

The taiga shows different characteristics, reflecting a more extreme and seasonal climate.
(biotic and abiotic components, biotic adaptations, nutrient cycles)

The largest biome on the Earth's surface is the taiga biome. It stretches from 50°N to 70°N across North America and Asia. The climate of this region is known as the subarctic climate. This is dominated by very cold, dry and long winters with average temperatures of -40°C. Summer months have mild temperatures and are short, the average temperature is 16°C. There is normally snow on the ground for the whole year, the annual precipitation rate is low with less than 500mm a year.

In comparison to the tropical rainforest the taiga has a lower productivity in terms of nutrients and a lower biodiversity. The taiga growth period is short due to a short summer this makes the biomass small, decomposition is slow due to the low temperatures and can even stop during the winter months. Because of these conditions only a few species are adapted to survive leading to low biodiversity.

Nutrient cycle—The biomass and soil stores are small and transfers of nutrients between the stores is low. The biggest store is the litter store, this is mostly made up of pine needles which are tough and decompose slowly. Due to the slow decomposition it takes a long time for nutrients to enter the soil. This means the soil cannot support a large amount of biomass. The pine needles that become litter are acidic therefore the soil becomes acidic which again limits the species that are able to thrive in the taiga environment. Generally, only coniferous species can survive along with mosses, lichens and fungi. With fewer plant species there is also fewer animal species. Most of the animals that live in the taiga environment have migration routes. Birds are very common due to lots of insects available.

Key Terms

- Biome
- Subarctic climate
- Productivity
- Migrating
- Food webs

Questions

1. Identify the largest store in the taiga nutrient cycle (1)
2. Explain how the process of leaching removes nutrients from the taiga ecosystem (2)
3. Explain (using the nutrient cycle) why the taiga forest is considered to be a fragile ecosystem (4)
4. Explain how plants are adapted to the taiga ecosystem (4)
5. Explain how animals are adapted to the taiga ecosystem (4)

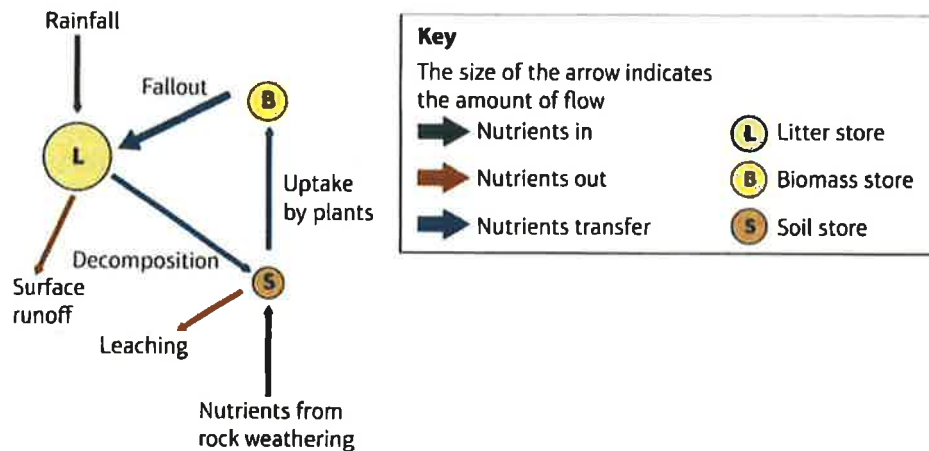
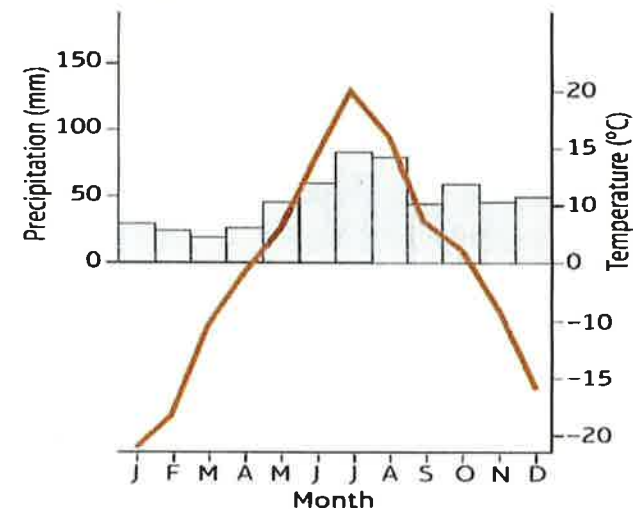


Figure 3 The nutrient cycle of the taiga



Plant adaptations Taiga

forests are usually full of conifer trees. These trees remain green all year round as they do not drop their leaves as they do not have the energy to regrow leaves each year. As well as this the trees need to be ready for photosynthesis to occur in spring. Conifer trees have specially adapted leaves which are needle shaped called pine needles. They are this shape so they have a small surface area so they lose less water from evaporation. They also have a waxy coating to help reduce water loss. The needles are a dark green colour so they can absorb as much sunlight as possible so they can photosynthesise. The needles contain only a little amount of sap so they do not freeze easily and can operate in cold conditions. There are only a few conifer species in the taiga ecosystem and they grow close together to gain protection from wind damage. Most are conical shaped with downward facing branches, this is so heavy snow falls off quickly.

Animal adaptations

Due to seasonality in terms of the climate there is also seasonality with animal life. During the summer months the taiga has a large amount of animal populations, this drops dramatically in winter. The Canadian taiga has over 300 bird species in the summer however, only 30 stay during the winter as many migrate south. They migrate to the taiga in winter due to a lot of insects. The animals that stay in the taiga all year round are specially adapted to live there. They generally have thick fur coats for insulation, smaller ears, noses and short tails to reduce the chance of frost bite. Many animals also hibernate during the winter months; they build up a large layer of fat during the summer months so they can go into a sleep-like state. Some animals develop a white coat during winter months to camouflage better.

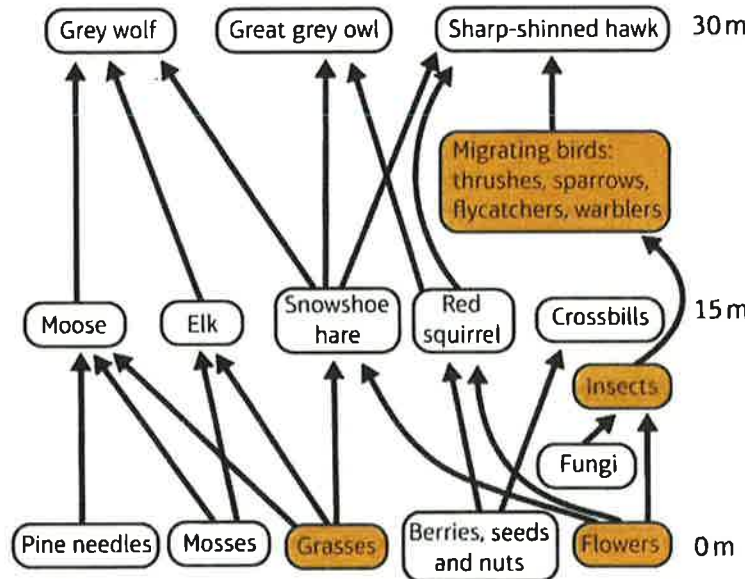


Figure 8 A food web for a Canadian taiga ecosystem



Food webs

The food webs in this ecosystem are much simpler in comparison to the rainforest as there is a lower biodiversity due to the climate. There is a limited amount of plant species, the trees are roughly the same height and only have one layer. The forest floors have little undergrowth and the soils are generally shallow with few nutrients. It is very dark due to conifers growing very close together. There are few reptiles and amphibians as they are cold blooded and they struggle to find heat in this environment. The few large mammals in the taiga have large territories and spend most of the summer building up their fat reserves.

The taiga is increasingly threatened by commercial development

(Direct threats and indirect threats, acid precipitation, forest fires and biodiversity loss)

Commercial development is a direct threat to the taiga environment. This happens when an area has valuable resources that can be sold to make money. The threats to the taiga can be classed as direct or indirect. Direct threats include logging as it removes trees that are a key biotic component of the ecosystem. An indirect threat is mining, HEP and oil and gas extraction as they damage the taiga due to their side effects such as flooding, pollution and oil spills.

Deforestation is high in the taiga environment due to the softwood available. They use a clear cutting method to collect the timber, this is where all the trees in an area are cut down and transported to sawmills to be cut into useable timber for construction and trees are turned into a pulp. Russia has a huge deforestation issue as huge amounts of forests are being cleared (average 12 million hectares a year in 2014). As much as half of the logging is illegal. This is a huge threat to the taiga as the plants that are logged are not replanted. In Canada the government controls logging and ensures that any trees felled are replanted.

Oil and gas extraction is another threat to the taiga in Russia as 20% of the world's oil and gas reserves are found here. Greenpeace an NGO (Non-governmental organisation) that campaigns environmental issues states that Russia's oil industry spills 5 million barrels (795 million litres) of oil each year through accidents and leaks. This affects the animals and people that live in the area. In contrast Canada which also have oil and gas reserves controls the extraction still have the occasional oil spill e.g. in 2011m, 5 million barrels' bitumen (oil) mixed with water spilled due to a broken pipeline in Alberta. Due to the poor drainage systems in the taiga environment the oil is not easily washed away and as well as this decomposition occurs very slowly therefore the oil remains in the ecosystem for a long time this can kill the roots of the trees.

Acid precipitation—This occurs when fossil fuels are burnt in industries, chemicals such as sulphur dioxide are created and are released into the atmosphere (Volcanoes also do this). When this reacts with water and oxygen it forms an acid which can form acid precipitation. The most damage that is caused is when the acid gets into the soils, lakes and ponds. Acidic water kills insects and their eggs, this means there is less food available for migrating birds. Microbes in the soil are killed therefore nutrients cannot enter the soil. As a result of this the plants become weaker and they become less resistant to changes in temperature, forest fires and pests and diseases.

Forest Fires— Natural causes of forest fires are lightning strikes. Most fires are caused by humans such as hunters lighting camp fires and gas flares in oil fields. The taiga is adapted to forest fires as the ash left after a fire is nutrient rich which plant species benefit from. The problem is naturally the forest is adapted to fires every 80-100 years, however they have become much more frequent as global temperatures have increased and saplings are burnt before they can replace the old trees.

Pests and diseases— The taiga has mould and fungus species that damage the needles, trunks and roots of conifer trees. Insects also eat the pine cones, young leaves and the saplings. As well as this other pests and diseases have migrated into the taiga biome as the temperatures have increased. The damage is happening on a large scale for, example the silkworm which spread into eastern Siberia from Mongolia in the early 2000s killed many plants it didn't help that the area was also suffering from forest fires and droughts. Plagues of spruce-bark beetles have killed large numbers of taiga trees in North America. In Alaska's forests over 6 million acres have showed signs of spruce-bark beetle activity.

Key Terms

Direct threat
Indirect threat
Acid precipitation
Forest fires
Pests
Diseases

Questions

1. Describe one direct threat and one indirect threat to the taiga caused by commercial development (2)
2. Assess the severity of the threats to the taiga biome (8).
3. Explain the process by which pollution can produce acid precipitation downwind of the source. (2)
4. Explain one way in which acid precipitation is a threat to the taiga forest. (2)
5. Explain why climate change could intensify the threats to the taiga forest. (4)

The taiga wilderness areas need to be protected from over-exploitation
 (National parks, Sustainable forestry, conflicting views)

The taiga is a fragile ecosystem and takes a long time to recover from damage. Due to the long cold winters and lack of nutrients vegetation grows slowly. As well as this, decomposition is slower so any pollution remains in the ecosystem for a long time. Species diversity is low in the taiga environment therefore if a disease affects one species it has a big impact on the whole ecosystem. The flora and fauna in the taiga would struggle to adapt to any changes, especially climate. Protected wilderness areas and National Parks can be created to prevent commercial development of the taiga within their boundaries. The aim of a National Park is to preserve the taiga environment and its biodiversity. Researchers find out as much as they can about the biotic and abiotic components of the ecosystem to inform the public and local government about its importance. In contrast protecting 'wilderness' areas is more proactive as it is active ecosystem management, rather than just leaving the area wild. One example of active management is culling elk as there is not enough predators to keep their numbers down, so rangers will kill a small percentage of the population. If there are too many elk in an ecosystem it prevents saplings growing into trees as they are eaten. There are not enough predators in the taiga ecosystem as they need large territories to survive and the National Parks and wilderness areas are generally not big enough. Any predators that range outside the National Park areas are not protected and are therefore at risk of being poached or trapped by farmers who see them as a threat. Licenced hunting keeps many predator populations down. National parks also want to attract tourists to educate about the environment, however tourists want to see big predators and the predators want to seek more remote areas away from humans. National parks are popular tourist destinations as well as conservation areas. E.g. Canada's busiest National park Banff has 3-4 million tourists visiting each year. Some are winter tourists that go to ski and sledge. All the tourists that visit the taiga ecosystem damage the ecosystem they come to enjoy through footpath erosion etc. Human-wildlife conflict occurrences can also happen such as grizzly bear attacks.

Sustainable Forestry—This is when trees are cut down and are replanted with native taiga species. The whole forest area is carefully managed so that the biodiversity is not lost. Forest corridors are created to allow species migration and the areas are preserved. Sustainable management is expensive and requires long-term planning. This is usually only possible for large companies or when international organisations provide funding.

Conflicting views—Many different groups of people have an interest in how the taiga is used.

Forestry — Countries like Canada have strict controls on logging and timber can only be used sustainably. However in some countries like Russia are unsustainable when it comes to forestry.

Mining and Energy production— Without mining and energy production Russia and Canada would be very poor, for example 380,000 Canadians work in the mining industry.

Indigenous peoples—They want to maintain aspects of their traditional uses of taiga resources, such as hunting.

Recreation and tourism—In North America and in Russia they go to the taiga environment to relax as well as this international tourism also brings visitors and money to the local economies.

Key Terms

Over-exploitation
 Commercial development
 Territories
 Sustainable forestry
 Indigenous people
 Recreation and tourism

Questions

1. Explain two reasons for conflicting views on protecting or exploiting the taiga (4)
2. Evaluate the obstacles that limit the effectiveness of global strategies aimed at conserving forest biomes (8)
3. Why might people living in forested areas of the world be against establishing national parks? (4)
4. Which do you think is in more need of protection the rainforest or taiga forest? Give reasons (6)

Other challenges include:

1. Migration
2. Money
3. Pollution