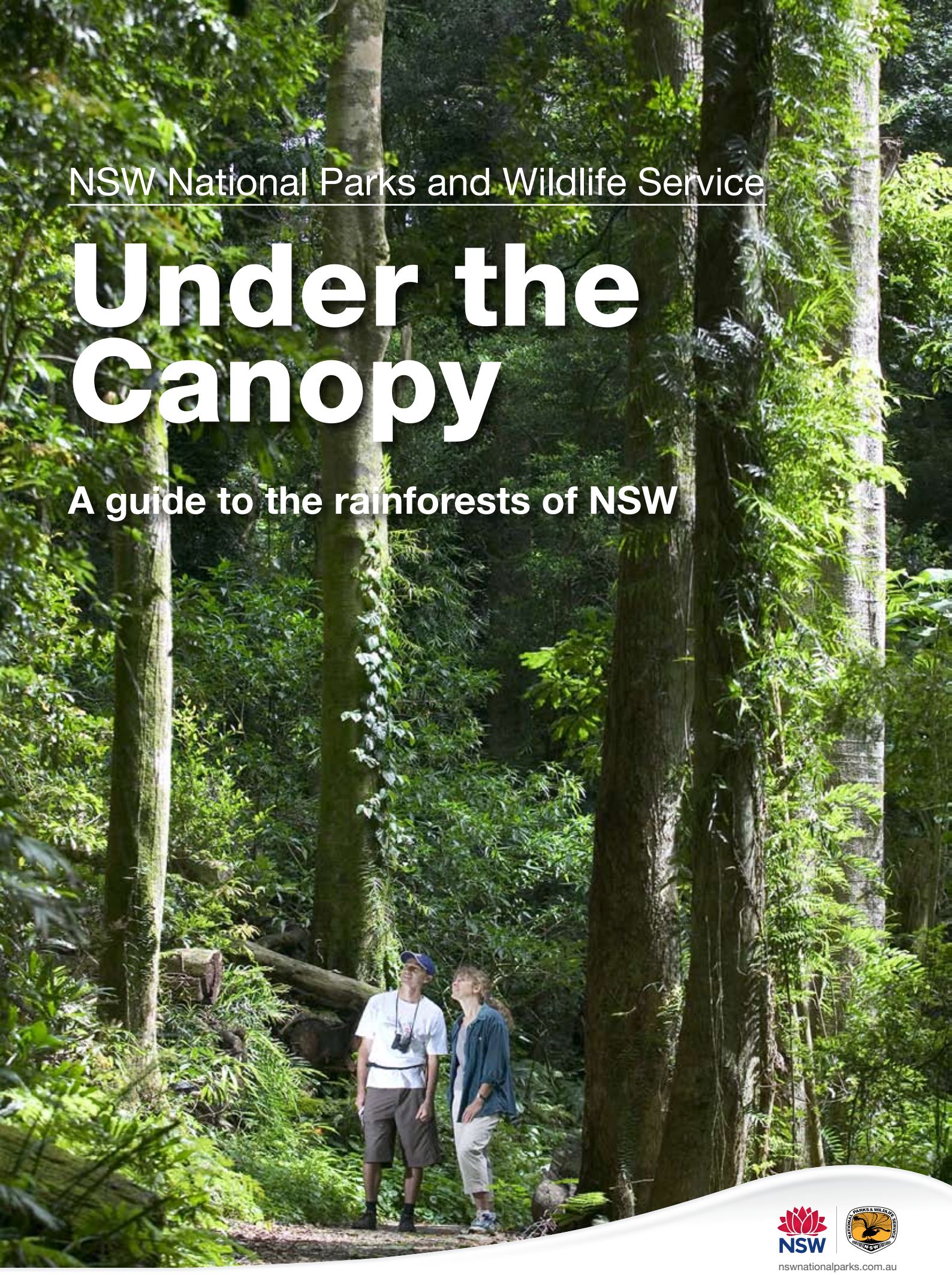


NSW National Parks and Wildlife Service

Under the Canopy

A guide to the rainforests of NSW

nswnationalparks.com.au

CONTENTS

As he saw the rainforest ...

A quote from Clement Hodgkinson, a private surveyor working for the Government in the late 1830s:

"I must here make a digression to attempt to convey to the reader some idea of the very peculiar appearance of that kind of vegetation to which the colobnists have assigned the unmeaning name of brush. It grows on the richest alluvial land, and consists of trees of almost endless variety, and very large dimensions, totally differing in appearance from the ordinary Eucalypti and Casuarinae, which grow in the common open forests of Australia, for the brush trees in general possess a rich umbrageous foliage of bright shining green. The peculiar appearance of the brush is principally caused by the countless species of creepers, wild vines and parasitical plants of singular conformation, which, interlaced and entwined in inextricable confusion, bind and weave together the trees almost to their summits, and hang in rich elegant flowering festoons from the highest branches. The luxuriant and vigorous character of the brush, on alluvial land, in the northern part of the territory of New South Wales, cannot be surpassed in any tropical region."

Cover photo: H. Lund, © Tourism NSW/ Hamilton Lund

Text: John Hunter

Photography: Cath Ball, R. Chapple, Helen Clark, Lyndall Coomber, Harry Creamer, W. Crozier, Allen Friis, Rod Holmes, Peter Kennedy, H. Lund, Greg Meek, Hugh Nicholson, Mark Price, Shane Ruming, Michael van Ewijk, Barbara Webster, Owen Wilson, Geoff Wood.

Design: hcdesign

First published 1991 by NSW NPWS
Revised and updated 2010
Second edition published Feb 2011

ISBN 9781 74232 567 5

DECCW 2010/158

What are rainforests?

When moving from the more typical dry open forest of Eucalypts with their tough leathery leaves hanging vertically, and sunny understorey with resilient shrubs and grasses, into rainforest, the difference is remarkable. A cool stillness is felt and the moist green lush growth creates a feeling of entering another world with softness underfoot and misty light shafting through from the lofty canopy above.

When viewed from below, a 'closed canopy' of trees which excludes at least 70% of the sky broadly defines a rainforest area.

Temperature and humidity fluctuations are therefore much less in the rainforest, moisture levels in the soil remain high, light levels are reduced and air movement is minimal.

These climatic conditions result in the presence of different plants - seedlings of rainforest trees able to regenerate under shade, vines and epiphytes (plants growing on another but not extracting from it) and consequently different animals.

Rainforests are a most interesting visual living link with the evolution of Australia although they now cover only about 0.25% of this continent. They contain about half of all Australian plant species and within that the greatest concentration of primitive plant families which are direct links with the birth of flowering plants over 100 million years ago. Also about a third of Australia's mammals and birds are found in the rainforest.

There are many different types of rainforest but some common features will become clear throughout this guide. One definition alone does not really cover the varieties except that all have abundance of life.

Like the roof of a giant greenhouse

the closed canopy maintains relatively low light, high humidity and constant temperatures within the forest interior. The canopy itself is subject to a full range of light conditions, fluctuating humidities and temperatures and buffering by wind and storms.

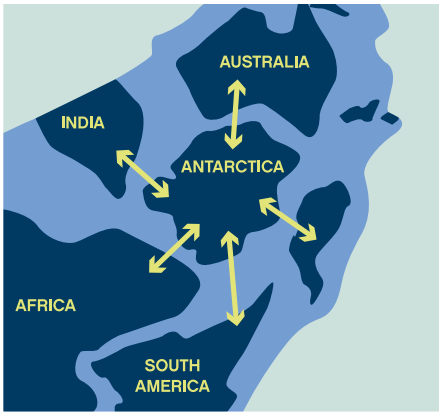
2

How did Australian rainforests originate?

Australia is a fragment of the southern supercontinent Gondwana which started to break up 140 million years ago. As Australia moved north complex events took place affecting climate and the structure of its surface. Continental uplift and subsequent erosion led to the formation of the Great Escarpment, a vast landscape feature highly effective in capturing rainfall. Combined with lava outflows from volcanic activity, conditions well suited to rainforests prevailed over extensive areas.

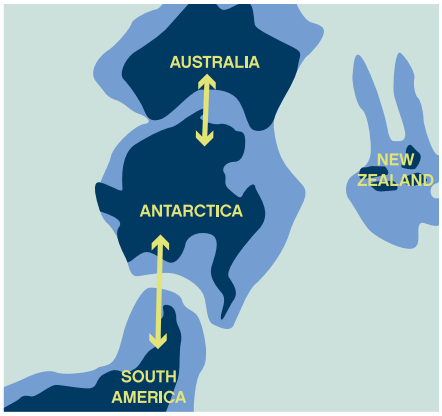
135 million years ago

All the southern hemisphere continents plus India are joined as Gondwana. Rainforest covers much of the supercontinent. Plants and animals can move between all continents.



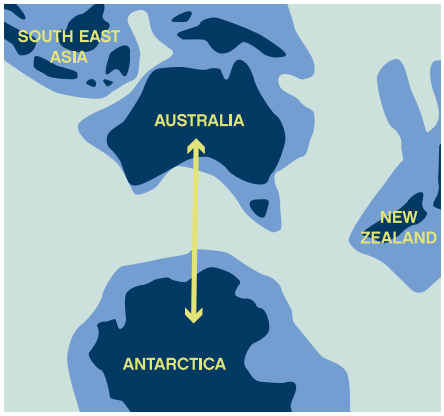
55 million years ago

Africa, India and New Zealand have split off from Gondwana. South America and Antarctica have begun to separate. As the continents split apart and drift towards their present locations, each carries a cargo of Gondwanic plants and animals. As the continents drift, climate and other factors change, placing new stresses on the plants and animals resulting in new adaptations and new species.



15 million years ago

Australia collides with the Asian plate. Plants and animals are able to migrate between the two continents. Some rainforest species which may have evolved from Gondwanic species, carried to Asia on India, are able to migrate to Australia.



Gondwana begins to split. The separate pieces are forced apart.

Australia separates from Antarctica about 45 million years ago. It begins to drift north towards its present location. For 30 million years it is isolated from other continents. Eucalypts evolved in response to decreased soil fertility and climatic change.

About 12 million years ago, Australia became cooler and more arid. The area covered by rainforest was greatly reduced with rainforest being generally restricted to the moister east coast in areas with more fertile soils.

What determines where rainforests occur?

GEOGRAPHIC DISTRIBUTION OF RAINFOREST IS DETERMINED BY THREE MAIN FACTORS - CLIMATE, SOIL AND FIRE.

Climate

Adequate moisture

Rainforests generally favour areas with ample rainfall which is relatively evenly distributed throughout the year. Dry rainforest can however occur in areas with rainfall as low as 600mm per year and with a pronounced dry seaon. Additional suppliers of moisture - mists, fogs, seepage and runoff - are important in some areas. The eastern fall of the Great Dividing Range and the Great Escarpment is a very significant area for rainforest; the mountains naturally force moisture-bearing coastal winds to rise and condense, producing rain and mists.

Temperature

Temperature is particularly important in determining the type of rainforest which occurs. The following types require progressively warmer sites - cool temperate, warm temperate and subtropical.

Exposure

Rainforests are sensitive to strong, dry and often cold winds such as westerlies, and prefer the more sheltered eastern and southern aspects.

Soil

Due to their high water-holding capacity and fertility, soils derived from basic volcanic rocks such as basalt support the best developed and most bio-diverse rainforests to be found in NSW. However, where local topography provides sufficient shelter and protection from fire, even relatively infertile soils can support rainforest.

Fire

Plants in the rainforest are generally not able to survive fire. While fire will normally not burn through rainforest, it can kill trees on the edge and push back the rainforest boundary.

Providing these physical factors are favourable,

rainforest will occur in an area if the rainforest plants and animals are present. The availability of plants is normally dependent on a seed source and means of moving seeds to the area. Animals are particularly important as seed dispersers. They are also vital to the maintenance of the rainforest as pollinators, in breaking down plant and animal debris and in recycling nutrients within the forest. Once established, the rainforest canopy that has been created produces a microclimate within the forest which is very different from that above it or outside the forest. This resultant low light and moister microclimate means that only those species adapted to these conditions can survive, and once established the rainforest is more or less buffered from outside influences.

The types of rainforest in New South Wales

Nowhere in the world other than Eastern Australia is there such an extended strip (over 3000 kilometres) of a more or less continuous series of rainforest types. New South Wales occupies a key position in this series, having within it considerably varied environments.

In New South Wales rainforest is often referred to as 'brush' or 'scrub'. The four main types are subtropical, warm temperate, cool temperate and dry, the latter being semi-evergreen. A fifth is littoral rainforest, named as a result of its proximity to the ocean on coastal sand dunes and headlands - it has features of both the subtropical and dry rainforest types.

While climate may appear to be the main cause of distribution, other local factors are important. Each of the five types can be defined in terms of climate, soil, structure, leaf character and special life forms. However, as there are more than 350 different types of tree and shrub present, this fascinating, self-generating life form is interestingly varied and complex in its makeup.

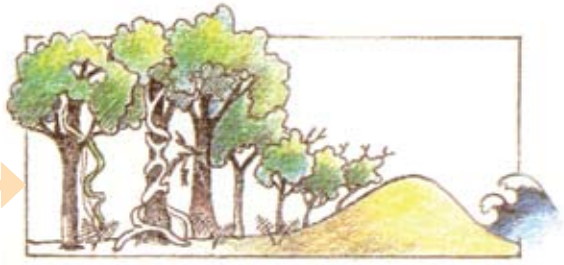
Subtropical rainforest

Warm moist habitat on fertile soils with a rainfall of over 1300mm annually.
Two or three tree strata forming a multi-layered billowing canopy.
Ten to sixteen tree species in canopy.
Tree leaves mostly compound, not toothed, leaves or leaflets over 7.5cm long.
Stranglers, palms, plank buttresses, epiphytes and woody vines prominent.
Large leaved herbs and ground ferns common.

Exposure to salt laden winds would change subtropical rainforest to littoral rainforest.

Littoral rainforest

Warm moist habitats on coastal headlands or on nutrient-enriched deep sands in the lee of coastal dunes.
Generally combining characteristics of subtropical and dry rainforest.
Upper tree canopy often wind-sheared.
Contains an abundance of blunt-leaved tree species tolerant of some salt spray.
Generally of distinctive species composition, conifers prominent in some stands.



Decreased rainfall would change subtropical rainforest to dry rainforest.

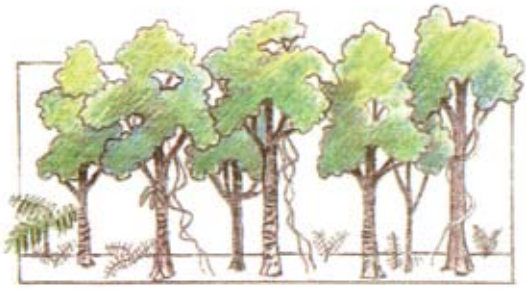
Dry rainforest

Warm habitats on fertile or moderately fertile soils with a rainfall marginal for rainforest, being only 600-1100mm annually with a marked dry spell.
Mostly two tree strata, the upper being of scattered emergents such as hoop pine and lacebark trees, the lower one 6-18m tall and continuous.
Ten to thirty species in lower canopy.
Leaves commonly compound, often thick, hard and under 7.5cm long.
Stranglers and woody vines common.
Palms, plank buttresses and large epiphytes rare.
Shrub layer well developed and prickly.
Herbaceous ground cover sparse.

Cooler temperatures or poorer soils would change subtropical rainforest to warm temperate rainforest.

Warm temperate rainforest

Cool moist habitat on poor often silica-rich soils with a rainfall of over 1300mm annually.
Two tree strata forming an even canopy.
Only three to fifteen species in canopy.
Leaves mostly simple and toothed, over 7.5cm long.
Stranglers, palms, plank buttresses, and woody vines rare or absent. Tree trunks slender and uniform.
Epiphytes common, mainly lichens, not conspicuous.
Ground ferns common.



A cooler and moister climate would change warm temperate rainforest to cool temperate rainforest.

Cool temperate rainforest

Cool reliably moist habitat on poor to fertile soils with a high rainfall (1700-3000mm annually.
One or two tree strata forming an even and uniform canopy.
Only one to three species in canopy.
Leaves simple, toothed, under 7.5cm long.
Stranglers, palms, plank buttresses and woody vines rare or absent.
Epiphytes of mosses and lichens forming dense coverings on tree trunks and branches. Large epiphytes rare or absent.
Ground layer of tree ferns and smaller ferns often very common.

Special features of rainforest plants

Plants have many adaptations for life in rainforest. These special life forms impart a distinctive character to rainforest and some are characteristic of certain rainforest types. Low light availability is a common factor.

1

1. Cauliflory

The production of flowers and fruit on the leafless branches and trunk. Common in the tropics, restricted to a few species in subtropical rainforests of NSW such as Syzygium moorei *(pictured at left).*

2. Epiphytes

Plants using other plants for support but not taking anything from them. This life form has developed to enable the epiphyte to receive adequate light within the low-light rainforest environment. Many ferns and orchids in the rainforest are epiphytes.

3. Buttresses

Swelling at base of tree trunks which are thin and parallel-sided (plank buttressing) or thick and rounded (spur buttresses). They may provide additional support for the tree or help in the uptake of oxygen from soils.

4. Hemi-epiphytes

These begin life as true epiphytes but eventually send roots down to the ground. Examples are found in all rainforest types. Strangler figs are a well known example from subtropical and dry rainforest. Figs may germinate up in the fork of a tree and send a root down to the ground. The root then branches and enmeshes the host tree which eventually dies leaving the fig free-standing.

5. Vines

An adaptation to get from the low-light of the forest floor to the light of the canopy. Large woody lianas are common in subtropical and dry rainforests. Wiry vines are also common in warm temperate rainforest and are the most common vines in cool temperate rainforests.

6. Palms

Particularly common in subtropical rainforest.

7. Ground ferns

Very common in cool temperate rainforest and locally common in subtropical and warm temperate rainforests, but scarce in dry rainforest.

2

3

4

5

6

7

Nutrient conservation mechanisms

Because of the relatively high rainfall, there is a real risk that plant nutrients cycling within the rainforest can be leached out. Rainforest plants have a number of features which help conserve nutrients and make the cycles of nutrients in rainforest very tight.

These include:

- removal of nutrients from leaves before they are shed,
- uptake of nutrients washed down from upper leaves by leaves further down,
- uptake of nutrients by epiphytes,
- aerial roots tapping nutrients in organic matter held in the canopy,
- shallow roots for efficient mopping up of nutrients released from litter,
- associations with fungi in leaf litter.

This results in most of the nutrients in rainforest being held in the plants and explains why rainforest sometimes grows on infertile soil.

8

9

8. Coppices

Shoots produced from the base of some trees which replace the main stem when it dies.

9. Large-leaved herbs

These grow on the moist forest floor in the shade, particularly in subtropical rainforest.

The animals living in our rainforests

Animals can be found at all levels of the rainforest, from the thick leaf litter on the forest floor to the canopy above. A number are known to have evolved specialised relationships with certain plants and with other animals. Some are dependent on a particular type of rainforest. The fruit-eating pigeons for example are usually found in lowland subtropical rainforest. The Hip-pocket Frog favours cool temperate rainforest and the Black-breasted Button Quail is found in the understorey of dry rainforest. In general however, the occurrence and behaviour of many of our rainforest dwellers is poorly known. Indeed, new species are still being discovered.

Northern leaf-tailed gecko

Mammals

Generally rainforest mammals are most active at night. Characteristic rainforest mammals include Red-necked Pademelon, Red-legged Pademelon, Mountain Brushtail Possum, Ringtail Possum and Fawn-footed Melomys. Bats are an important group ofrainforest mammals with about 25 species known from New South Wales rainforests. They include well known types such as the Fruit Bats and less common species such as the Tube-nosed Bat and Dome-headed Bat.

Grey-headed flying fox

Red-necked pademelon

Reptiles

The most common reptiles seen in the rainforests are species most commonly associated with eucalypt forest, including the Red-bellied Black Snake, which have come into the rainforest by way of tracks, clearings and creeks. The rainforest reptiles are generally so well camouflaged that they are not easily seen. They include Southern Angle-headed Dragon, Northern Leaf-tailed Gecko, Burrowing Skinks and Carpet Python.

Carpet python

Superb lyrebird

Eastern yellow robin

Birds

Birds are probably the best studied of the rainforest animals. They are well represented by fruit-eaters and insect eaters. They include distinctive species such as the rainforest pigeons, Paradise Riflebird, Bowerbirds, Brush Turkey, Lyrebirds, Scrub-birds and Parrots. The Noisy Pitta lives on rainforest snails, while birds of prey such as owls and goshawks consume other birds and small mammals. Many of the birds undertake long-distance or local migrations to ensure sufficient food year-round, and remaining lowland forests are very important as winter feeding areas. Moist eucalypt forest with a rainforest understorey is also very important for rainforest birds and provides one of the richest bird habitats in Australia.

Giant barred frog

Frogs

Frogs are well suited to the wet, humid rainforest environment. Rainforest frogs include a diverse range of tree frogs, plus less well-known species such as barred frogs and the Hip-pocket Frog. This last species is remarkable because the male broods the tadpoles in pouches along its sides.

Invertebrates

Insects and invertebrates of New South Wales rainforests are very poorly known. There is a very large number of species present and many are restricted to rainforest. They are often highly specialised and are essential in the rainforest recycling system as leaf-eaters, as decomposers of decaying litter and wood, as food for other animals, as pollinators of flowers and as seed dispersers. One group commonly seen are butterflies and include a number of spectacular species such as the Richmond Birdwing, the largest butterfly in New South Wales. Land leeches are also commonly encountered, and the shells of land snails, of which very many species occur.

Giant land snail

Regeneration under the canopy

Rainforest has a timeless quality, often giving the impression that little has changed for thousands of years. This is however not the case.

Because rainforests are complex, with a multitude of interactions between the different layers of plants, and between the plants and animals, the process of regeneration is also complex.

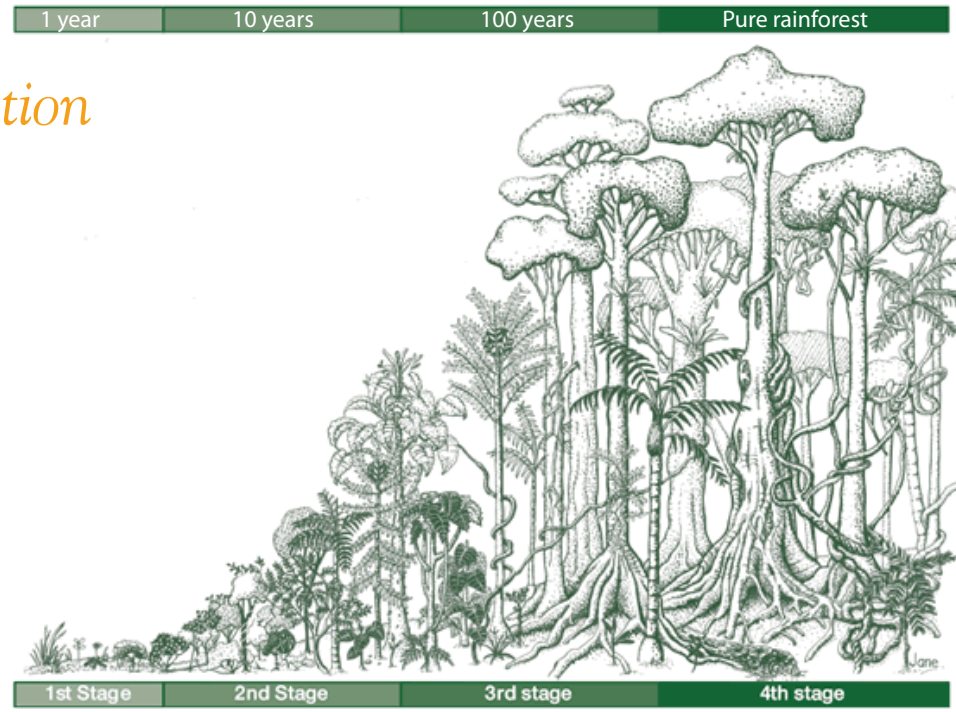
Apart from subtle changes as rainforests gradually evolve over the long term, natural regeneration essentially maintains a dynamic equilibrium within a rainforest stand. The species which occur on any one site may change but the composition of the forest as a whole remains essentially the same. The pattern in any one area is determined by the avilability of new plants and by the type and degree of disturbance which stimulates the regeneration.

Large gaps create significant changes in rainforest environment such a increased light, temperature and wind and set in train a complex 'succession' of plants culminating in a forest which is essentially the same as the original undisturbed forest. There are four stages, involving successive short-lived herbs and small shrubs. Following these are soft-wooded shrubs and small trees, short-lived trees and, finally, long-lived trees can be recognised in this succession. The whole process of regenerating a large disturbed area back to mature rainforest takes hundreds of years.

Each rainforest species has its own place within the dynamic cycles which take place in rainforest. Each has its own particular pattern of seed production and dispersal and the way in which its seed germinates and begins growth. The species which occur early in the succession often produce many seeds every year but seeds of long-lived trees may only be produced at infrequent intervals and sometimes in small numbers. The seeds produced may be moved about by animals such a birds and bats, by wind or water or even by the fruit exploding and throwing seeds out. When animals are involved the fruit or seed is often attractively coloured or displayed. One the seed arrives on a site it may begin growth immediately or lie dormant awaiting the right conditions. Many long-lived trees may then spend a considerable time as seedlings or saplings in the understorey before a gap opens above them and promotes further growth towards the canopy.

The individual life styles of each species and the inter-relations between the plants and animals mean that, while, the direction of regeneration is predictable, the exact species composition at any one spot is often a matter of chance.

Natural regeneration



The status of rainforest conservation in NSW

About 15 % of the three million hectares of remaining rainforest in Australia is in New South Wales. Over 60% of this is protected in nature conservation reserves, but rainforest is still threatened by logging, weed invasion, fire, grazing, clearing for farming and development, rubbish dumping or simply because it occurs in very small patches.

Dry rainforest is the most poorly conserved type, while littoral rainforest is still in a precarious position because the surviving areas are only scattered fragments of the original. Warm temperate rainforest is the best conserved.

With more than three-quarters already gone, the conservation of rainforest will only be adequate when all the sub-types of rainforest and all the species of plants and animals are well represented over their full range.

Of the threatened plant species and communities in NSW, 138 are associated with rainforests, and 81 of these are considered endangered (at imminent risk of disappearing from the wild). Most of the threatened plants occur in the 17% of rainforest which is privately owned. The future of these species is therefore dependent on either purchase of private land, which is very expensive, or sympathetic management of the land by the owner.

It is expected that adequate conservation of all the rainforest sub-types will also result in adequate conservation of most animals associated with rainforest. Several facts must be borne in mind however:

1. Moist eucalypt forest with a rainforest understorey supports more species of vertebrates than the most complex of New South Wales rainforests and most rainforest species use these forests.

2. Many rainforest animals, particularly birds, migrate from the higher altitude rainforests (which are relatively large and well conserved) to lower altitude rainforests (which are largely cleared) in winter. The remaining remnants of the lowland rainforests also support a large part of the populations of some species of animals.

Adequate conservation of rainforest animals must therefore include conservation of associated moist eucalypt forest and preservation of remaining remnants of lowland rainforests.

How can we all help preserve the rainforest?

The best way to help healthy rainforest of course is not to interfere with it and to encourage others to do likewise. As has been previously illustrated human interference has caused untold devastation.

In many parts of New South Wales rainforest exists now only as isolated remnant. Some have suffered from excessively large canopy gaps, invasion by exotic vines, trees and shrubs and disturbance by introduced animals and humans.

Remnants are particularly important as the last vestiges of once more extensive rainforest areas. Many of the rarest rainforest plants and animals have their homes in thes remnants. Increasingly, concerned people are taking action to remove the threats to these areas and to assist the rainforest to recover.

Your guided involvement in this program is welcomed.

Rehabilitation

is the repair of damaged forest and simple remedial steps can be taken. Firstly, removal of outside threats, such as cattle grazing, which endanger the area. The next step is the repair of the canopy, by removing agents such as exotic vines which are destroying it. This allows surviving canopy trees to recover and stimulates the growth of seedlings and saplings in the understorey to eventually close the gaps. Once the canopy is closed the natural processes of regeneration becomes increasingly effective in maintaining the rainforest. Removal of understory weeds may then take place. It may be necessary to weed out exotics for some years before the rainforest is once again healthy.

Replanting

to re-establish rainforest in areas where it previously occurred, to expand remnants or to supplement natural regeneration is also being undertaken. Where a rainforest exists nearby the aim is to establish a 'cover crop' of plants typical of the earlier stages of succession to create the appropriate shade, allowing the later stage species to naturally regenerate. Where seed is not available nearby, long-lived trees must also be planted once early-stage shelter is established. It is important to plant only species suitable for the site and grown from locally obtained seed.

Recycling resources

As individuals we impact on the future but also the past impacts on us. Fortunately our awareness of environmental protection is increasing. The rainforest itself is a magnificent example provided by nature of life, of growth, of adaptation to changes, and the recycling of materials. By our efficient use of energy and resources, the use of products that are pollution-free, and the use of recyclable materials (always ensuring that those materials are passed back into the community for recycling) we will all help preserve our rainforests for future generations.

Join a team

Another way you can become involved in protecting what is left of our rainforests is by supporting one of the following community associations.

Foundation for National Parks & Wildlife
GPO Box 2666 Sydney 2001. Ph: (02) 9221 1949
www.fnpw.org.au

Australian Conservation Foundation
Suite 504, 32 York St Sydney. Ph (02) 8270 9900
www.acfonline.org.au

Landcare
Search for your local Landcare group at:
www.landcarensw.org.au

or your local conservation association which will be listed with the:
Nature Conservation Council of NSW
Level 2, 301 Kent St Sydney 2000. Ph: (02) 9279 2466
www.nccnsw.org.au

World Heritage

World Heritage areas are places which are so important that they have been set aside for all people for all time. These areas include some which are monuments of human culture such as the Pyramids of Giza and the Taj Mahal. Others are natural wonders such as the Grand Canyon.

In 1986 the global significance of the rainforest of New South Wales was recognised: 16 rainforest areas were combined and joined the list of World Heritage areas as The Australian East Coast Temperate and Subtropical Rainforest Parks. Large extensions to the area including reserves in southeast Queensland were listed in 1996 as the Central Eastern Rainforest Reserves (Australia). Then in 2007 the name was changed to Gondwana Rainforests of Australia to better reflect the values of the property. Approximately 50 separate reserves located between Newcastle and Brisbane make up the World Heritage area.

GONDWANA RAINFORESTS OF AUSTRALIA

The World Heritage emblem symbolises the interdependence of cultural and natural heritage: the central square represents Humanity and the circle Nature, the two being intimately linked. The circle is round like the world, but at the same time it is a symbol of protection.

Areas of rainforest in New South Wales were added to the World Heritage list because

1. *They are outstanding examples representing the major stages of earth's evolutionary history,*

2. *They are outstanding examples representing significant ongoing geological processes, geological evolution and human interaction with the natural environment,*

3. *They contain unique, rare or superlative natural phenomena, formations or features, or areas of exceptional natural beauty,*

4. *They are places where populations of rare or endangered species of plants and animals still survive.*

Few places on earth contain so many plants and animals which remain relatively unchanged from their ancestors in the fossil record.