Unit 3: Topic 8 Forests Under Threat

How does the tropical rainforest reflect the equatorial climate?
Most tropical rainforests (TRF's) are located in a zone 20N or south of the equator called the equatorial climate. (See world map on Unit 3 Topic 7 People and the Biosphere). The climate is hot and wet all year round with average temps of 25C-30C never falling below 20C and 2000-3000mm of precipitation ideal for plant growth all year round. Abiotic components of the TRF such as the atmosphere, soil and water interact closley with all of the biotic characteristcs including plants, animals and humans.

What is the nutrient cycle like in the TRF?

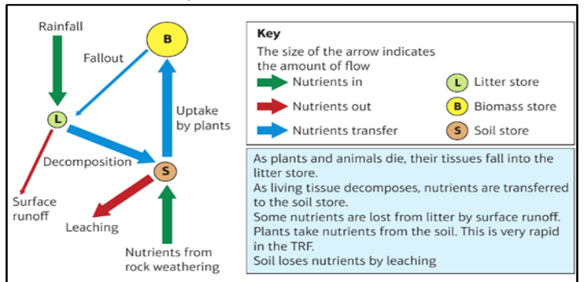


Figure 1 The tropical rainforest nutrient cycle

All ecosystems have three compartments: soil, litter and biomass. Nutrients are transferred between the stores which differ in size dependent on the ecosystem. The biggest store in the TR is biomass which is made up of all living things. When leaves and branches fall into the litter store they decompose quickly releasing nutrients in to the soil for the plants to quickly absorb them. Rain water takes nutrients and minerals with it as it soaks through the soil, this is called leaching. Biodiversity in the TRF is high supporting thousands of species that have evolved over thousands of years.

How have plants in the TRF adapted?

Although climatic conditions are ideal for plants they face major challenges in the TRF, the main challenge is light. The emergent's are the tallest trees (50m+) that 'emerge' through the canopy (30-40m) made up by the other tress. When a tree dies and falls and a gap appears and the light reaches the forest floor enabling tree saplings to race upwards to the light. The gap will soon fill with broad leaves to maximise the sunlight it receives. Two other adaptations are drip-tip leaves and buttress roots.

How have animals in the TRF adapted?

A huge number of animal species are supported by the TRF. The forests of Madagascar are estimated to have 14,000 species of plant that support 250,000 animal species 75% of which are not found anywhere else in the world. Trees and plants produce flowers, leaves and fruit which the animals travel across the canopy to eat. Monkey's for example, have evolved gripping hands and prehensile tails for balance and colour visions to identify ripe fruit. Eagles have adapted strong legs and clawed talons to grab monkeys from the canopy whilst other animals are camouflage to avoid being eaten e,g. stick insects mimicking sticks and leaves.

How does the taiga reflect the subarctic climate?
The taiga is the largest biome on the earths surface stretching about 50˚to 70N across the north of Asia and America in a zone called the subarctic climate. (See world map on Unit 3 Topic 7 People and the Biosphere). Very long and cold winters dominate this climate with average temps –40C compared to summers which are short and mild rarely above 16C. Precipitation is low, less than 500mm. There are significant differences in biodiversity and productivity between TRF and the taiga due to the climate. Taiga plant growth is limited to short summers and with limited biomass productivity is low. Soil is low on nutrients due to slow decomposition of litter which even stops during the deep freeze of the winter. With only a few plant and animal species able to survive it's winters biodiversity is low overall.

What is the nutrient cycle like in the taiga?
The litter store is the biggest store. Biomass and soils stores are small and transfers between stores are low. Litter is mainly made up of pine needles which are slow to decompose so the litter layer builds up and provides limited nutrients to the soil and as a result the soil is unable to support a large biomass. The needles make the soil slightly acidic so along with frozen winters, low precipitation and short growing seasons they produce extreme conditions that only a small number of species can survive e.g. coniferous trees, mosses and lichens. As a low nutrient, low productivity ecosystem, there are fewer permanent animal species although in summer insects attract large numbers of migrating birds.

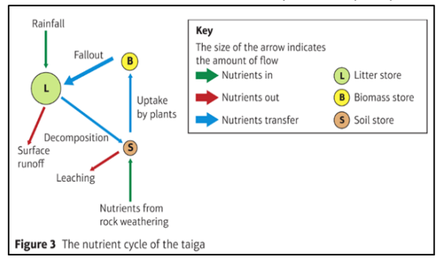


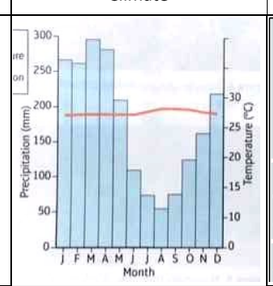
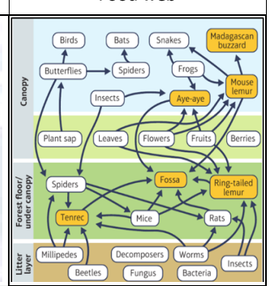
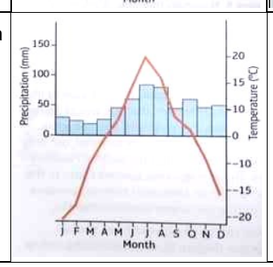
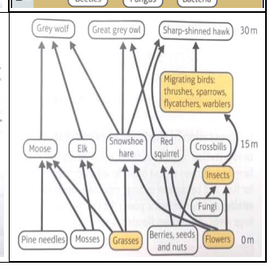
Figure 3 The nutrient cycle of the taiga

How have plants in the taiga adapted?

Almost entirely conifer trees, they don't drop leaves in autumn because leaves take energy to grow and there's a shortage of energy in the Taiga. When it begins to warm up again in spring the tree need to be able to photosynthesise straight away. The pine needles have the following characteristics:
-small surface area and a waxy coating so they lose less water.
-dark green colour to absorb the maximum amount of sunlight
-they don't freeze due to limited sap content. It has a simple structure compared to the TRF with a few species of conifer that grow close together to prevent wind damage. Most are conical shape to shed heavy snow rather accumulating it.

How have animals in the taiga adapted?
Summer sees large populations of birds, 300 species, which migrate to take advantage of the lakes that produce billions of insects but in winter this drops to just 30 species. Permanent residents have adapted I the following ways:
- Thick fur coats, smaller ears and tails to avoid frost bite
- the ability to hibernate e.g. bears build up fat in summer then enter a sleep like state in winter which allows a fall in body temperature.
- developed winter camouflage such as white fur.

How different are the TRF and the taiga?

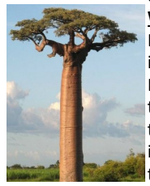
	Climate	Food web
TRF		
Taiga		

How do their climates compare?
Climate in the TRF has little variation as it is hot and wet all year round 25C+, precipitation from 50mm in August to almost 300mm in March. The temperature range in the taiga is 40C from –20C in January to 20C in July. Precipitation in the taiga is always below 75mm with a low in march of approx. 20mm and a high of 75mm in July.

How do their food webs compare?
TRF webs are highly complex due to very high biodiversity. The forest structure has different layers from the dark, damp forest floor right up to the emergent layer 50m+. Each layer is like a mini ecosystem in itself with adaptations adding to the complexity of the food web. Food webs in the taiga are much simpler because the climate produces much less biodiversity. Slow growing conifers produce a single consistent layer of trees at a similar height. The dark forest floor has little undergrowth with pine needles cover the low-nutrient floor. There are few amphibians and reptiles in the taiga because of the climatic challenges for cold blooded animals however there are large mammals that eat as much as possible in summer in order to survive winter.

What are the threats to the TRF? (Deforestation)
Commercial agriculture e.g. cattle farming in Brazil accounts for 75% of deforestation. Recent clearance for sugarcane and palm oil as a biofuel 'deforestation diesel'. **Subsistence agriculture** clears 1/3 of the forest through 'slash and burn' for people to farm to feed their families. Due to rapid population more forest is cleared and isn't given time to recover so the soil loses nutrients. **Commercial logging** was commonly used to pay off international debt but now there are strict logging controls although illegal logging still takes place in the TRF. **Open cast Mining** for minerals and **road building** account for approx 15% of deforestation. **Fuelwood** and **charcoal** are increasingly becoming a cause of deforestation due to population increases.

Why is climate change a threat to the TRF?



Logging and farming are direct threats to the TRF whereas Climate change is an indirect threat. Rising global temperatures can affect the weather systems that bring the wet season to equatorial regions as they are likely to shift polewards. Conditions are likely to be hotter and drier more like a seasonal tropical forest with a dry season lasting several months. Animal species are unable to cope with heatwaves and plants are unable to survive forest fires or drought. Plant species that have adapted to hotter drier conditions e.g. baobab tree would spread out and compete with TRF species causing ecosystem stress with TRF species exposed to new pests and diseases.

What are the threats to the taiga?
Commercial developments are the greatest threat to the taiga, some having a greater impact than others. **Logging for softwood** which is used for timber in construction or in paper mills is a direct threat removing trees which are a key biotic component to the nutrient cycle, no pine needles=lower soil nutrients. Cleared at a rate of 12million hectares per year, with as much as half of it illegal (in Siberia), is a huge threat as there is no effort to replant trees. Logging in Canada is much more sustainable with government polices for replanting. **Mining minerals, oil and gas** have indirect threats such as oil spills and forest fires. Russia has 20% of the worlds oil and gas the mainly in the taiga. According to Greenpeace, Russia's oil industry spills 5million barrels of oil each year due to accidents or leaks in pipelines. In Canada the government have stricter controls although leaks can still happen (Alberta tar sands, 2011, 5million litres). Oil spills are damaging because drainage is poor so the oil doesn't get washed away and due to climatic conditions decomposition is very slow. Therefore it remains in the ecosystem for many years killing trees by entering their shallow root systems. **Acid rain** from sulphur dioxide released from burning fossil fuels affects the soil, lakes and ponds killing insects and their eggs. This reduces the food available for migrating birds in summer and weakens plant species. **Forest fires** from camp fires or gas flares in oil fields can produce nutrient rich ash benefitting plants although their occurrence is now too frequent burning young saplings before they can grow. **Pests and diseases** such as fungus and mould damage confers' needles etc. Silkworm spread through Siberia in the 2000's and spruce-bark beetles have affected over 6million acres of Alaskan forest.

What global actions have been taken to protect tropical rainforests?
International organisations have tried to establish agreements to protect the rainforest . By signing up to these agreements, member countries receive aid and assistance. Two examples are CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) which has 35,000 different species under it's protection with countries monitoring trade across their borders. REDD (Reducing Emissions from Deforestation and forest Degradation) is a UN scheme that advises governments on how to reduce the rates of deforestation and replant forest areas. It uses remote sensing to monitor deforestation rates and uses money from the world bank to fund schemes for example a REDD scheme in brazil has a US$1bn fund behind it.

Table 1 Advantages and disadvantages of CITES and REDD

Advantages	Disadvantages
CITES	
It has a very large international influence – 181 countries have signed up.	The illegal trade in rainforest products is increasing, not decreasing. This is because demand remains high so it is worth the risk to make illegal trades.
CITES is targeting the right problem – most trade in endangered species products is international. For example, rosewood timber from Vietnamese rainforests going to China.	CITES cannot possibly hope to monitor all 181 countries at the same time. It is difficult to check that all countries are doing all they should be doing to halt trade in protected species.
REDD	
Tackling deforestation is very challenging but REDD provides international expertise to develop the best approaches.	Deforestation remains very rapid in South Asia, despite its countries signing up to the REDD scheme.
The funding that REDD can access is very attractive to governments.	REDD is vague about what counts as forest for replanting. In some cases, funding has been given to projects that have replanted deforested areas with oil palm trees.

What is been done to cut rates of deforestation?
Whilst forest are still commercially valuable this remain the biggest challenge for rainforests around the world. Although with enough political and financial backing it can be slowed E.g. Brazil from 2004. The are a range of reasons for the reduction experienced in Brazil:
-The change in the demand for soya. Prices crashed in 2005 due to TNC's only sourcing soya from sustainable farmers
-A REDD fund set up by Norway protected areas which were enforced by government officials and the police.

What are the challenges of sustainable forest management?
Deforestation went up again in Brazil (2014-2015) mainly due to cattle ranching. Ecotourism however is an attempt to benefit local people economically. By creating jobs as forest guides, hospitality and catering services as well as tourists spending money on their handcrafted products. For these people they see that it makes economic sense for them to protect the forest from illegal poachers and loggers. Sustainable farming schemes that aim to keep the fields fertile for longer with crops that provide higher yields means that new plots do not need to be cleared and existing plots support more people.

Why does the taiga Wilderness area need to be protected?
The taiga is a vey fragile ecosystem and takes a long time to recover form damage as pollution remains in the ecosystem for years. Plants grow slowly due to the climate and lack of nutrients from slow decomposition. It may take 50 years for a single tree to be replaced and with only a few highly specialised species, disease or climate change affecting one species would be a disaster.

How can National Parks and protected wilderness help?
Designated areas where development is prevented with the aim to preserve the ecosystem through researching the abiotic an biotic components. Wilderness areas need ecosystem management by park rangers including possible culls e.g. Elk that eat saplings. Big predators e.g. wolf/grizzly bear, need large areas but NP's are often not big enough but beyond their boundaries they are not protected from farmers or game hunters. Licensed shooting keeps predator numbers down. Canada's busiest NP, Banff NP attract 3-4 million tourist per year for skiing and ice festivals which inevitable causes damage and risks known as 'human-wildlife conflict occurrences' (attacks).

What challenges are national parks facing?
-Migration of species beyond the protection of the NP boundary
-Income from resource exploitation puts governments under pressure
-Damage from atmospheric pollution caused by tourist from the cities

How can sustainable forestry help?
Trees that are cut down are replaced with native species. Corridors of forest are maintained to support species migration from area to area but this is expensive and needs international organisation funding.

What are the conflicting views on protecting the taiga?
Forestry - use it sustainably e.g. Canada or unsustainably e.g. Russia
Mining— countries are poorer without it, 380000 Canadians emp. in mining.
Indigenous people— desire to maintain traditional activities e.g. hunting
Tourism—tourists visit the taiga to relax bringing money into local economies
Taiga products—paper, oil and gas for many countries comes from the taiga