

The world's biomes

Earth has many natural landscapes including rainforests, deserts, mountains, grasslands and tundra lowlands. However these landscapes differ because of geographic factors such as climate, especially temperature and rainfall, soils, topography and aspect. The largest of these landscapes are called **biomes** (bios = Greek for life) and extend over large masses of land. Similar biomes may also occur on different continents and be separated by oceans. Biomes differ mainly because each contains its own unique ecosystems of plant and animal communities that have adapted to its physical conditions.

The largest biomes are:

Rainforests

Dry forests, woodlands and shrub land

Savannah woodlands and grasslands

Desert Landscapes

Grasslands

Boreal (Coniferous) Forests

Frozen landscapes - tundra and ice caps

<See Jacaranda World map of biomes>

Fragile Rainforests

From very early times, large parts of the Earth's surface have been covered by trees and other forms of vegetation. Research shows that in the pre-agricultural era, the planet supported some 62 million square kilometres of **forest** and **woodland**, most of which was in temperate lands. Since then however, occupants of those lands learnt to use timber for a number of purposes, such as building homes, boats, weapons and tools, and as a fire fuel. Constant felling of trees for these uses has seen global forest areas gradually reduced by about one third. Today, only isolated forests remain in many temperate lands, many preserved in national parks.

The biggest tracts of forest are **rainforest**. Protected by equatorial heat, torrential rain, inaccessible mountains and plagues of mosquitoes, these primeval forests have survived throughout human history and are testimony to the process of ecological succession. The largest and possibly oldest rainforest lies wedged in the Amazon River basin, between the Andes Mountains and the Atlantic coast of northern South America. Covering an area the size of Australia, the Amazon forest has flourished since primeval times. Because of its location, the forest thrived even when other parts of the world yielded to the cold of the last ice age. Some scientists suggest it is over 100 million years old. Despite its vast area, the Amazon is not infinite.

Rainforests transfer and recycle nutrients between three stores, namely:

- litter, which is the surface layer of vegetation that breaks down into humus
- biomass, which is the total mass of living organisms per unit area — plant tissue, for example
- soil.

TEXT BOX - The term 'tropical rainforest' is thought to be of German origin (tropische Regenwald), as it first appeared in the writings of the German geographer A.F. Schimper (1898) who defined tropical rainforest as "Evergreen, hygrophilous in

character, at least thirty metres high, but usually much taller, rich in thick stemmed lianas (Fr) and in woody as well as herbaceous epiphytes."

As its name implies, tropical rainforests are found in the warmest and wettest parts of the earth, such as South America, Central America, central Africa and south-east Asia. Here annual rainfall ranges from 1500 millimetres up to 5000 millimetres and temperatures seldom get below 18 degrees Celsius. Today, the term rainforest is used to describe a lush, forest-type specially adapted to areas of high rainfall.

Rainforest features include:

- A clearly identifiable series of layers, each with its own particular function - The upper layer, or **canopy**, consists of dense luxuriant foliage which restricts the penetration of sunlight to the **understorey** and ground layers. In the canopy stratum tree crowns, woody vines, strangler figs, and **epiphytes** vigorously compete for space and sunlight, while shade tolerant plants (sciophytes) occupy the lower levels. Lack of sunlight ensures ground plants are more sparsely distributed. In places, very tall trees known as **emergents** intermittently pierce the canopy and tower high above the forest.
- Extreme age and development - Rainforests that have existed for millions of years without climatic disturbance and fire have been able to attain a state of ecological climax. Scientists suggest the rainforests of north Queensland were established during the Cretaceous period, 110 million years ago. So complete is their development, some forest support up to a hundred trees per hectare.
- A diverse variety of plant species including stinging vines, woody **lianas**, air plants, ferns, palms and fungi. Although occupying only about six per cent of the world's land surface, tropical rainforests harbour between twenty and fifty per cent of all known plant and animal species. Most of these species have evolved with interdependent relationships where one species needs another for survival. An example of **co-existence** is where trees like the Bumpy Satin-ash rely on fruit bats and tiny pygmy possums for pollination rather than the wind. Such **diversity** and inter-dependence makes rainforest ecosystems highly complex.
- Unique plant types that have adapted to the wet conditions - Mature trees have large exposed **buttress** or aerial root systems which not only support the tree in moist soil, but also seek nutrients from surrounding damp shallow soils. Another unusual plant development process is **cauliflory**, where flowers grow on leafless woody stems.
- A ground layer of thick leaf and twig litter (humus) that decomposes in the damp conditions to provide nutrient to the topsoil and support a range of fungal and bacterial species.
- Still, shady conditions that provide the lower levels with a stable **micro-climate**. High levels of soil and air moisture enable species adapted to these conditions to become established as well as assisting in the decomposition and nutrient recycling process.
- An extensive variety of reptiles, small mammals, birds, amphibians and insects. Due to the limited extent of rainforests today, many of these creatures are endemic to particular rainforests, such as the cassowary or Daintree River ring tailed possum in north Queensland.
- A variety of plant species with a potential for medical and drug research. Because of localised distribution, some plants may be prone to extinction and their potential medical benefits lost.

<sketch of rainforest features>

Rain forests in Australia

Australia has relatively little rainforest, partly due to aridity and a small number of areas that receive high rainfall. Today, most rainforests are scattered like "islands" amid a sea of development, generally along the eastern ranges. Australia has three main types of rainforest, each largely determined by variations in climate.

They are:

- tropical rainforest, such as that scattered between Townsville and Cape York. Around 857,000 hectares in area, this belt contains the largest remaining continuous corridor of coastal lowland rainforest in the world, growing adjacent to coral reefs, such as that around Cedar Bay.
- sub tropical rainforest, like that found between central Queensland and northern New South Wales, eg Eungella (near Mackay), Fraser Island, Lamington Plateau and the Washpool Area, west of Grafton. The Washpool forest contains the largest remaining stands of coachwood in the world.
- temperate rainforests like those found throughout New South Wales, Victoria and Tasmania. Temperate rainforests are not as complex or diverse as tropical forests, containing fewer plant and animal species. Trees have smaller-leaved and less luxuriant foliage and are absent of epiphytes, orchids and lianas. They do, however, have special scientific interest because of their Antarctic origins. The rainforests of Tasmania contain the planet's only communities of Huon pine.

Reviewing features of a rainforest

1. Examine the features of a typical rainforest ecosystem shown by the letters A to I. Then match each letter with the correct term from the list - fern, buttress roots, orchid, epiphyte, cauliflory, palm, strangler fig, fungus, leaf litter, liana.
2. Refer to the map (Figure 3.0) and data in Tables 3.0 and make a list of geographical factors that influence where rainforests are found in Australia.
3. Explain why South Australia does not have any significant stands of rainforest today.

Destruction of rainforests

While rainforests contained extensive stands of tall high density trees, their timber was not sought during early times due to their inhospitable locations. Until the 20th century, rainforests experienced minimal human impact. Today however, the situation is different.

Large tracts of rainforest are found in developing countries like Brazil, Malaysia, New Guinea, Indonesia and Zaire. Here governments short of cash are desperate to use natural resources to generate income as well as open up more farmland for food production and employment. As a result large tracts of forest are being cleared every day, often at an increasingly rapid rate. Some media reports warn that about 50 thousand square kilometres of closed tropical forest are logged each year simply to obtain between four and ten per cent of their timber resource. This area is equivalent to the size of Costa Rica (Central America), while the rate of destruction is about one hectare every few seconds.

Environmentally, the destruction of tropical forests is particularly alarming because they contain a vast store of the Earth's carbon. For example, it is estimated that the loss of Brazilian rainforest, which has averaged 20000 square kilometres per year since 1980, equates to one-fifth of the world's carbon dioxide emissions.

Deforestation also has a considerable impact on the **nutrient cycles** of the areas involved.

When rainforests are cleared, trees are no longer available to provide necessary minerals to the forest floor. Constant heavy rain continues to dissolve and remove remaining minerals causing soils to lose their fertility and become subject to erosion. This mistake was made in north Queensland last century when tracts of coastal rainforest were cleared to grow sugar cane. Within a few decades, yields declined so noticeably that farmers were forced to replenish soils annually with expensive fertilisers. This practice is now linked to pollution of the Great Barrier Reef.

To find out more about rainforest destruction around the world, visit

www.rainforest.net/pictures

To view the impact of logging on forest animals, visit the site below and watch the video - http://www.green.tv/orangutans_special

Woodlands, Open forests and Shrub lands

The size and thickness of a forest usually depends upon rainfall. If an area receives only a moderate annual rainfall or it is unreliable, then it is unable to support large forests. Plant communities that do grow tend to have a low tree density and are scattered over a large area. Trees and shrubs grow further apart because there is less moisture to share about and more sunlight penetrates the canopy. These forests are known as open forests and generally grow in areas between wet forests and dry country.

Review

1. Why do most of our forests grow near the coast?
2. Which parts of Australia have little vegetation?
3. Why are there few forests near the western coast? (See Page 00)

Australia's dry forests are generally dominated by eucalypts such as gums, ironbarks, stringy barks and grey box. These trees belong to a family known as sclerophylls, a term that refers to the hard waxy coating on their leaves. This adaptation not only allows leaves to reflect sunlight, but also reduce the amount of water lost to the atmosphere.

Most sclerophyllous trees grow to heights of more than thirty metres. Their giant root systems burrow down to depths of at least half the height of the tree seeking moisture. Because of the large number of gum trees found in dry forests, they support Australia's wild koala population, as well as a variety of birds such as kookaburras, magpies and owls. The dry regions of inland southern Queensland and northern NSW also contain extensive forests of Cypress Pine, a native hardwood with hard, durable and termite-resistant timber, often used in floorboards.

< photo of kookaburra >

In North America, shrublands are known as chaparral, a term originating from the Spanish word 'chaparra' meaning scrub oak. Most chaparral vegetation grows in California and Baja California. Like the Australian shrublands, these plant communities need periodic fires to remove old trees, reduce twig litter to nutrient and stimulate new seed growth. Most fires are started by lightning strikes.

Open forests also provide durable hardwood timber for a variety of purposes such as home construction, bridges, fencing, landscaping and signs. Hardwood may also be pulped for paper or chip board. Much of Australia's hardwood comes from dry sclerophyll forests owned by state forestry services or large milling companies. Because of their versatile use, they have been extensively logged, with around two thirds of our original forest now gone. To ensure timber is available in future years, large softwood and hardwood plantations have been established in Western Australia, Victoria and Queensland. The growing of trees on plantations is known as silviculture. Because they attract taxation incentives for investors, such projects are often referred to as Managed Investment Schemes. Private landowners are also given incentives to plant trees on spare paddocks or degraded land. This practice has been traditionally called **agroforestry**.

Boreal Forests

One of the largest biomes extending across the northern continents is the boreal forest belt. This region includes the cold countries of northern Europe (Norway and Finland), parts of Russia including Siberia, as well as Alaska and Canada. The word boreal means 'northern', although in Russia these forests are called 'taiga', which means 'forest of sticks'. Boreal forests are unusual because they are dominated by a single species of tree, the conifer. Some examples of conifers include pines, fir, spruce and larch.

<See world map + Canada – distribution of boreal>

Features of coniferous trees

- ◆ cone bearing evergreens adapted to low temperatures and poor mountain soils
- ◆ needle-like leaves which do not allow snow to collect
- ◆ small surface area also reduces moisture loss
- ◆ shallow root systems for growing on rocky slopes
- ◆ a cone protects seeds during Winter, then breaks open in Spring so seeds germinate in the damp soils.

Exercise

1. Why do you think boreal forests cover such large areas?
2. Why have these areas been sparsely occupied for such a large time?
3. Do you think this type of region could be described as wilderness? Explain.
4. What are conifers considered to be hardy plants?
5. In one or two sentences, describe the beauty of the boreal forest biome.
6. What species of conifer grow in Australia?
7. Using a comparison matrix, identify the main differences between boreal conifers and local trees, say eucalypts.