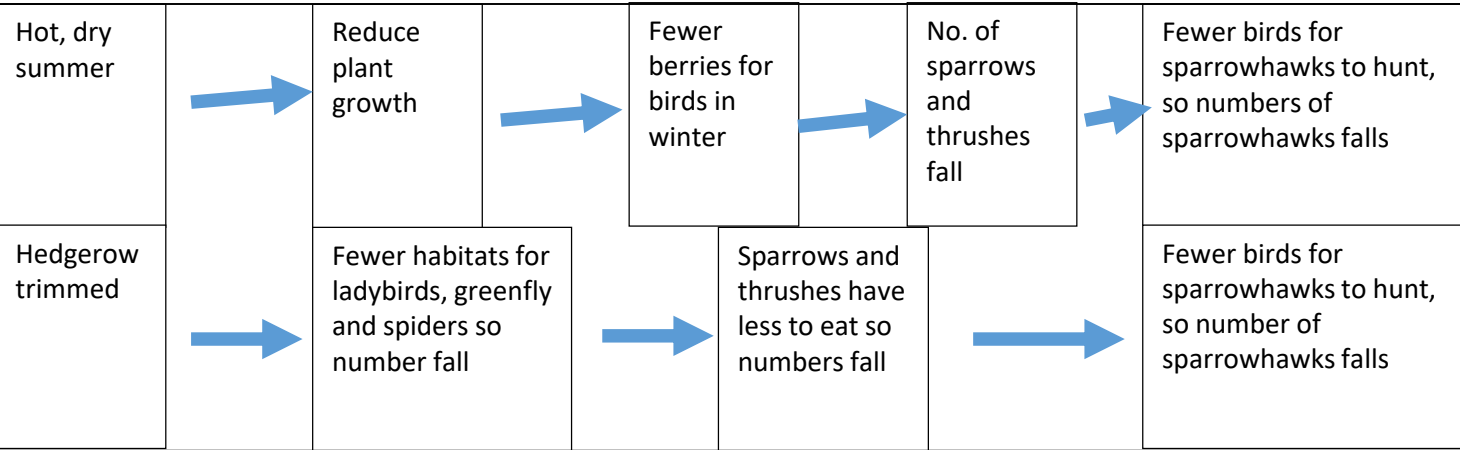


Ecosystems

Example food chain: Ladybird -----> Sparrow -----> Sparrowhawk

Changes to an ecosystem

• A change in one part of an ecosystem has an impact on other parts



Global Ecosystems – distribution = where are they found? How are they spread out?

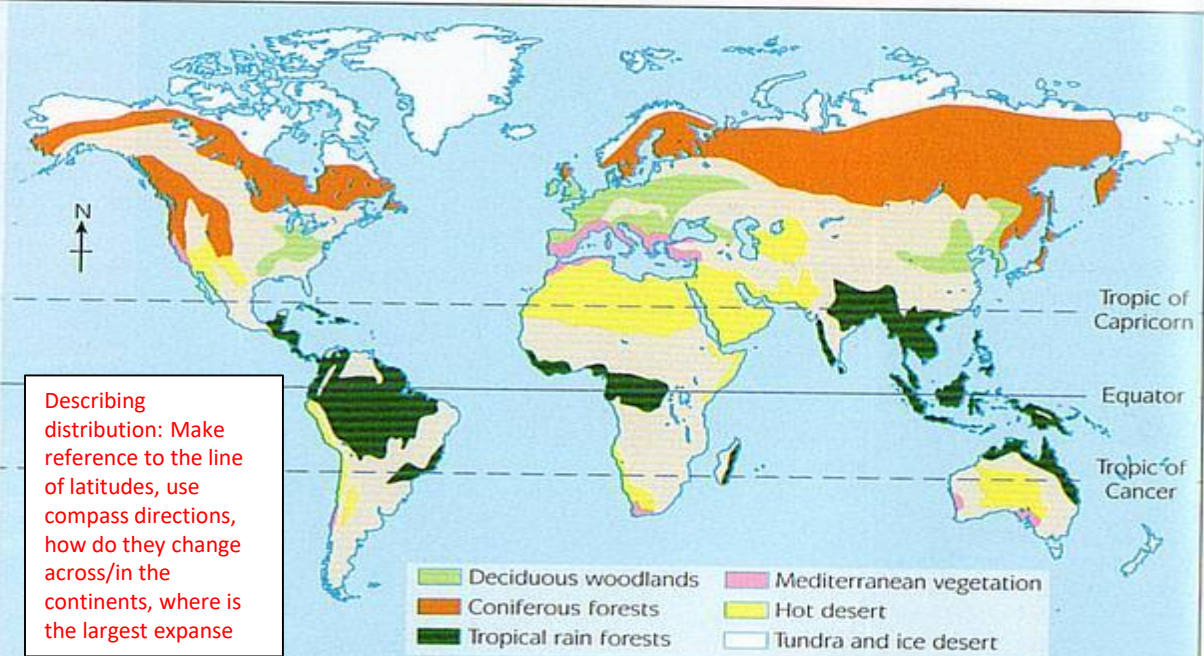
Tropical rain forest
Climatic summary. Hot all year – average temperature 27–30°C. Wet all year – annual precipitation 2000–3000mm

Hot desert
Climatic summary. Very hot most of the year – above 30°C. Low annual rainfall – below 250mm

Mediterranean vegetation
Climatic summary. Hot summers – about 25°C. Mild/warm winters – about 10°C. Dry in summer, wet in winter. Annual rainfall total – about 750mm

Deciduous woodland
Climatic summary. Warm summers – about 18°C. Mild/cool winters – about 5°C. Precipitation all year – about 1000mm

Coniferous woodland
Climatic summary. Warm summers – 16–20°C. Very cold winters – well below freezing point. Precipitation mainly in summer – low annual total – less than 500mm



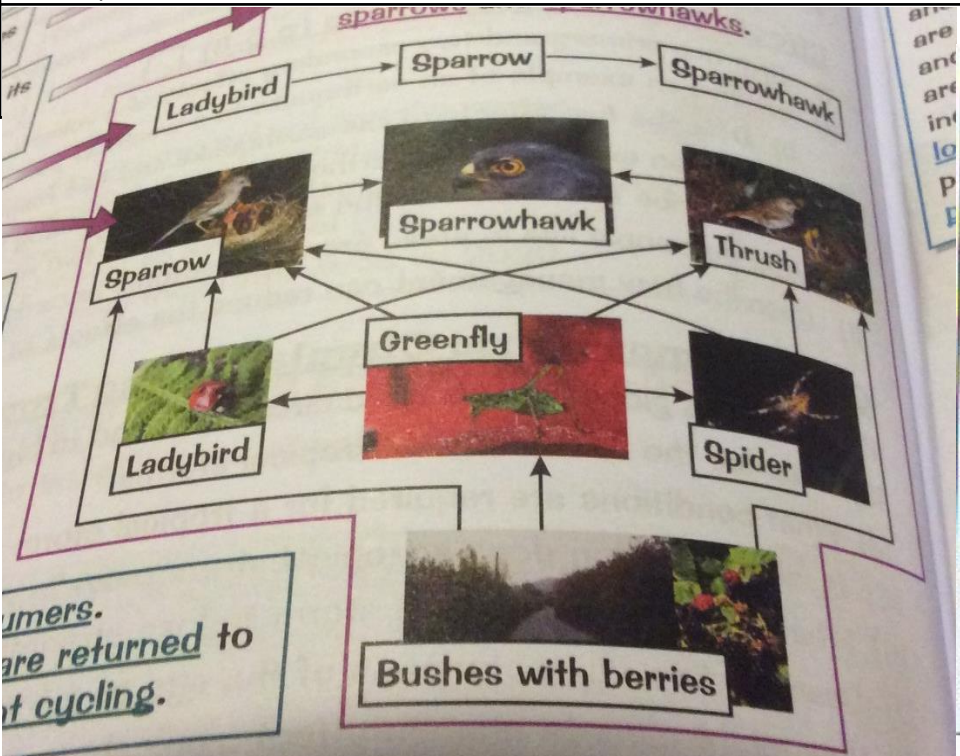
What is an ecosystem?

- An ecosystem includes all the living and non-living parts in an area
- Organisms can be classed as producers, consumers or decomposers
 - Consumers get their energy by eating other organisms
 - Producers create their energy from the sun
 - Decomposers get their energy from breaking down dead material
- A food chain shows what eats what
- A food web shows lots of food chains and how they overlap

Topic: Ecosystems Context: A small-scale ecosystem

Basic information:

- A hedgerow ecosystem includes
 - the plants that make up the hedgerow
 - the organisms that live in it and feed on it
 - the soil in the area
 - the rainfall and sunshine it receives
- The producers include hawthorn bushes and blackberry bushes
- The consumers include song thrushes, ladybirds, spiders, greenfly, sparrows and sparrowhawks

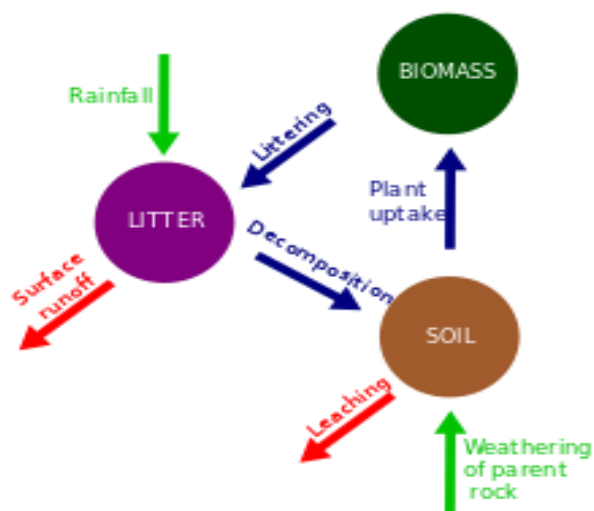


<p>Climate</p> <ul style="list-style-type: none"> • Same all year round with no definite seasons • Hot between 20-28 degrees – varies by a few degrees each year • Sun overhead all year – on the Equator • Rainfall is very high – 2000mm + per year – rains every day 	<p>Soil</p> <ul style="list-style-type: none"> • Not very fertile • Heavy rain washes out the nutrients • There are nutrients at the surface due to decayed leaf fall, but this layer is very thin as decay is fast in the warm, moist condition 	<p>Plants</p> <ul style="list-style-type: none"> • Most trees are evergreen (don't drop their leaves) • To take advantage of the constant sunlight and continual growing season • Trees are really tall and vegetation cover is dense • Very little light reaches the forest floor
<p>Animals</p> <ul style="list-style-type: none"> • Rainforests are believed to contain more animal species than any other ecosystem • Lots birds and insects 	<p>People</p> <ul style="list-style-type: none"> • Rainforests are home to many people who have adapted to life there over many generations • They survive by hunting and fishing gathering nuts and berries and growing vegetables in small garden plots 	

All parts of the ecosystem work together and are dependent on each other – if any one of them changes, everything else is affected:

- The warm and wet climate means that dead plant material is decomposed quickly by bacteria and fungi on the forest floor. This makes the surface soil high in nutrients, meaning plants can grow quickly and easily
- Plants pass on their nutrients when they are eaten by animals. The dense vegetation provides lots of food, so animal populations are high. Many plants and animals rely on each other to survive
- Changes to the rainforest, such as people reducing tree cover by deforestation, can have knock-on effects on the whole ecosystem. For example reducing the amount of CO2 being absorbed from the atmosphere adding to the greenhouse effect
- Trees also intercept and take up lots of water, and release it back into the atmosphere, providing moisture for further rainfall. Deforestation means the climate may change, and the risk of drought increases, affecting plants and animals that live in the ecosystem

Nutrient cycling



Biomass – the weight of all living material
 Nutrients are taken up from the soil and turned into leaves. The leaves fall from the tree to form 'litter' on the floor. The leaves decompose (broken down) and the nutrients are returned to the soil.
 Nutrients can be added to the cycle through rainfall and the weathering (breaking up) of the rock. Nutrients can be lost through surface run-off and leaching (nutrients are washed out of the soil).
 It is an example of a recycling system as the nutrients are converted into different forms and moved around

Rainforests have very high biodiversity

- Biodiversity is the variety of organisms living in a particular area – both plants and animals
- In rainforests it is extremely high – around half of all life on Earth
- Stable and productive environments as it is hot and wet all year round. Plants and animals do not have to cope with changing conditions and there is always plenty to eat
- Many species have evolved to depend on a specific habitat and food source
- Deforestation and uncontrolled development of the rainforest are likely to lead to extinction of many species and a loss of biodiversity

Adaptations

Plants in the rainforest are adapted to cope with high rainfall, high temperature and competition for light:

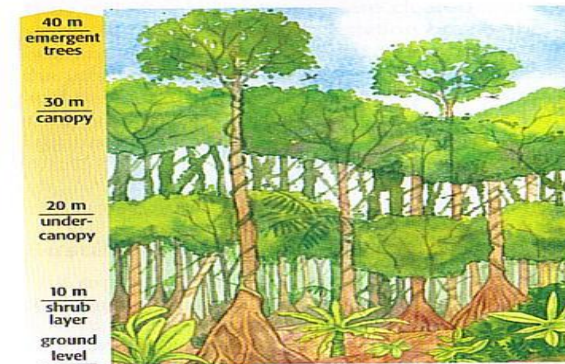
- Tall trees have buttress roots to support their trunks
- Plants have thick, waxy leaves with pointed tips (drip tips) which channel water to a point so it runs off – that way the weight of water doesn't damage the leaf. Waxy coating repels rain water
- Trees have smooth, thin bark – no need to protect the tree from cold temperatures. As it is smooth water runs down to the roots easily
- Four distinct layers:
 - Emergents – tallest trees – only branches at the crown so they get the most light
 - Canopy – lots of trees here
 - Undercanopy – large leaves to absorb as much light as possible
 - Shrub layer/forest floor – adapted to cope with little light
- Climbing plants such as lianas, use the tree trunks to climb up to the sunlight

Animals are adapted in different ways so that they can find food and escape predators:

- Many animals spend their lives in the canopy – strong limbs to go climbing and leaping (monkey)
- Some have flaps of skin so they can glide/fly between trees
- Frogs have suction cups on their feet to help them climb
- Birds have short wingspans to fly between the trees
- Some are camouflaged – they can hide from predators (lizards)
- Many are nocturnal - move at night when it is cooler to save energy
- Some have a strong sense of smell to find food on the dark forest floor
- Jaguars can swim in the river channels

Ecosystems

Explaining the rainforest structure



The way the rainforest is divided into four distinct layers is all due to the availability of light, which all plants need for the process of photosynthesis.

The **emergent trees** and those in the **canopy** receive most of the light and therefore grow tall.

Below the canopy, competition for sunlight is fierce. Trees in the **under-canopy** are shorter, as they are in the shade, but they are waiting for their chance to take advantage of the next light space to become available.

Only 1% of sunlight reaches the forest floor, so growth in the shrub layer is more limited.

Deforestation

Deforestation is the cutting down of trees and the main threat to tropical rainforests

Causes:

- Population pressure – as the population increases in the area – more trees are cut down to make land for new settlements
- Mineral extraction – minerals are mined and sold to make money
- Energy development – building dams to generate hydro-electric power floods large areas of forest
- Commercial logging – trees are felled to make money. Road building for logging also requires more tree clearance
- Commercial farming – forest is cleared to make space for cattle grazing or for huge palm oil or soya plantations
- Subsistence farming – forest is cleared so farmers can grow food for themselves and their families

Rate of deforestation is changing

Rate is very high

Globally the rate seems to be slowing down but there are still hotspots where the rate of deforestation is increasing

Brazil has reduced its deforestation rate since 1990

CASE STUDY

Topic: Ecosystems		Context: Tropical rainforest – causes, impacts/effects and management	
Location:			
<ul style="list-style-type: none"> The Amazon is the largest rainforest on Earth – covering an area of around 8 million KM squared, including parts of Brazil, Peru, Colombia, Venezuela, Ecuador, Bolivia, Guyana, Suriname and French Guiana 			
Deforestation – Causes:			
<ul style="list-style-type: none"> Since 1978, over 750,000 km squared (more than three times the size of the UK) has been destroyed by deforestation There are lots of causes – for example between 2000 and 2005: <ul style="list-style-type: none"> 65-70% was caused by commercial (cattle) ranching 20-25% was caused by small-scale subsistence farming <ul style="list-style-type: none"> Many farmers have been settled by the Brazilian government 5-10% was caused by other commercial farming – mostly soy farming, but rice, corn and sugar cane are also grown 2-3% was caused by logging, including lots of illegal logging. New roads have opened up areas of forest that were previously too hard to get to 1-2% was caused by other activities such as mineral extraction (e.g. gold mining), road building, energy development and building new settlements Population growth and migration to the area is also putting pressure on the Amazon rainforest, especially as the Brazilian government offer land in the rainforest to poor people from overcrowded cities. There are many more small-scale subsistence farmers now, and people who have no land or whose land has become unproductive are opening up more areas of the forest. 			
Deforestation – impacts/effects:			
Environmental:			
<ul style="list-style-type: none"> The Amazon stores around 100 billion tonnes of carbon – deforestation will release some of this as carbon dioxide, which causes global warming Brazil is losing 55 million tons of topsoil every year because of soil erosion caused by soy farming Pollution of rivers from the chemicals used in mining Loss of many plant and animal species and a reduction in biodiversity 			
Deforestation – impacts/effects:			
Economic:			
<ul style="list-style-type: none"> Economic development as brought wealth to countries that were very poor Farming makes a lot of money for countries in the rainforest, e.g. in 2008, Brazil made \$6.9 billion from trading cattle. It is also the world's second biggest exporter of soy beans The mining industry creates jobs for lots of people, e.g. the Buenaventura mining company in Peru employs over 3100 people Logging contributes a huge amount to Brazil's economy Local Brazilian rubber tappers who extract natural rubber from rubber trees have lost their livelihoods as trees have been cut down 			
Sustainable management in the Rainforest:			
Method	What is it?		
Selective logging	<ul style="list-style-type: none"> Only some trees (e.g. just the older or inferior ones) are felled - most trees are left standing This is less damaging to the forest than felling all of the trees in an area. If only a few trees are taken from each area the overall forest structure is kept – the canopy's still there and the soil exposed. This means the forest will be able to regenerate so it can be used in the future The least damaging forms are 'horse logging' and helicopter logging' – dragging felled trees out of the forest using horses or removing them with helicopters instead of huge trucks 		
Replanting	<p>This is when new trees are planted to replace the ones that are cut down</p> <p>This means there will be trees for people to use in the future</p> <p>It's important that the same types of tree are planted that were cut down, so that the variety of trees is kept for the future</p>		
Education	<ul style="list-style-type: none"> Education of the international community about the impacts of deforestation can encourage people to buy products that are certified from sustainable managed sources Some local people don't know what the environmental impacts of deforestation are. Local people try to make money in the short-term (e.g. by illegal logging) to overcome their own poverty Educating local people about the impacts of deforestation and ways to reduce the impacts decreases damage to the rainforest environment Also, educating local people about alternative ways to make money that don't damage the environment as much, e.g. ecotourism, means they aren't dependent on unsustainable options in order to make a living 		
Conservation	<ul style="list-style-type: none"> Many countries have set up national parks and nature reserves within rainforests. In these areas damaging activities, e.g. logging are restricted. However, a lack of funds can make it difficult to police the restrictions 		

Map of tundra and polar areas

Cold environments – tundra and polar



Climate:

Polar areas are very cold, temperatures are never normally above 10 degrees. Winters are normally below -40 degrees and can reach -90 degrees

Tundra areas are also cold – temperatures in the warmest month are a maximum of only 10 degrees and winters can reach around -50 degrees

Rainfall (and snowfall) is low – no more than 100mm a year in polar areas and 380mm or less in tundra areas (mainly in the summer)

There are clearly defined seasons – cold summers and even colder winters

Animals:

There are relatively few different species of animals compared with other ecosystems

Polar bears, penguins and marine mammals like whales, seals and walrus are examples of animals found in polar regions

Lemmings, Arctic hares, wolves and reindeer are all animals that live in tundra areas

Soil:

Polar environments are covered by ice sheets, so there is no soil exposed and few plants and animals

Soil in tundra environments is thin and acidic and not very fertile

There is normally a layer of permanently frozen ground called permafrost beneath the thin soil – the permafrost layer contains large amounts of trapped greenhouse gas

People:

Polar environments are almost uninhabited. A few scientists live on Antarctica for short periods. Some indigenous people live in Arctic regions
Tundra environments are home to many people including indigenous peoples, and oil and gas workers in larger towns

Plants:

There are very few plants in polar areas – some lichens and mosses are found on rocks, and there are a few grasses on the coast of Antarctica where it's warmer

Plants grow slowly and don't grow very tall – grasses are the most common plants. Further north, only mosses and lichens can survive

Some small, short trees grow in warmer sheltered areas

Cold environments have low biodiversity

Cold environments have very low biodiversity – there are fewer species of plants and animals in cold environments than most other environments.

Low biodiversity means when the population of one species changes it can affect the population of dependent species – e.g. changes in the number of lemmings affect the number of Arctic foxes (their predators).

Global warming is causing some species to move towards the poles, where it is cooler to cope with temperature rises elsewhere

The biotic (living) components of cold environments (plant, animals and people) and the abiotic (non-living) components (climate, soils, permafrost) are closely related – if one of them changes, the others are affected.

1. Plants gain their nutrients from the soil and provide nutrients to the animals that eat them. In turn, animals spread seeds through their dung, helping the plants to reproduce
2. Plant cover is low – the cold climate causes plants to grow slowly and also to decompose very slowly. This means that the soil is relatively low in nutrients – further reducing the ability of plants to grow.
3. Herbivores like reindeer that rely on plants like mosses to survive must migrate to areas where plants are able to grow to find food. Carnivores like wolves have to follow the herbivores.
4. In summer, when the tundra has greater plant cover, the surface plants absorb heat from the sun, and prevent the permafrost below from thawing. The permafrost provides water for plants.
5. Changes to parts of the ecosystem, such as vehicles damaging plant cover, can have knock-on effects on the whole ecosystem, e.g. by causing permafrost to melt. Melting permafrost can flood land, preventing plants from growing. It also releases trapped greenhouse gases – leading to increased global warming, and changes to the climate of cold environment, threatening plants and animals.

Plants and animals have adapted to the cold, dry climate

Plants:

1. Most plants become dormant (stop trying to grow) to survive the cold, dark winters.
2. Plants are small and round-shaped to provide protection from the wind.
3. Most plants have shallow roots because of the layer of permafrost beneath the soil layer.
4. Leaves are generally small to limit the amount of moisture lost through transpiration.
5. The warmer, wetter summer is very short, so most plants have adapted to a growing season of just 50-60 days.
6. Many plants use underground runners or bulbs instead of seeds to reproduce because the growing season is so short.



Animals:

1. They are well-insulated – they might have a thick fur coat like polar bears or a layer of blubber like seals. This reduces the amount of energy they have to use to keep warm.
2. Some animals hibernate to conserve energy and survive the winter, e.g. Arctic ground squirrels hibernate for 7-8 months of the year and can survive even if their body temperature drops below freezing.
3. Animals that don't hibernate have adapted to survive on the limited food sources available in winter. Reindeer have adapted to eat lichens in winter.
4. Many birds migrate to warmer area during winter – Arctic terns live in the Arctic during the northern hemisphere summer then fly to the Antarctic for the southern hemisphere summer.
5. Many animals have white coats in winter for camouflage – this helps predators sneak up on prey, and prey to hide in the snow. Arctic hares are white so they are harder for predators to spot in the snow.

Development opportunities in Alaska	Challenges to development in Alaska
<p>Oil and gas – over half of Alaska’s income comes from the oil and gas industry. Most oil fields are around Prudhoe Bay and the Trans-Alaska oil pipeline links to the oil fields with Valdez where the oil can be shipped to customers.</p> <p>Mineral resources – gold, silver, iron ore and copper ore are mined particularly in the Tintina gold belt. Generates \$2.2 billion to Alaska’s GDP in 2013.</p> <p>Fishing – salmon, crab and Pollock are fished. Fishing employs 79,000 people and contributes over \$5 billion to Alaska’s economy.</p> <p>Tourism – tourists are attracted by Alaska’s wilderness scenery. Around 2 million tourists visit Alaska each year, bringing in money and creating opportunities for employment.</p>	<p>Access to resources, finding a workforce, providing buildings, infrastructure and protection from extreme weather.</p> <p>Extreme temperature - It’s really cold – annual temperature is around -9 degrees. Extreme weather such as snow and strong winds are common – exposure to them can kill with healthcare a long way away. Extremes in the amount of daylight – in winter it can be dark nearly all the time.</p> <p>Inaccessibility - Alaska is a long way from the rest of the US. Some areas are extremely remote, and the mountainous terrain makes access difficult and expensive. In winter, the only way to get to some towns is via air or dangerous ice roads. In summer, there are no roads to some towns because the ground is too soft. The population of Alaska is small and scattered – people in small towns may be a long way from employment opportunities or services.</p> <p>Buildings and infrastructure – providing buildings and infrastructure that can cope with the ground and weather conditions is difficult and expensive. Most construction work can only take place in summer, when the days are longer and temperatures are warmer. The value of some resources means that people find ways to overcome the challenges, e.g. some parts of the Trans-Alaska oil pipeline are raised on stilts, to prevent it melting the permafrost which would make the ground unstable</p>

Cold environments – sustainable management – Alaska, USA

Strategies need to balance economic development with conservation

There are lot different strategies that can help balance conservation with economic development:

Use of technology:

1. Development can cause problems that can be solved by modern technology. E.g. heated buildings can melt permafrost, leading to subsidence which may cause roads and buildings to collapse and pipes to crack.
2. Modern construction methods can minimise environmental impacts, for example elevating buildings on piles or building on gravel beds can prevent buildings warming the ground

Role of Governments:

1. If development is allowed without regulation, it can cause damage to the environment. E.g. mineral and energy mining can cause ground and water pollution and logging activities destroy habitats
2. Governments can make laws to protect cold environments, such as the 1964 Wilderness Act that designated wilderness areas and protected them from development, including large parts of Alaska

International agreements:

1. Some cold environments are protected by international agreements, e.g. Antarctica.
2. The 1959 Antarctic Treaty, signed by 12 nations, limits visitors landing at one site to 100 at a time, ensures peaceful non-military activities, prohibits nuclear activities and prevents cruise ships of over 500 passengers stopping.

Conservation groups:

1. Conservation groups pressure governments to protect cold environments that are at risk or have been damaged.
2. For example the World Wild Fund for Nature (WWF) and Greenpeace encourage sustainable management of cold environments and argue for governments to prevent actions that would cause damage.

Cold environments are valuable wilderness areas worth conserving

Wilderness areas are wild, natural environments that haven't been changed significantly by people. They are mainly undeveloped, uninhabited and undisturbed

They are important and worth protecting for the future because:

1. Provide habitats for organisms, so help protect biodiversity
2. Scientists can study wild plants and animals in their natural habitats
3. Natural ecosystems that are useful to compare to managed ecosystems
4. They are the last remaining areas that haven't been altered by human activity

Cold environments are fragile and take a long time to recover

If they are interfered with they can take a long time to recover:

1. Plant growth is very slow – if plants are damaged (e.g. by vehicle tyres) they take a long time to regrow
2. Species are highly specialised so find it difficult to adapt to change – e.g. polar bears are adapted to hunt on sea ice and their number are decreasing as sea ice melts earlier each year