetlands include:

Dragonflies
Source: Rowlhouse

Water Vole
Source: Wild Scotland

Curlew
Source: Birdspot

The UK's Marine Biodiversity:

Source: erpfm.com

The UK is an island and the UK Government owns up to **12 miles out** from their coastline. This means that the UK has a large body of water to:

- **Fish** - There are over **5,900 fishing vessels** across the UK waters, but the fishing industry is shrinking. Fishing rights are now frequently being questioned and fought over as a result of **Brexit** and many cannot afford to maintain their ship and crew because they are being outcompeted by cheaper imports.

- **Transport Goods by Boat** - **Container ships** transport imports and exports cheaply, meaning the UK can minimise trade costs. Since the UK **imports** large quantities of its food supplies, access to the sea is crucial.

- **Energy Production** - Many **wind farms** are found offshore (built out at sea rather than on land) since nothing is close by that is tall enough to obstruct the wind. However, the UK could generate 20% of its energy using **tidal power,** which we barely utilise!

Impact of Human activities

People are increasingly degrading the UK's vital marine ecosystems. This has caused a direct threat to the UK's waters. There are three main impacts:

1. **Fishing** - overfishing and unsustainable methods
2. **Pollution** - plastic pollution a threat to fish and birds
3. **Damages to the seabed** - container ships and dredging

Fishing

Some fishermen have adopted **intensive fishing methods**, which is **unsustainable** to the ecosystem and threatening future populations of fish; if too many fish are caught, species may become **endangered** and the fishing industry may die out.

Solution: UK laws are trying to reduce fishing to a sustainable number so stocks don't run out in the future. In addition, there has been the rise of **locally-sourced fish**, with many restaurants and cafes wanting to support their local fishermen. Finally, fisheries are growing fish in **fish farms** such as salmon and carp, so natural stocks aren't impacted.

Pollution

Litter is a rising problem across the entirety of the UK, but especially along the coast. There is a risk that litter may be washed into the sea which would: damage ecosystems, **plastic** can be swallowed by fish and **suffocate birds**.

Source: BBC

Solution: Beach clean ups and **advertising campaigns** to reduce littering on days out. Many coastal communities are coming together to help to protect their coastlines!

Damages to the Seabed:

Finally, there are many **fragile ecosystems** under threat from industry. Large **container ships** will scour the seabed, stripping the sea of natural reefs, seaweed and rockery which marine life lives within.

Dredging used to construct fishing routes also destroys marine ecosystems as it **damages plants and nutrients are removed**. This lowers the amount of food available for aquatic organisms.

Source: Yumping

Solution: Some coastal regions are protected under the law as **Sites of Scientific Interest**. However, many locals are trying to petition to protect their local coasts from heavy boat traffic.

Tropical Rainforests

What is a Tropical Rainforest?

A **tropical rainforest** is a **warm, wet ecosystem** located within the **Tropics** (between the Tropic of Cancer and the Tropic of Capricorn).

The photo to the right was taken in the **Amazon Rainforest**, the world's **largest rainforest**. The **lush, dense vegetation** seen here is extremely typical of rainforests.

(Source: Pete Oxford / Corbis)

Examples of tropical rainforests include:

- Amazon Rainforest, South America
- Congolian Rainforests, Central Africa
- Daintree Rainforest, Australia
- South-East Asian Rainforests, Asia

Tropical Rainforest Characteristics

Like all **global-scale ecosystems**, tropical rainforests around the world have similar environmental characteristics, including their **climate, soil type** (abiotic components) and **plant, animal and human life** (biotic components).

Climate Characteristics

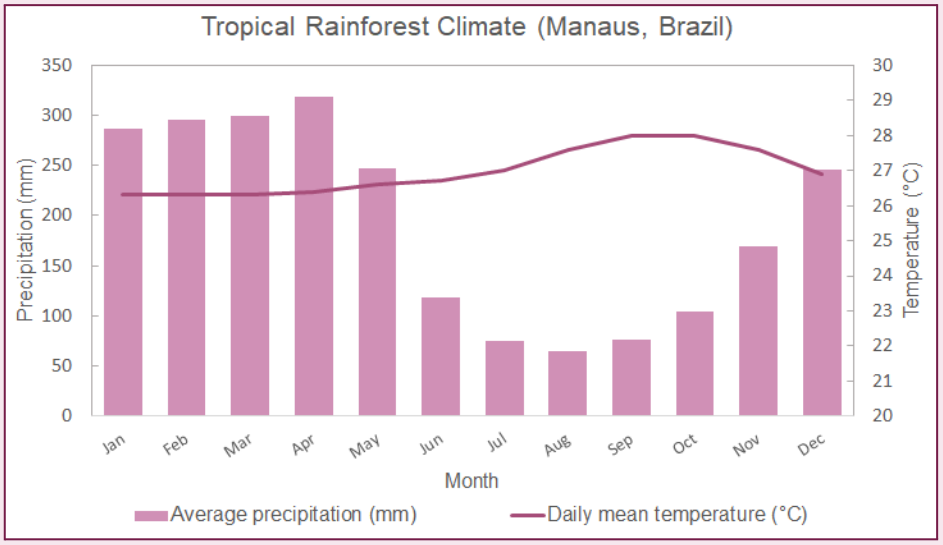
Rainfall

- Tropical rainforests are characterised by **extremely high rainfall**. In fact, tropical rainforests are some of the **wettest biomes in the world**.
- Annual rainfall exceeds **2000mm per year**, which is over **double** the amount of rainfall the UK receives!
- Rainfall is usually **seasonal**, with a distinct **wet season** where monthly rainfall can exceed **well over 200mm of rain**. All of this rain also means tropical rainforests are **very humid**.

(Source: Center for International Forestry Research)

Temperature

- Temperatures in tropical rainforests are **high**, at around 26-27°C.
- Temperatures stay **consistent throughout the year**, with little variation seasonally.
- Temperatures are **high** and **consistent** due to the sun shining **directly on the equator** throughout the year. These patterns of temperature can be seen on the **climate graph** for Manaus in Brazil below.



Soil Characteristics

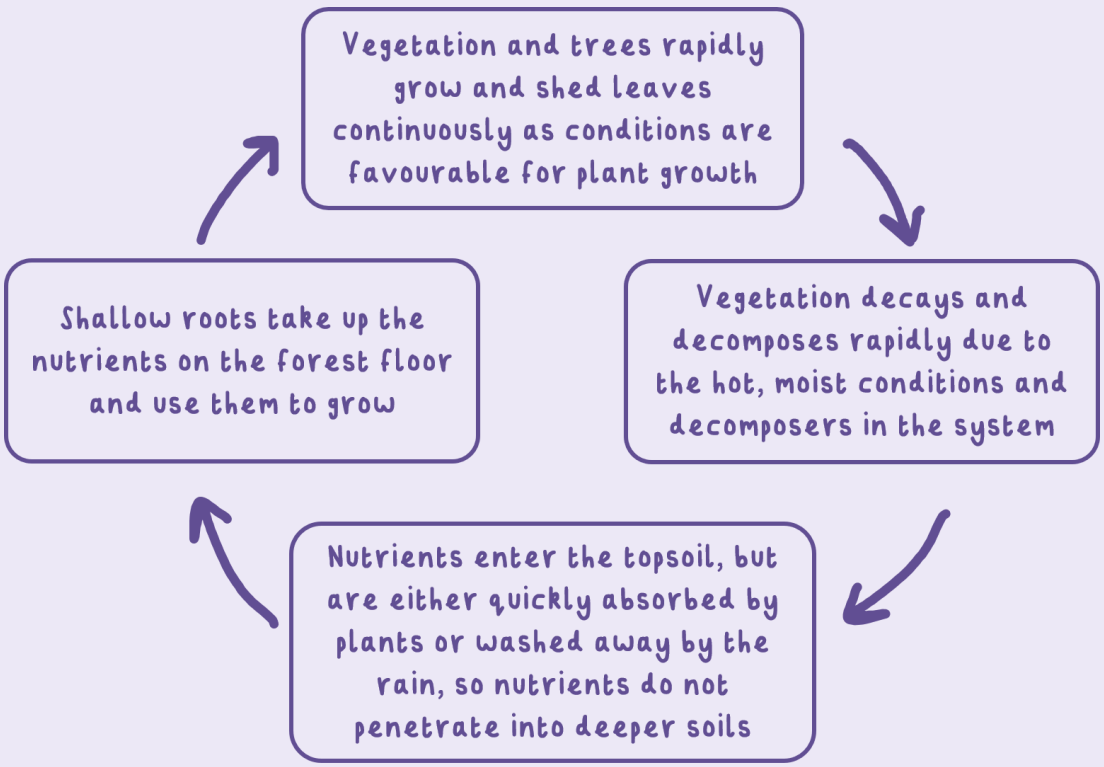
- Despite the **lush vegetation** in tropical rainforests, the soils are actually **extremely nutrient deprived** and **infertile**. This is because nutrients are **washed away and dissolved very quickly** by the intense and continuous rainfall in a process known as **leaching**. This leaves an infertile, iron-rich soil called a **latosol**.

- Plants get their nutrients from the layer of **decomposing organic matter** that sits on the top of the **nutrient poor soil**. Dead plants and animals fall here and are **broken down by decomposers**, sped up by the **hot and humid conditions**. The nutrients released by decomposition are then rapidly absorbed by roots and put back into the living ecosystem.

(Source: earthobservatory.nasa.gov/features/Deforestation)

The **nutrient cycle** in tropical rainforests occurs very **quickly**, which means the nutrients are transported from vegetation (and animals when they eat the vegetation), to the soils, back to vegetation relatively **rapidly**.

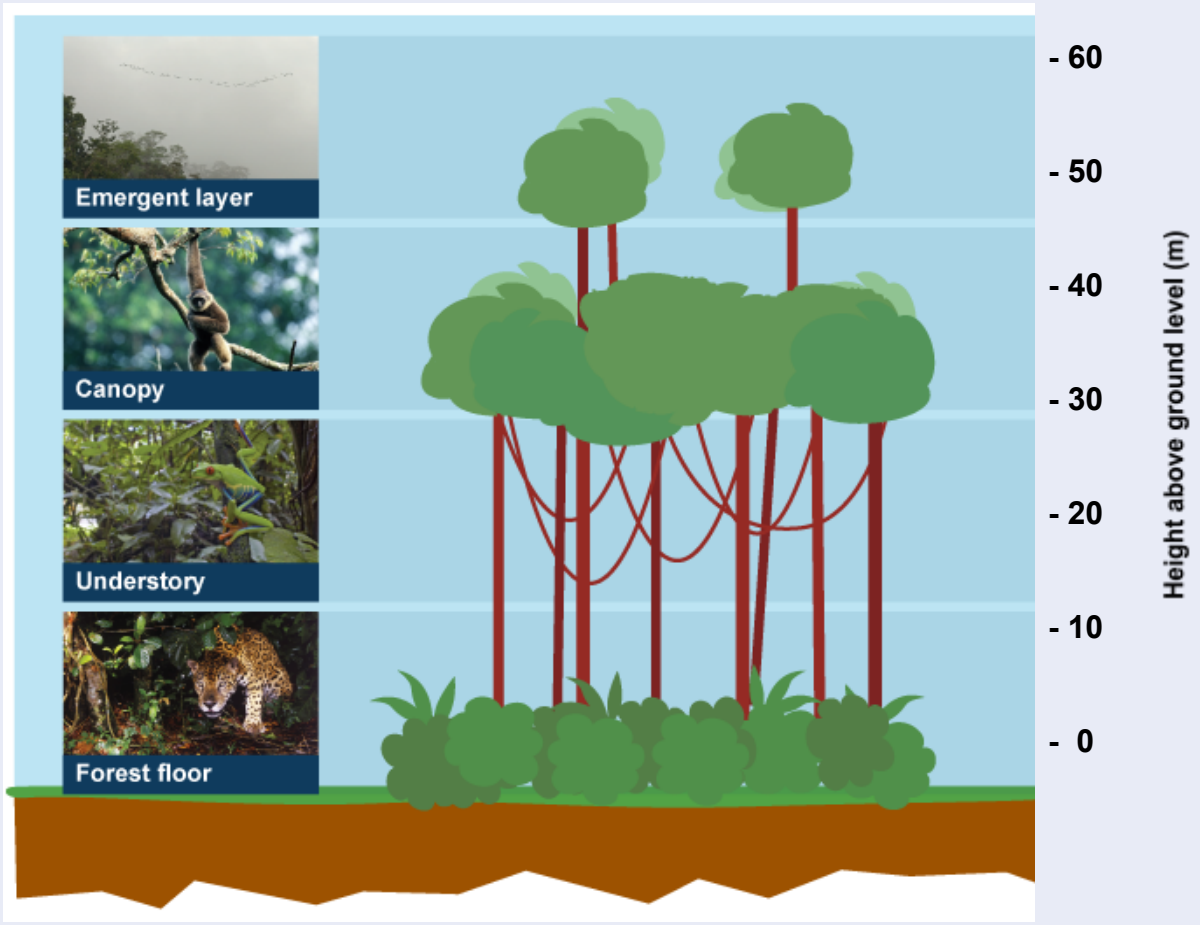
Nutrient Cycling in Tropical Rainforests:



Plant & Animal Characteristics

- The nutrient rich soils and hot, moist climate supports huge levels of **biodiversity** within tropical rainforests. Over half of **all of the world's plant and animal species** are found within this ecosystem.
- The tropical rainforest ecosystem is separated into **layers**, which can be seen in the diagram below.
    - **Birds** and **flowers** live amongst **very tall** fast-growing **trees** in the **upper canopy**.
    - **Mammals** such as monkeys and sloths live in the **canopy**.
    - **Insects, snakes, frogs**, and other animals live in the **understory** beneath the canopy, away from predators on the forest floor. Some predators also hunt in the understory, like jaguars.
    - **Rodents**, larger mammals and **decomposers** (like fungi) live on the forest floor within the decaying organic matter.

Typical Structure of A Tropical Rainforest Ecosystem



(Source:www.bbc.co.uk/bitesize/guides/zpmnb9q/revision/1)

Plant Adaptations

Plants have adapted to the tropical rainforest climate and soils in different ways:

Buttress roots

- These are large, above ground roots that look like **ridges** at the bases of large tropical trees.
- Some trees have adapted to the **nutrient deprived**, waterlogged soils by growing large roots above ground.
- Buttress roots ensure tall trees are kept **stable** without growing roots **far down into the soil**. Having the roots above ground also ensures the roots receive enough **air**.

(Source: https://flic.kr/p/2G6GLW)

Leaf structure

- Some leaves have adapted to the **heavy and consistent rainfall** in tropical rainforests by developing **'drip-tips'**.
- A drip-tip is a **tapered end** of a leaf that allows excess rainfall to quickly drip off the leaf, ensuring plants are not left **too wet**, which can cause rotting.
- Many leaves also have **'flexible'** stems that move to find light, which is important as the **dense canopy blocks light** from reaching lower levels of the rainforest.

(Source:https://flic.kr/p/7ReuBn)

Lianas

- Lianas are **woody vines** that have adapted to the **dark** lower levels of tropical rainforests.
- Lianas have roots that grow **in the ground**, but their vines grow **high up** into the canopy by climbing and wrapping around trees.
- This means lianas can access the nutrients on the forest floor, but can access the light in the canopy.

Epiphytes

- Epiphytes are plants that live on the **surface of other plants**, receiving their nutrients from these plants.
- They have adapted to **growing on trees** high up in the canopy so they receive more **sunlight**, as the forest floor is so dark.

(Source:/Flickr - ggallice - Bromeliads.jpg)

Animal Adaptations

Animals in tropical rainforests have had to adapt to the **physical conditions**, as well as **threats from predators** and **competition for resources** as there are **so many different animals** living in this ecosystem. The **high biodiversity** in this ecosystem means there is a lot of competition.

Poisons and venoms

- Animals have adapted to the threat of **being eaten** by the thousands of predators in rainforests by developing **poisons** or carrying **venoms**.
- Many ants, spiders, snakes and frogs can **paralyse** and **kill** other animals. Some animals sting or bite if they feel **threatened**, whereas others are **poisonous to eat**. The photo to the right is a **golden poison frog**, which holds enough poison to kill 10 people!

(Source: Dirk Ercken/Shutterstock

Physical characteristics

- Animals that **live in trees** have developed adaptations to help them move around and find food.
- **Primates** such as the spider monkey have adapted by developing very **long limbs** and long, **strong tails** to help them swing between trees and avoid predators.
- Some animals have **strong claws** to assist with climbing trees. Geckos have special pads that 'stick' to **leaves and trees** to assist with climbing.

Camouflage

- To hide from **predators**, some animals **camouflage** by blending in with sticks and vegetation. Leaf-tailed geckos have a tail that looks like a **leaf** to camouflage from predators. Look how difficult it is to spot in this image!

(Source:Thomas Marent/Minden Pictures)

Size

- To ensure animals can move through the **dense vegetation**, many have adapted to be a smaller size so they can **move through the growth** easily.
- **Jaguars** found in tropical rainforests are **significantly smaller** than jaguars found elsewhere in the world. The smaller size is advantageous for moving through the dense forest. They usually do not exceed 6 feet in length.

(Source:Getty Images/iStockphoto)

Human Characteristics

Tropical rainforests are a **vital ecosystem for both humans and the environment** due to the various goods and services it provides. This contributes to the immense importance of tropical rainforests in **supporting the planet**.

Tropical rainforests provide many **goods and services** which include:

- **Medicines** - many wild plants and flowers are traditionally used as medicine in Amazonian tribes, communities etc. For instance, the **rosy periwinkle** in the tropical rainforests of Madagascar can help treat childhood leukaemia but can be poisonous. (Source: Southern Living)

- **Raw materials** - logging rainforests to produce **timber** such as **hardwoods** for exporting garden furniture. For example, in Indonesia oil palm plantations cover 7.8 million hectares and **employ over 2 million people**. Palm oil is used in countless products such as cosmetics, food, detergents, confectionery and many more. (Source:Wayfair)

- **Food** - rainforests produce foodstuffs like different **nuts**. Nuts are an important part of the local diet for the people living in the Amazon. (Source: Rainforest Alliance)

- **Cash crops** - the growth of wild, disease-resisting **coffee** generates income for the local people and has a higher abundance than typically used Arabica beans. (Source: Seventeen Goals Magazin)

Tropical rainforests are also **life support systems** for Earth, since they:

- **Regulate the atmosphere** - all tropical rainforests regulate the gases in the atmosphere and reduce the effect of climate change by **taking in the carbon dioxide** through photosynthesis and releasing oxygen. (Source: Rainforest Alliance)

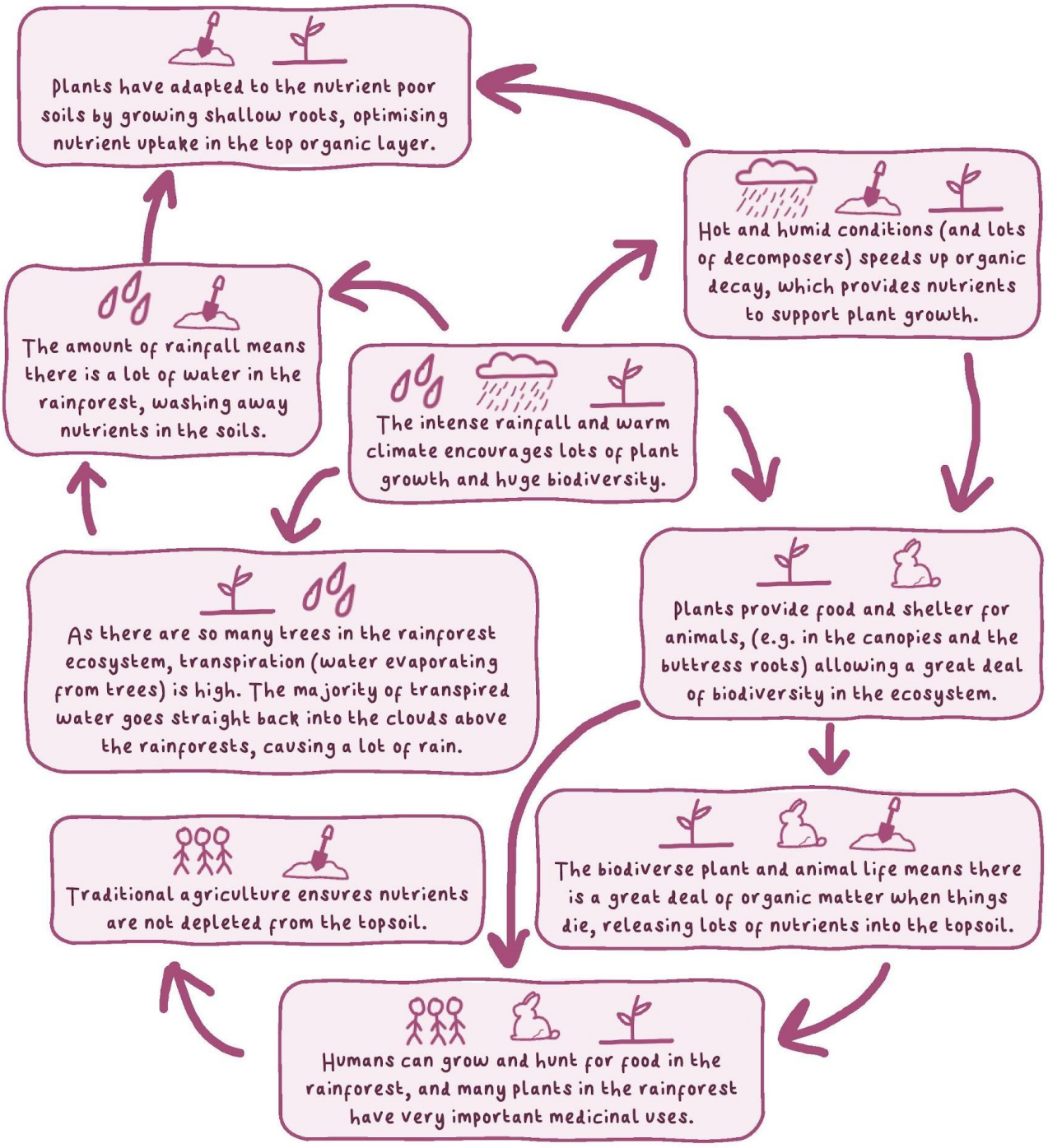
- **Keep the hydrological cycle balanced** - rainforests provide **water** for people. Trees store water by intercepting rainfall and release this water into the atmosphere through **evapotranspiration** (evaporation plus transpiration). The water then falls again as precipitation which provides the people living in tropical rainforests like the Amazon a **continuous supply of water**. Tree roots also **increase infiltration**, because they enable more water to percolate to the groundwater stores and create aquifers.

- **Maintain soil health** - tropical rainforests such as the Amazon have produced rich **fertile top soils** as a result of the **rapid leaf fall and decomposition** in the extremely fast nutrient cycle. Cassava and maize are able to be grown in these top soils and are characteristic of local peoples' diet because they are a staple food. (Source: UGA)

Interdependence in Tropical Rainforests

Within tropical rainforests, the **abiotic** (non-living) and **biotic** (living) factors of the ecosystem **interact with and influence each other**. These complex interactions are important to keep the rainforest ecosystem in a delicate balance.

There are many **examples of interdependence** within tropical rainforests; some examples of the interactions between physical and biological aspects of the ecosystem are outlined below. The arrows indicate the flow of interactions between different components of the ecosystem.



Nutrient Cycling in Tropical Rainforests

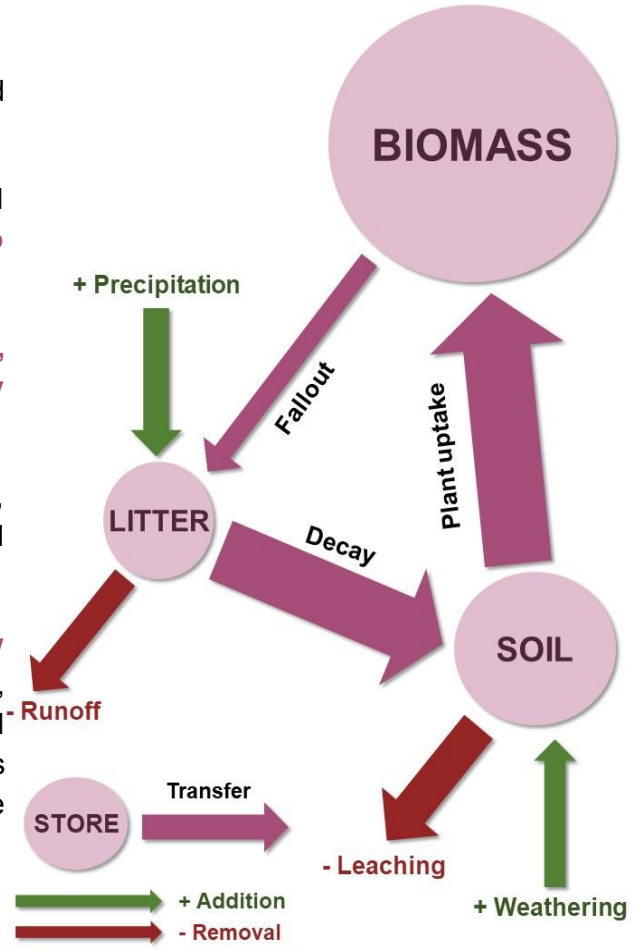
As previously mentioned, there is a **very quick nutrient cycle in tropical rainforests**. This means that nutrients which are very important for the **growth of plants and animals** (like phosphates, potassium, magnesium, and nitrogen) are transferred through the system **rapidly**.

The **rapid rate** of the tropical rainforest nutrient cycle means that there are always plenty of nutrients readily available for plants and animals to use, supporting **high levels of biodiversity**.

The **interactions** within tropical rainforest nutrient cycles and the **reasons why** the nutrient cycle is fast can be illustrated using a nutrient cycle diagram (Gersmehl model):

Stores and Transfers

- Very large **biomass stores** due to the dense, layered vegetation, large trees and high biodiversity.
- Fallout (e.g. dead animals, faeces, leaves, dead plants) is constant, continually adding **nutrients to the litter store**.
- Litter store is small as **decay is so rapid** in **hot, moist conditions**, meaning any litter is **very quickly decomposed** or washed away.
- The majority of nutrients are stored in the **topsoil**, and the rest of the soils are nutrient deprived and heavily leached.
- Plant uptake of is substantial as **plants grow continuously** throughout the year in the hot, moist, sunny conditions. Nutrients are transferred from soil to biomass quickly as there are many plants absorbing nutrients, and growth is accelerated by the climate.



Nutrient Additions

- There are high levels of **precipitation** due to high rainfall levels, **adding nutrients** that are **dissolved in rainwater**.
- **Chemical weathering** is greater due to hot, wet conditions, **releasing nutrients from the rocks** into soils.

Nutrient Removals

- High rainfall means a lot of **litter is washed away** by the rain into rivers.
- Heavy rainfall washes **water-soluble nutrients** from the **soil** in a process known as **leaching**.

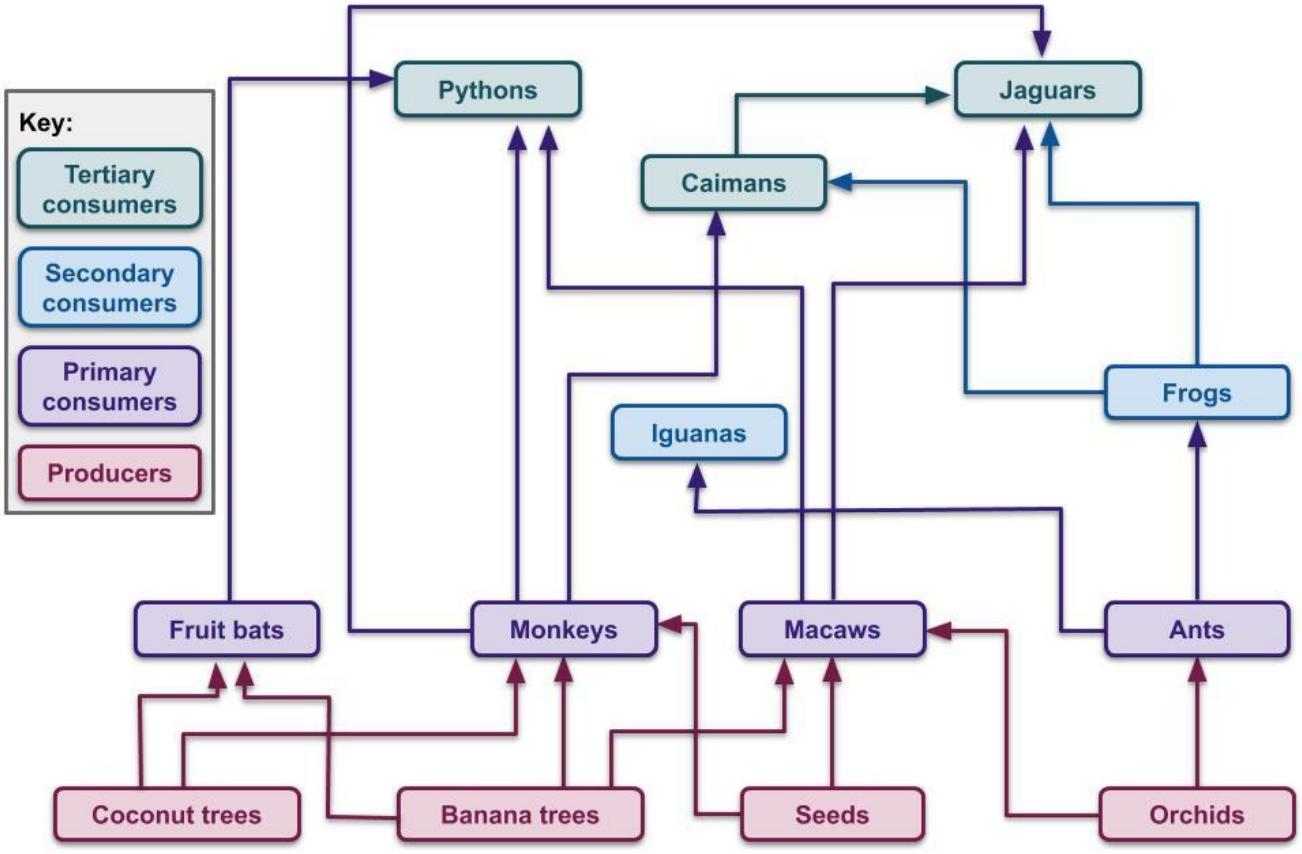
Food Webs in Tropical Rainforests

Food webs show how energy is transferred through an ecosystem, from **producers** to the top **consumers**.

In tropical rainforests, food webs are very complex as there are **thousands of species interacting with each other** in this biodiverse ecosystem.

Some plants and animals are **highly adapted to their environment**, meaning only certain animals are able to eat these species (e.g. a snake could have a natural resistance to a frog's poison), making the food webs even more complex.

The food web below shows how some species interact with each other in a typical tropical rainforest:

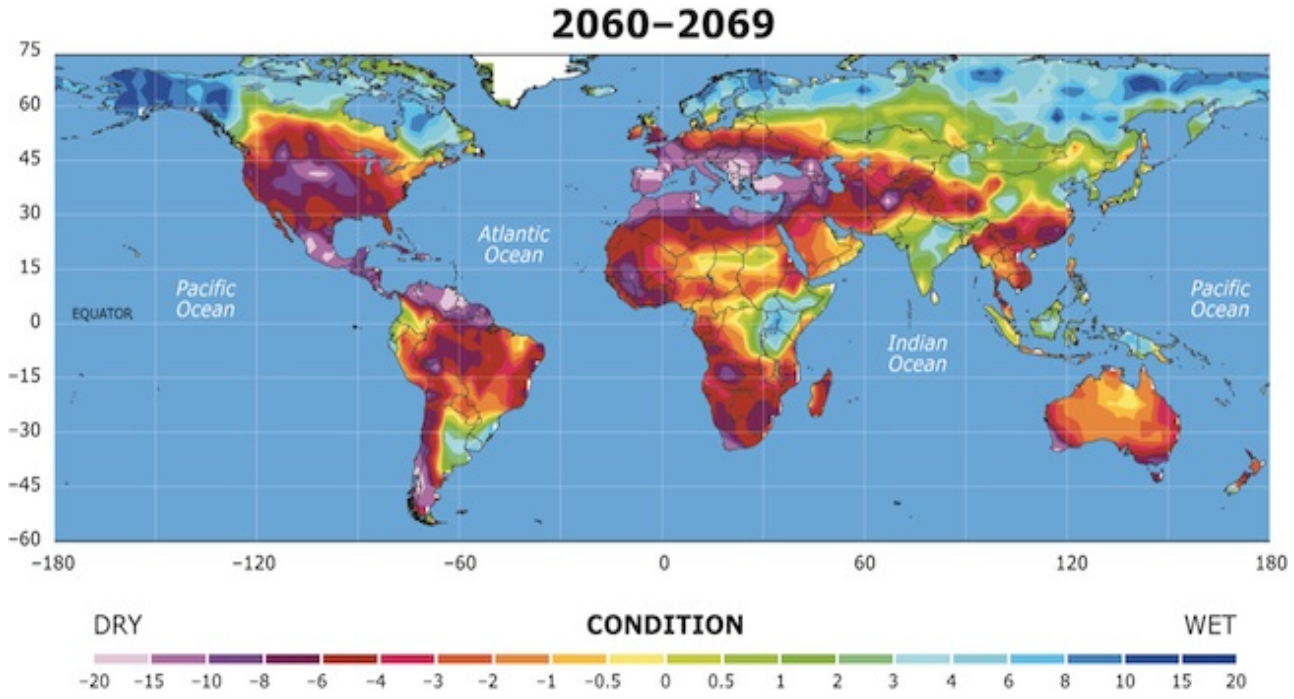


Climate Change and Tropical Rainforests

Indirect threats to tropical rainforests are often harder to manage, which makes them potentially more dangerous than **direct threats** (**deforestation**) outlined later on. The effects of **human-caused climate change** are predicted to **alter tropical rainforest ecosystems** all over the world, and are already having negative effects.

Temperature and precipitation patterns are projected to change in tropical regions. By the middle of the 21st century, temperatures in tropical rainforests may rise by between 2-3°C.
Tropical regions are predicted to become more dry, with **droughts** potentially becoming more severe and prolonged.

The map below shows how tropical biomes are expected to become drier, especially the Amazon.



Changing patterns of **precipitation and temperature** can alter the complex ecosystem, putting stress on different components. For example:

- Prolonged droughts can **dry out the forest floor**, killing **decomposers** and altering the **nutrient cycle**.
- Lack of water can have **severe effects on trees**. **Leaves fall off trees** when they are **dehydrated**, creating gaps in the canopy and thus changing the behaviour of plants and animals that are adapted to the **dark** understory. The **tallest trees** suffer the most, as they cannot transport water high enough when it is dry. This causes the tallest trees to die, fall over, and leave **huge gaps in the canopy**.

(Source: TUM/ Rammig)

- **Flowering and fruiting patterns may alter**, which affects species that rely on these plants, and carnivores that rely on those species.
- **Aquatic habitats** like streams and rivers can **dry out**, having serious consequences on the plants and animals that depend on these areas.
- Droughts can create **forest fire conditions**, which **ravage through areas of tropical rainforests**. The frequency of severe droughts is thought to have increased in recent years; severe droughts have hit the Amazon in 1997-98, 2005, 2010 and 2015-2016, all having devastating forest fires as a result.

(Source: https://rainforestpartnership.org/amazon-wildfires/)

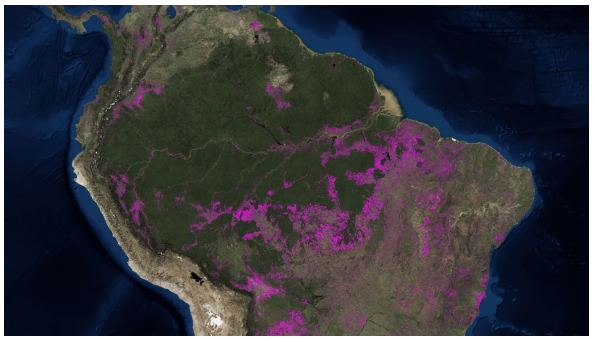
Deforestation in Tropical Rainforests

Deforestation is the **permanent** and usually **large-scale removal of trees**.

Deforestation has been occurring on a **huge scale** in tropical rainforests all over the world, usually for timber or to clear land for agriculture. Deforestation is a major **direct threat** to the delicate **tropical rainforest ecosystem**.

(Source: Mongabay)

It is estimated that overall global rainforest cover has reduced from **6 million square miles to 2.4 million square miles**. In 2019, a football pitch-size patch of tropical rainforest was lost every six seconds.



(Source: Global Forest Watch)

The Amazon Rainforest is estimated to have lost around **17% of forest cover in 50 years**. The majority of this deforestation is due to land clearing for **cattle ranching**, as well as **plantations**. The **purple** on the map to the left shows tree cover lost to deforestation in The Amazon.

Causes of Tropical Deforestation

There are many reasons why deforestation occurs on such a **huge scale** in tropical rainforests. Tropical deforestation has many environmental, social and economic impacts.

Subsistence Farming

Subsistence farming is where farmers only produce enough food for **themselves and their families to eat**, rather than growing **surplus** food for **profit**.

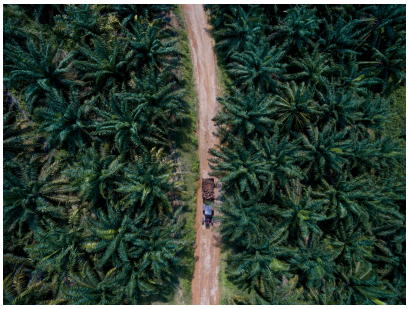
In tropical rainforests, subsistence farmers usually clear land using **slash-and-burn:**

- Farmers **cut down trees** and use the wood for building materials or to sell.
- The land is left to **dry out**.
- The **shrubbery** left behind is then purposefully **burnt**, as this clears the land quickly and **the ash releases nutrients into the soil**.
- After a **few years** of cultivation, the soil becomes **infertile**, so farmers leave the land to recover (usually from 20-100 years) and move to a different area.

(Source: KU Leuven - Pieter Moonen)

This traditional method has historically been **sustainable** as the land has been left to recover. However, with more people moving into rainforest areas, there is **less land available** and some are **not educated** in the subsistence farming practice. Less time is being left for the rainforest to **fully recover** (only 5-8 years) before burning again, permanently altering the ecology of the rainforest. Also, poorly controlled fires can grow out of control and lead to **wildfires**.

Commercial Farming



Unlike subsistence farming, **commercial farming** is agriculture with the direct intention of making **profit** from the produce.

Commercial farming is a massive contributor to tropical deforestation, as huge areas of land are cleared to make space for **plantations** (such as **soy** or **palm oil**) or **cattle ranches** for beef production. Furthermore, a lot of deforestation for commercial agriculture is done **illegally**, often with little consideration for the **environmental impacts**.

Clearing land for palm oil plantations has accounted for **47% of all deforestation on Borneo since 2000.** This has huge environmental consequences, especially for the wildlife. Deforestation and hunting killed nearly **150,000 Bornean orangutans** from 1999 to 2015.

This article by National Geographic questions whether palm oil can ever be cultivated sustainably.
(www.nationalgeographic.com/magazine/2018/12/palm-oil-products-borneo-africa-environment-impact/)

Cattle ranching accounts for up to **80% of all deforestation in the Amazon.** A lot of cattle ranches are set up to satisfy the demand for beef in developed countries like the USA.

Fuel Wood

When **other sources of energy** are not available, **wood** is heavily relied upon as a source of energy for cooking and heating. In **tropical rainforests** where gas and electricity may not be available, communities have cut down large amounts of trees to either use the wood for burning directly, or to process into **charcoal**. Wood as a source of energy accounts for over **90% of rural communities' fuel** in some countries.

Logging

Logging is the process of **cutting down trees for wood**, which is then sold as timber or processed into other products. Logging occurs in rainforests as **tropical hardwoods** are very popular woods and can sell for **high prices**.

Clear felling (or clear cutting) is a form of logging where **all the trees in an area** are cut down, including young trees. This method is more **profitable** as it can be done quickly.

(Source: Romeo Gacad/AFP/Getty Images)

However, there are obviously **huge environmental effects** with this method of logging. **Habitats** are **completely destroyed**, other vegetation is usually severely disrupted and animals are displaced. Also, leaving the land bare exposes the soil to the heavy rainfall, causing **soil erosion**.

Biofuels

Biofuels are fuels produced from **biomass** (i.e. organic matter). Biofuels are increasingly being used as a fuel source across the world as they can **substitute fossil fuels** (coal, oil and gas).

However, huge areas of **land need to be cleared** to make space for crops like oil palm, soy and sugar cane that are eventually processed into biofuels.

(Source: © shutterstock.com)

Mineral Extraction

Some areas of tropical rainforests have vast reserves in **metals, gemstones** and **fossil fuels** which are extracted by **mining** and **drilling**.

Large areas of land need to be cleared for **roads and mines**, which causes severe environmental degradation. The rainforest ecosystem is unlikely to recover from this level of damage and deforestation, leaving vast areas of tropical rainforest bare for hundreds of years.

Energy Development

Itaipu dam on the Brazil–Paraguay border

Hydroelectric power is a rapidly growing form of **energy production** in **tropical rainforests** (**80%** of Brazil's energy comes from hydroelectric power!) as the large rivers and huge drainage basins generate a lot of **water movement**. In order to **harness this energy**, **huge dams** have been constructed in tropical rainforests throughout the world, with many more planned.

Dam construction causes deforestation as **large areas of land need to be flooded** to make reservoirs. As tropical rainforests are very **flat**, a lot more land is flooded than necessary, completely destroying **terrestrial habitats** and **displacing indigenous communities**.

(Source: Ember Stefano/Agefotostock)

Sustainable Management of Tropical Rainforests

To **preserve tropical rainforests** for years to come, sustainable management is necessary:

Selective logging & replanting

Selective logging is the **partial** felling of trees in an area, intended to reduce the **environmental impact of logging** as disturbances are limited. Usually, **only mature trees** are cut down; younger trees are **left in the ecosystem** to grow. Trees are also cut to **fall away from other trees** so they do not damage them, and trees are marked so **illegal logging can be traced**.

Replanting reduces environmental impacts further by preventing **soil erosion** and ensuring **carbon dioxide intake** is not lost. After many years, replanted trees can eventually be felled, meaning this is **a sustainable practice**.

Ecotourism

Ecotourism is a form of **sustainable** tourism that aims to have **reduced environmental impact** and support **conservation** efforts. **Tropical rainforest ecotourism** is becoming more common, as many people want to **visit rainforests** and take part in activities (bird watching, canoeing, wildlife photography etc.) in a sustainable way.

Ecotourism can also **provide income** to indigenous populations **and fund conservation efforts**. For example, The Chalalan ecolodge in Bolivia is ran by an **indigenous community** and is eco-friendly, attracting 1600 tourists a year.

Sustainable Management of Tropical Rainforests

International agreements

Debt-for-nature swaps are agreements where one country **cancels part of the debt owed by another country** in return for the owing country agreeing that they will **conserve and protect their environment**.

The **Tropical Forest Conservation Act** has enabled many debt-for-nature swaps. The US recently **cancelled $30 million of debt** owed by Indonesia in agreement that Indonesia would better protect Sumatra Island, for example.

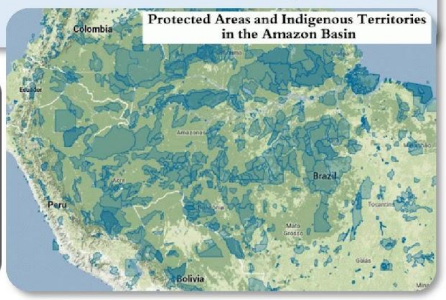
International agreements are also useful ways to spread awareness of issues and collaborate with other countries to find solutions. **The 2006 International Tropical Timber Agreement** works to develop **sustainable sources of tropical hardwood** for trading. Tropical hardwoods are **valuable** as they are are in high demand, which has caused issues surrounding **unsustainable logging**.

Conservation & Education

Designating **protected status** to tropical rainforests **legally enforces protection** by making environmentally-damaging activities illegal. **National parks and nature reserves** are a sustainable way to **allow wildlife to live** undisturbed, and also encourage **tourism** (which is economically beneficial and can **support conservation**).

Educating **consumers** and **companies** on the **environmental impacts** of rainforest products (meat, palm oil etc.) reduces the demand for these products, and encourages brands to use more **sustainable products**.

PALM OIL FREE®



Sustainable Forestry

Sustainable forestry is where forestry activities such as logging are carried out with **low environmental impact**, meaning these activities can continue in the future. Sustainable forestry practices can include many things, such as:

- **Limits** on the amount of trees allowed to be **cut down**, enforced by having **records** for **felled trees** so that every lost tree is accounted for.
- **Selective logging** rather than clear-cutting.
- Tree **replanting** to balance deforestation.
- **Monitoring** forestry businesses and practices, with regulations in place to abide by and inspectors to conduct visits on businesses.

One example of sustainable forestry practices is the **Forest Certification scheme**.
This is where businesses can be **certified** as a sustainable forestry business if they prove their practices are environmentally, socially and economically beneficial.

Region Example: Nordic Countries

This can offer **economic benefits** (e.g. they stand out as a sustainable business during trade) which is especially helpful for **small-scale and family-run forestry businesses**, who account for the vast majority of logging in Nordic countries.

"Finnish forestry is often family forestry: private individuals and families own 60 percent of Finnish forests, and the average holding is only 23 ha" (Source: K. Salonen / FAO)

Although these protection efforts are helpful, their creation and maintenance present challenges:

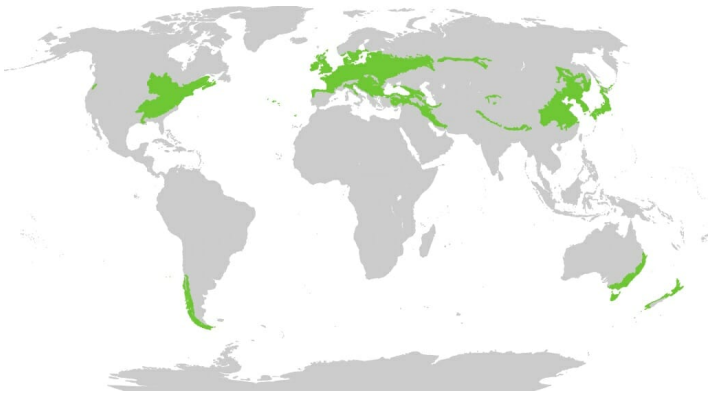
- Taiga forests are **massive areas to monitor**, which requires huge amounts of **time, resources and money**. Some areas are simply too large to properly enforce restrictions.
- There can be **conflicts** between **land-owners and local businesses**, and **governments**. The introduction of new regulations may not go down well with those who have **lived and worked on the land their whole lives** without these rules.
- **Replanting is slow.** Trees take years to grow, especially in the unproductive taiga biome, which means it takes decades for forestry practises to be 'sustainable'.
- **Money and resources** are needed for all of these protection and conservation efforts.

Deciduous Woodlands

Deciduous woodlands are seasonally-varying regions of land with a high density of woodland. Most woodlands can be identified by the types of trees that are found there: broad leaves, a mixture of types of plants and the trees lose their leaves each year.

Deciduous woodlands are found at temperate latitudes - 40 to 60. The woodlands are found across:

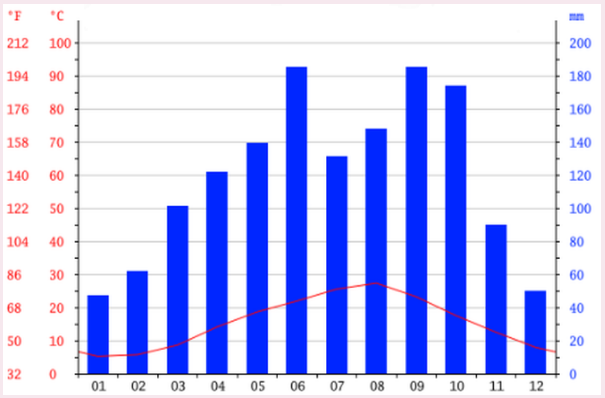
- Europe
- North-East USA
- Eastern Asia



Climate Characteristics

The climate in deciduous woodland regions is **highly seasonal**, meaning it **varies** greatly between **winter and summer months**.

The climate affects other components of the ecosystem, such as **nutrient cycling** and **plant and animal behaviour.**



Winter

- Temperatures remain above zero, so the soil **doesn't freeze** over winter. The rainfall remains high during the year but the rainfall is **four times less** during summer than during the summer.
- Despite this, **vegetation cover** deceases and leaves fall off the trees, to minimise energy loss and moisture loss.

Source: Asia Lenea

Summer

- High levels of **rainfall** and **temperatures**
- **Vegetation cover** has increased largely, with leaves growing back and small plants on the woodland floor.

Source: Sun Surfer

Water

Precipitation is high, between 500-1,500 mm/year. Rain falls throughout the year and supplies lakes, streams and rivers.

Plants

Trees in Deciduous Woodlands typically have large broad leaves, such as oak, beech and elm. These form the **canopy layer**.

Since some light is able to travel through, the **vegetation is layered**. The shrub layer forms beneath taller trees and species such as hazel, ash and holly are found in it. The **ground layer** usually contains grass, bracken or bluebells.

(Source:geograph.org)

Soil Characteristics

Soils and **humus** (dark, organic material that forms in the soil during decomposition**)** in deciduous woodland are rich.

Brown earth (which is **fertile**) is the soil type present in deciduous woodlands. During the Autumn season, leaves fall off from the trees and decompose, contributing to soil nutrients. **Earthworms** in the soil also help to mix the nutrients, and blend the layers within the soil.

Source: Sengis

The roots of trees are **deep**, enabling the break up of the rock below which helps to give the soil more minerals. The trees then take up these nutrients in the soil as they grow. However, more nutrients are put back in the soil when Autumn arrives, through the large **litter fallout**.

Plant and Animal Characteristics

Productivity

Deciduous woodlands have a low productivity, but this varies over the year (productivity reduces over winter). Productivity refers to how much **new plant and animal growth** there is in a given time, usually measured in **grams per square metre per year** (i.e. how much biomass is added in a set area over the course of a year).

- If productivity is **high** in an ecosystem, this means **plants and animals grow a lot**, usually due to there being plenty of **sunlight**, high **temperatures**, sufficient **precipitation** and good **nutrient supply**.
- In the woodland, productivity is low due to **low average temperatures** and **limited sunlight** underneath the trees. However, due to the **high rainfall** there is a high rate of vegetation growth during the summer.

Biodiversity

(Source: Practical Bio)

Biodiversity varies with the **amount of sunlight** available, since the woodland varies in light intensity in many ways:

- The darkest areas & dampest regions can be under **leaf litter** and fallen wood, which is perfect for woodlice and fungi.
- The **canopy** receives the most amount of light, encouraging trees to grow upwards over time.
- Some breaks in the trees' canopy can provide light for **small vegetation** which can provide food for animals such as deer.

In order to survive in this harsh climate, plants and animals have had to **adapt** in special ways.

Plant Adaptations

(Source: The Garden Shop)

To optimise their **plant growth**, plants have had to adapt to receive the largest amount of sunlight and reduce their **loss of water**.

- **Large leaf area** to intercept the maximum amount of sunlight

- **Vines** (such as Ivy) can grow up the trunks of trees to reach sunlight on top of the canopy
- Leaves and branches **grow in all directions**, which makes the trees **symmetrical** in shape. This means that as the sun passes over during the day, the tree will keep receiving light during most of the hours of the day.
- Leaves fall off some plants during the winter to **reduce water loss**. Water can be lost from a plant during **transpiration** through the trees' leaves which will be more difficult to replenish.

Animal Adaptations

There are three ways which animals living in deciduous woodlands have adapted to their surroundings:

Migration

Birds migrate from **colder temperatures** during the winter where vegetation continues to grow and there is an **abundance of food** to survive. The birds will return to the deciduous woodland during the **spring**. For example, British Nightingales travel to Africa during the UK winter months.
(Source: Pinterest)

Hibernation

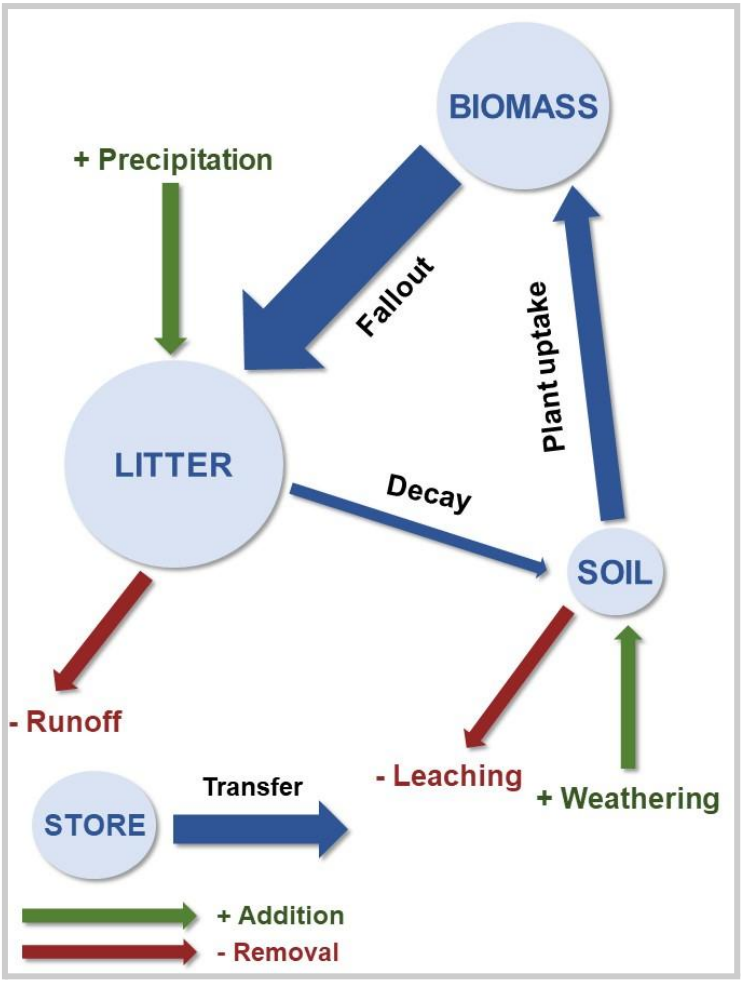
Some animals - often small animals - hibernate to avoid the winter months. **Hibernation** occurs when the animal's body temperature drops, which **reduces energy loss** and so reduces the amount of food and sugars needed. For example, a **hazel dormouse** will hibernate for up to 9 months of the year to survive!
(Source: Country Life)

Food Storage

For animals who don't hibernate, they will need to **stockpile food**. **Squirrels** are the best example of animals that store food during autumn to survive during winter. Many **nuts and seeds** can be kept so that animals don't go without food during the snowy winters.
(Source: Cairngorms Wildlife)

The Nutrient Cycle

The nutrient cycle - also known as the **Gersmehl model** - determines the flow of minerals and biomass around the woodland.
Decomposers in the litter are an important part of the woodland's cycle since the rate of minerals is quick for the **low temperatures** that the woodland experiences.



Stores and Transfers

- The **biomass store** fluctuates during the seasons, since vegetation loses its leaves annually.
- **Fallout** is large due to the leaves falling off the trees, adding **nutrients to the litter store**.
- **Plant uptake is low** as there is low biodiversity and plants only grow when there is enough water available and it is warm enough (late spring).

Interdependence in Deciduous Woodlands

Like many ecosystems, the water, soil, climate, animals and humans are all interdependent within deciduous woodlands. Interdependence means that **changes in one factor** (e.g amount of rainfall) **triggers changes in others** (e.g. soil moisture).

These factors are connected by the nutrient cycles and the **water cycle in deciduous woodlands** where trees take up water and nutrients from the soil. During photosynthesis, oxygen (which **animals and humans require to breathe**) is released. In the Autumn season, leaves fall from trees, decompose and return nutrients to the soil.

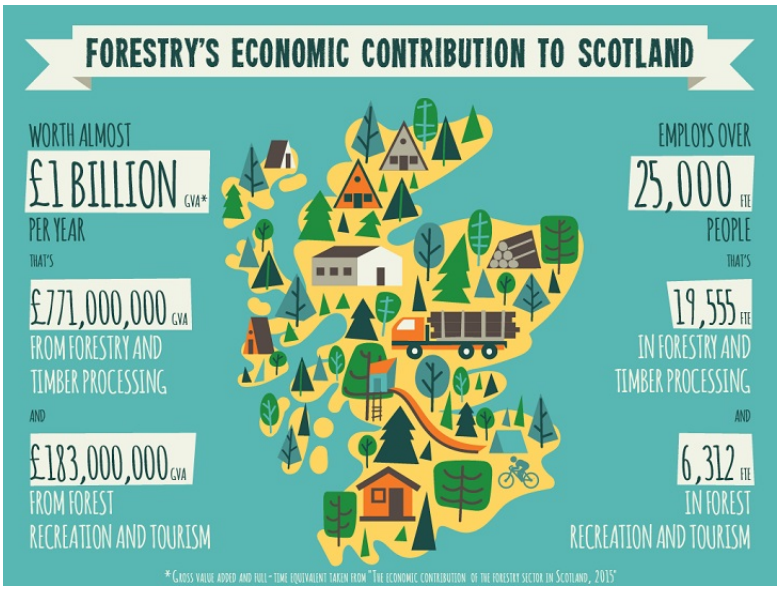
Deciduous Woodlands are **sheltered** - the wind does not spread their seeds. So instead, **animals disperse seeds** in their faeces and then grow into new plants. For example, **ants** can also carry seeds from the forest floor to their nests. This aids the distribution of seeds across the forest.
(Source: The Daily Ant)

Goods & Services provided by Deciduous Woodlands

Logging

Wood is the primary resource for deciduous forests.
Timber is grown and felled in parts of the deciduous woodland, since timber is a primary resource for construction.
In the UK alone, **12 million tonnes** of timber is produced each year.

(Source: Scotland Forestry)



Recreation

Deciduous woodlands are important to the local and national **community**. Many countries have a strong **sense of identity** due to the woodlands, such as the English legend of Robin Hood. In addition, there are huge **mental health** benefits of exercise in nature.

The woodlands are home to:

- Walking and cycle paths
- Woodland adventure parks for family days and team building
- School trips and educational trips

Conservation

Deciduous woodlands tend to be **protected environments** since more land is being built on due to urbanisation. Woodlands in the UK are home to some **endangered species** and habitats:

- The **red squirrel** is endangered, due to an alien species outcompeting the red squirrel (the grey squirrel from America).
- **Pine Martens**, which were hunted for sport during the 19th Century.

(Source: Coniferous Forest)

Direct Threats to Deciduous Woodlands

Deciduous woodlands are also under threat from human activities, especially **commercial activities** which have exploited this ecosystem. There are both economic and **social causes** for exploitation and deforestation.

- ➔ **Direct threats** are a clear link between one thing occurring and the damage it causes to another.
- ➔ **Economic Causes**: timber extraction and agricultural change
- ➔ **Social Causes**: urbanisation and population growth

According to the Wildlife Trust, there are approximately **240,000 hectares of lowland mixed deciduous woodland in the UK**. However, the original expanse of woodland has actually drastically decreased by **40% since 1935**. This is due to clearance to make way for development and agriculture. For instance, some ancient woodland was deforested after WW2 to provide building materials (e.g. for houses). This was replanted by the Forestry Commission, as conifer woodland, which has had a negative impact on wildlife since it is not the original deciduous woodland that provided a specific habitat for wildlife.

Deciduous woodlands are a source of **wood** - timber and an array of other resources which are extracted by felling the area. The expansion of producing timber to build houses is a direct threat to deciduous woodlands. As a result of the **housing demand from the expanding UK population**, woodlands are sacrificed for building wider roads due to rising car ownership and expanding cities. (Source: Woodland Trust)

Climate Change and Deciduous Woodlands

- As Climate change leads to warmer temperatures, species must respond and adapt if they are to survive.

- Climate change poses a threat to deciduous woodlands by potentially **reducing biodiversity levels**. Since pests are beginning to survive milder winters caused by **warmer temperatures**, diseases threaten the survival of deciduous woodland species. Climate change could also significantly **alter the structure of deciduous woodlands**. This is because increasing temperatures and a drier climate are making conditions more suitable for coniferous trees rather than trees like oak, beech, birch and maple that belong in deciduous woodlands. (Source: Woodland Trust)

Sustainable Use and Management of Deciduous Woodlands

Case study: Epping Forest

Epping Forest (located in North-East London) is an example of a deciduous forest.

The forest is maintained to preserve wildlife and its historic landscape and is used by visitors for recreation, leisure etc.

These include:

- Walking
- Horse riding
- Cycling
- Fishing in the larger ponds and lakes
- There are also 60 football pitches and an 18 golf course

(Source: The Times)

Epping Forest is a site of special scientific interest **(SSSI)** and is managed by the **City of London Corporation** which legally protects the trees.

However, it is challenging to manage and balance keeping the forest an open resource for visitors alongside conserving and maintaining the wildlife and forest.

Pollarding is an example of a traditional management technique which encourages new growth, and maintains the trees for future generations. This is a form of **sustainable management** in the woodland and also attracts **birds to nest**.

Dead wood is left to rot because it supplies **fungi and encourages wildlife**. Some grassy areas are left uncut to attract butterflies.

The areas where biking and horse riding occur are clearly marked and separated which **reduces damage to other areas of the forest**.