

Tropical Topics

An interpretive newsletter for the tourism industry



Plants without flowers — lichens, mosses, ferns and conifers

No. 61 April/May 2000

Notes from the Editor

Following on from the December issue of *Tropical Topics* (No. 59) which focussed on cycads, this issue looks at the other main groups of plants which manage without flowers. They have ancient origins and flourished back in Mesozoic times when dinosaurs roamed the earth and flowering plants had not yet made an appearance.

Botanists who study these plants can only dream of the time when ferns formed forests and conifers proliferated in the southern hemisphere as well as to the north. They consider these plants to be now in their 'sunset years', in the process of being superseded by the dominant angiosperms. Nonetheless, the plants we see today are the survivors. Some, such as the seed ferns, giant clubmosses and giant horsetails became extinct. However, despite competition from flowering plants which were able to reproduce more efficiently and adapt to different conditions more quickly, an impressive and fascinating variety of non-flowering plants have held their ground.

I would like to thank Gary Wilson of the Queensland Herbarium for his very valuable assistance with this issue.

Mini-ecosystem on a leaf

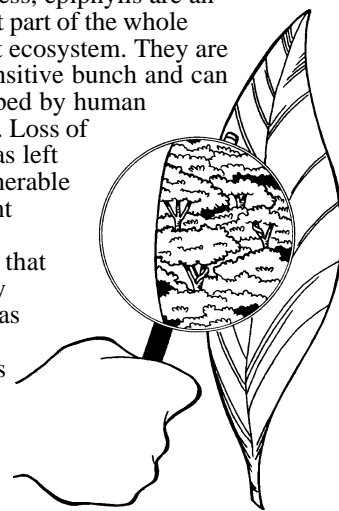
In the forest we tend to concentrate on the big picture — the whole forest, the magnificent trees and any animals we can spot in and around them. We focus on the fresh green (or new red) leaves and tend to ignore those which look a bit blotchy, dirty and old. However, a closer look may reveal an entire ecosystem, with whole communities of tiny plants and animals flourishing right there on the surface of the leaf.

The little plants which live on leaves are called epiphylls. 'Epi' means 'upon' and 'phyll' means 'leaf'. (Epiphyte, the more familiar name used for a number of ferns, orchids and so on, means 'upon-plants'.) Epiphylls include a variety of non-flowering plants including lichens (the main group), mosses, leafy liverworts and algae. Twenty species, or more, may be found on a single leaf. They flourish best where light levels are low, on leaves in the understorey. Indeed, almost every understorey leaf supports at least a few of these plants and among them lives an entire microscopic fauna population of mites, worms and insect larvae as well as bacteria and a number of fungi species. We often talk of biodiversity in rainforests in terms of the bewildering number of tree species but the variety of microscopic epiphylls and their dependent animals make a very valuable contribution to this.

Many of the bacteria which live on leaves play an important part in the rainforest ecosystem by using nitrogen from the atmosphere and recycling nutrients. However, epiphylls can be quite a burden for a plant. A heavy population of them on a leaf significantly reduces its ability to photosynthesise (produce food from sunlight). To discourage this

many rainforest leaves are shiny and their shape, designed to encourage water to run off quickly, is thought to reduce the ability of epiphylls to colonise them.

Nonetheless, epiphylls are an important part of the whole rainforest ecosystem. They are also a sensitive bunch and can be disturbed by human activities. Loss of habitat has left them vulnerable and recent research suggests that some may function as good indicators of forest stress.



Tour-op tip

Take a magnifying glass or hand lens with you into the rainforest to show visitors the leaf-top ecosystems. However, please bear in mind that epiphylls are sensitive. Handle the leaf with care (do not break, tear, squash or remove it) and avoid touching the epiphylls.

An excellent small brochure with coloured, magnified photos, has been produced by the Rainforest CRC. Miniature Gardens on Rainforest Leaves: A guide to common epiphylls in the Wet Tropics can be obtained by contacting them on Ph: 4042 1246 or via PO Box 6811, Cairns, QLD 4870.



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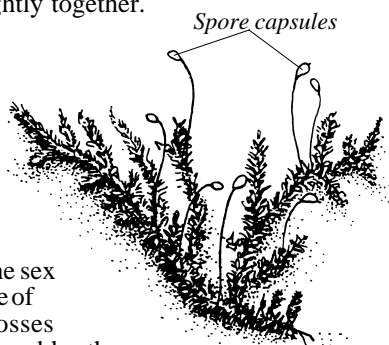
Small and flowerless

Algae

were the first proper plants to evolve and green algae are the ancestors of all of today's land plants. They are very simple cellular plants, with no roots, stems or flowers. While most are found in water bodies, salt and fresh, the notorious blue-green algae forming blooms where nutrient loads are high, others are found on land where conditions are moist. Small forms grow as parasites below the 'skin' (the cuticle) of rainforest leaves.



Mosses represent an evolutionary step up from algae. They have no roots and no system of woody vessels which allow more advanced plants to grow tall. As the first land plants mosses probably created the first forests, mini-ecosystems just 5cm or so high, achieving this impressive height simply by packing themselves tightly together.

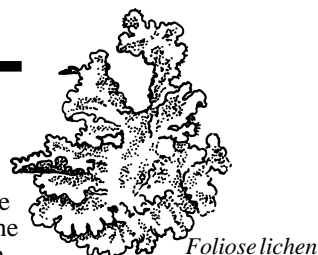


The sex life of mosses resembles the complicated system of alternate generations found in algae. However, mosses keep the next generation at home! Whereas algal male and female cells meet by swimming freely through the water, female moss cells are attached firmly to the parent plant. When they have been fertilised by free-swimming male cells they grow into spore-filled capsules on the end of long stalks. These capsules eventually open to release the spores which are blown away to grow into new moss plants. In some respects, this tendency to retain the female egg on the parent plant resembles the habit of later plants, such as cycads, conifers and flowering plants, to do the same. Perhaps it represents a step along the evolutionary way.

Liverworts are very similar to mosses. However, where the pointed 'leaves' of mosses are arranged in spirals on the stems, liverworts have rounded (liver-shaped) 'leaves' which grow flat in double rows.

Lichens could perhaps be regarded as terrestrial algae.

They are remarkable organisms. Each is a combination of an alga (blue-green or green) and a fungus, functioning together in a symbiotic partnership. The fungus provides the 'root system' (hyphae), drawing up water and minerals for the pair. The rootless alga has the chlorophyll, the green stuff in most plants which enables them to photosynthesise — to create food from sunlight. To do so the alga needs the water provided by the fungus, while the fungus needs the food manufactured by the alga. Together they are a lichen. Generally the fungal threads create the body of the lichen with the algal cells living within them. This gives the lichen strength and prevents the alga from drying out. The fungi also manufacture a type of acid which serves to eat away at underlying rock and provide the lichen with a foothold. Lichens therefore erode rock, very slowly. It has been estimated that they produce a centimetre of topsoil in two thousand years.



Foliose lichen

Many lichens produce small powdery granules called soredia on their surface. These contain both algal cells and fungal threads. When washed or blown away, or carried by insects, they grow into new lichens. Larger upright packets (isidia) work in a similar way. However, sometimes the fungal partners make their own fruiting bodies. These vary in appearance, resembling small volcanoes, cups or jam tarts. When these burst, the fungal spores are dispersed but if they do not pair up with the correct algal cells they cannot develop. (The algal cells, on the other hand, are able to live independently.)

Lichens grow on rocks, walls, trees, fences, roofs and on the ground, as well as on leaves. They are limited by light, needed by the algae for photosynthesis, and also need clean air. The presence of sulphur dioxide, produced when fuels such as coal and oil are burned, and which is responsible for acid rain damage, kills lichens. These plants are therefore good indicators of a clean environment. Since some are more tolerant of pollution than others, the type of lichen growing can tell us how bad the pollution is. However, lichens are very hardy in natural conditions, living in the tropics, on mountain tops, in salty seashore splash zones and even polar regions, where they survive temperatures well below freezing. They can stop growing if conditions are dry, resuming when moisture returns and are usually the first organisms to invade barren ground, such as new lava flows. Here they provide a foothold for other plants to move in.

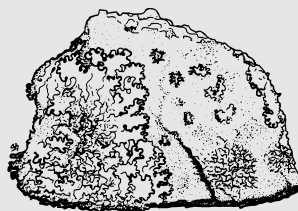
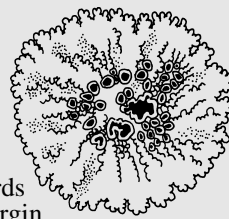
The human element

Lichens were used traditionally in many countries to make dyes for cloth, notably Harris tweed, in Scotland. The dye litmus is also derived from lichens. It changes to red when exposed to an acid and blue when exposed to an alkali. An infusion of the lichen lungwort was used for treating coughs and asthma.

Reindeer 'moss', the staple diet of reindeer and caribou in winter, when nothing else grows, is actually a lichen. Unfortunately, because lichens tend to accumulate certain environmental contaminants, after the Chernobyl nuclear power plant accident in 1986 reindeer 'moss' accumulated so much radioactivity that the Saami people who live in the Arctic were unable to eat their reindeer.

There are three main types of lichens.

Crustose lichens form flat crusty plates. They grow very slowly outwards around the margin, increasing their radius by as little as 0.5mm a year.



Foliose lichens

are leafy in appearance, although the lobed or branched structures are not true leaves. They often grow near mosses.



Fruticose lichens

are even more finely branched and may hang down like beards from branches or grow up from the ground like tiny shrubs. These last two are particularly fussy about clean air but grow faster than the crustose lichens.

Out and about

At this time of year the weather patterns are changing, our rain coming not from the monsoon trough which has retreated back towards the equator but from the south-east trade winds. Instead of thunderstorms and dramatic torrential downpours we will experience a more steady type of rain. With the return of the south-easterlies, conditions on the Reef will become choppy.

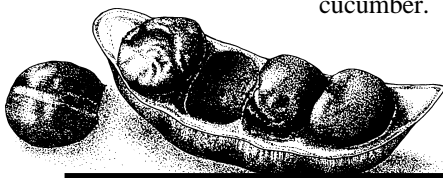
Life in the estuaries changes as the Wet declines with many fish choosing this time to spawn. Without the flooding rains flushing out the rivers, the water becomes cleaner and, as the saline influence moves further inland, some fish retreat upstream.

As we look forward to the dry season ahead, the change marks the end of a time of plenty for many other animals. Insect numbers decline as the weather becomes drier and cooler so frogs, birds, reptiles and other animals which eat them are making the best of them while they last.



Frogs can still be heard calling but this doesn't mean that they are breeding. Male frogs are compelled by instinct to call as a reflex to rain — but do not take it further than that. Times ahead will be particularly challenging for the young frogs which have to compete with each other as well as with the adults for diminishing food supplies.

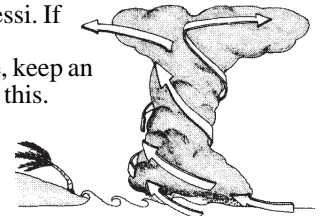
Not many rainforest trees are fruiting at this time of year which makes life difficult for young cassowaries which are being evicted from their father's range as he turns his attention to producing the next generation. One exception is the black bean tree (*Castanospermum australe*) which has been dropping its large leathery pods full of chestnut-like seeds. These seeds contain the toxin saponin but have traditionally been a staple food for Aboriginal people who remove the toxin through a long process of soaking, leaching and roasting the beans. The trees are particularly common alongside rivers where their red flowers sprinkle the ground in spring. The bark of the trunk, when scratched, smells remarkably like cucumber.



Some items, past their 'use-by date', have been removed from the web version of the newsletter.

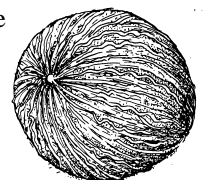
About a year ago, in Out and About (*Tropical Topics* No. 54), you may remember a mention of an apparent coincidence between **cyclones and flowering golden pendas** (*Xanthostemon chrysanthus*). In 1997, approximately five weeks after Cyclone Justin, the golden pendas were blooming magnificently in Cairns. In 1999 they performed the same feat five weeks after Cyclone Rona. Botanists thought it may be a coincidence — but this year, exactly five weeks after Cyclone Steve, residents in Cairns will recall that our streets and parks were golden once again.

Botanists in Townsville are now keeping a sharp eye on the trees there. If there is a connection, they can expect a golden treat around May 7, five weeks after the visit of Cyclone Tessi. If you live in Townsville, keep an eye out for this.



Along the beaches, fruit has been dropping from Alexandrian laurels (*Callophyllum inophyllum*). The name 'Callophyllum' means 'beauty leaf', chosen for the large glossy dark green and densely veined leaves. The round fruits are often dispersed by sea water where they can float for four months due to the oily seed and the air in the tissue between the seed and its shell. The oil, which is poisonous, has been used for lighting and to make a bright yellow soap. The outer grey-green flesh is eventually lost, leaving the fruit covered with fibrous brown strands.

Resilient to cyclones and tolerant of salt, this tree grows right on the shoreline and is one of the best species for coastal protection and shade.



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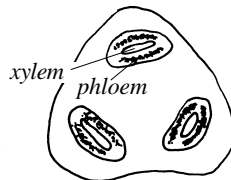
Ferns

Most ferns love the tropics where the warm moist conditions, not unlike those in which they evolved, suit their requirements. As a result the Wet Tropics is home to a wide range of relict ferns — species which have survived from the earliest times. They represent all the major evolutionary fern groups.

Ferns — the advanced model

In the evolutionary development of plants, ferns represent a great advance on all previous models. Whereas all the surface cells of an aquatic alga are able to absorb water and nutrients, on land it is necessary to divide up the tasks, a step which makes the plants more adaptable.

- Roots were a revolutionary new feature dedicated to seeking out less accessible sources of water, thus allowing plants to move inland. They also served to stabilise the larger models.
- Water and nutrients, taken up by the roots, had to reach other parts of the plant so a plumbing system — the vascular system — evolved. Woody vessels (xylem) performed this function, moving water and nutrients upwards. These vessels had a dual function, providing rigidity to the tissues. With these load-bearing structures the plants were able to grow much taller and reach up to the light.
- Leaves were another fern invention — a system of solar panels dedicated to capturing the energy of the sun and turning it into food. Exposed to the air, these had to be sealed to prevent the water gathered by the roots from leaking away so a waxy skin (cuticle) was developed. Since the process of photosynthesis requires an intake of carbon dioxide from the atmosphere and waste oxygen must be released, special design features in the cuticle — pores — allowed this exchange of gases to continue.
- Another plumbing system was needed to move the sugars and other photosynthetic products from the leaves to the rest of the plant. This function was performed by another new system of vessels, the phloem.

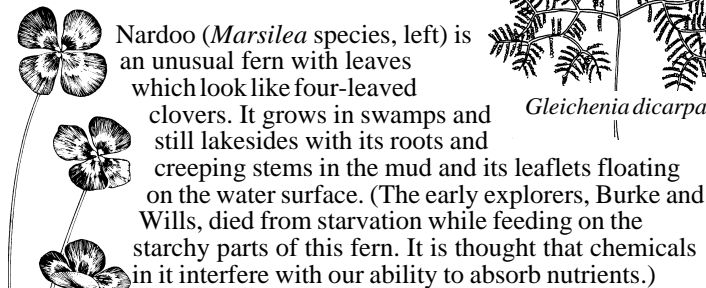


Although ferns were among the earliest vascular plants (algae, lichens, mosses and liverworts are all classed as non-vascular plants) they were not the only ones. The fossil records tell us that at one time the world was dominated by massive clubmosses, giant horsetails and others which created magnificent forests 45m or more in height as they used their newly developed vascular systems to reach higher and higher in competition for sunlight. Many of these plants are now extinct, their relatives hanging on in comparative obscurity.

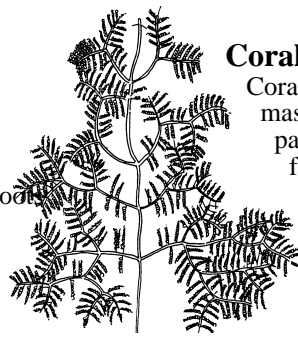
Forty fern species are endemic to the Wet Tropics.

Water ferns

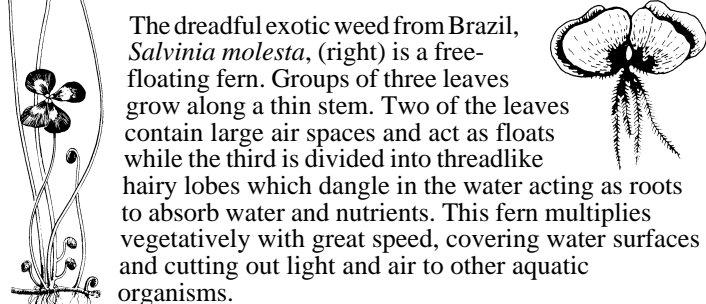
Certain ferns live in water. Some have their roots in the mud while others are free floating.



Nardoo (*Marsilea* species, left) is an unusual fern with leaves which look like four-leaved clovers. It grows in swamps and still lakesides with its roots and creeping stems in the mud and its leaflets floating on the water surface. (The early explorers, Burke and Wills, died from starvation while feeding on the starchy parts of this fern. It is thought that chemicals in it interfere with our ability to absorb nutrients.)



Gleichenia dicarpa



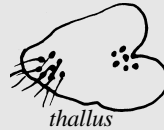
The dreadful exotic weed from Brazil, *Salvinia molesta*, (right) is a free-floating fern. Groups of three leaves grow along a thin stem. Two of the leaves contain large air spaces and act as floats while the third is divided into threadlike hairy lobes which dangle in the water acting as roots to absorb water and nutrients. This fern multiplies vegetatively with great speed, covering water surfaces and cutting out light and air to other aquatic organisms.

Sexual links with the past

Although ferns are structurally more advanced than mosses, like the more primitive algae and mosses their sex life involves two generations and a dependence on water.



- Spores are produced by the fern plant in spore cases, usually beneath the leaf.



- When released, each spore grows into a tiny heart-shaped structure known as the thallus which, in turn, produces male sperm cells at the pointed end and female cells in the notch.

- In the presence of water, the sperm burst free from the thallus and, attracted by chemicals, swim to the female cells.

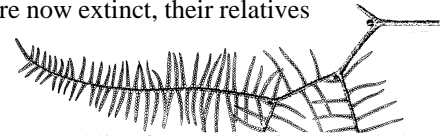


- Following fertilisation, an adult plant develops, eventually dwarfing its 'parent' thallus. Curiously this large spore-producing fern plant is the equivalent of just the tiny spore capsule and stalk of the moss plant while the much more obvious green moss plant is the equivalent of the tiny fern thallus; both produce sex cells.

Many ferns can, of course, increase their numbers asexually by spreading their rhizomes — stems which are either below the soil surface or just above it. Roots grow down from the rhizomes while fronds sprout from the top.

Coral ferns

Coral ferns (left & above) are scrambling ferns which form tangled masses. The multi-forked fronds, which form almost geometrical patterns, can grow to 4m on a long, brown, woolly stalk. They are found in large colonies in a variety of wet sunny sites. They like to have their roots in water and their fronds in the sun.

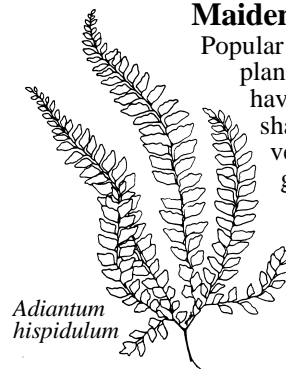


Filmy ferns

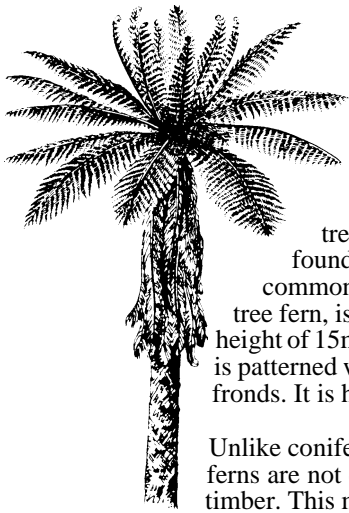
These are extremely delicate ferns with leaf blades just one cell thick. They grow best in humid tropical conditions because the entire leaf surface is open to the atmosphere and they can dry out very easily.

Maidenhair ferns

Popular with gardeners and as house plants, maidenhair ferns (left) usually have fine black stems and frilly fan-shaped leaflets. Some species are very common in the Wet Tropics, growing in moist open sites along river and track banks.



Adiantum hispidulum



Tree ferns

There are seven species of tree ferns in the Wet Tropics, three of them endemic. Although all seven are found in the uplands, only two, the scaly, or Cooper's, tree fern (*Cyathea cooperi*) and black tree fern (*Cyathea rebecca*) are found in the tropical lowlands. The most common and most widespread, the scaly tree fern, is also the largest, growing to a height of 15m with a 30cm thick trunk. The trunk is patterned with large oval scars left by fallen fronds. It is hardy and often grown in gardens.

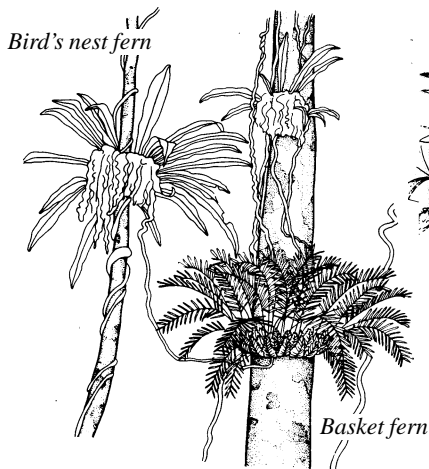
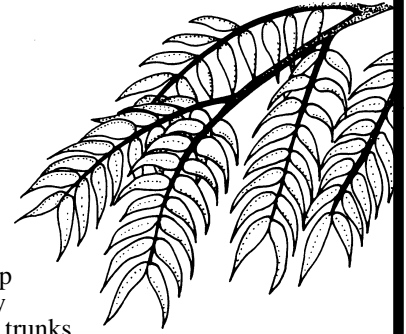
Unlike conifers and other advanced trees, tree ferns are not capable of producing secondary timber. This means that their trunks cannot

become thicker, growth occurring only from the top. The trunk is pithy on the inside but hard on the outside and is often covered with a mass of tough aerial roots. If the tree fern is knocked over these can grow into the ground and develop as normal roots.

King fern (*Angiopteris evecta*)

Easily mistaken for a trunkless palm, the king fern produces possibly the longest fern fronds in the world, growing up to 7m in length. Fronds usually sprout from near ground level, trunks (butts) developing slowly. King ferns like dimly-lit rainforest stream banks and plenty of water. The related potato fern (*Marattia oreades*) has weeping fronds up to 2m long.

Like tree ferns both these giant ferns have an ancient history. Fossils well over 300 million years old, and very similar to the modern versions, have been found on most continents. They predate the dinosaurs.



The Gondwana connection

The name Gondwana, given to the original supercontinent of which Australia was a part, comes from a region of India where the fossil seed fern *Glossopteris* was first described. The widespread geographic distribution of this genus in ancient times was one of the clues which led to the realisation that the continents had once been joined.

Fern allies

A 420 million-year-old clubmoss fossil found in Australia is one of the oldest known land-plants. Although they once grew as enormous trees, present-day clubmosses are more modest plants, known as fern allies. They are not mosses but the arrangement of their tiny pointed leaves in spirals around the stems is moss-like in appearance. They are credited with producing the first cones — long before the conifers developed them to perfection. These are formed from tightly packed leaf-like structures each of which bears spores beneath it.

Fern allies produce two types of spore, small ones which produce male thalli and large ones which produce female thalli. The sperm must then swim the extra distance to find a female thallus before fertilisation can take place.

Selaginella species (left) are pretty, multi-branched fern allies which form low dense carpets in damp shady areas. They too have an ancient history and once formed forests 40m high. Now they rarely reach more than 10cm in height and scramble along the ground producing new roots at intervals along the stems. Little scale-like leaves line the stems. Thin, elongated tips on some branches are the spore-bearing cones made up of modified leaves.

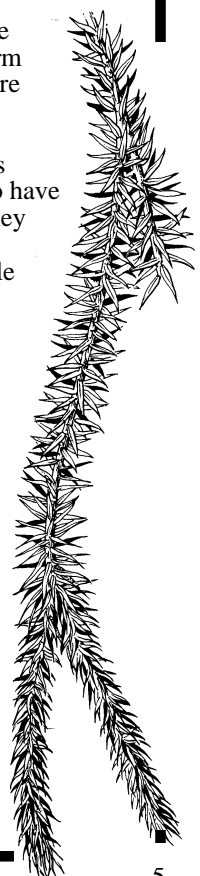


Tassel ferns

This an ancient group of fern allies which has declined dramatically since their peak in the Carboniferous era. The rock tassel fern (*Huperzia squarrosa*, right) which grows in the Wet Tropics today is very similar to 415 million-year-old fossils from Victoria.

Tassel ferns are epiphytes, with long dangling stems. Some end in long tassel-like 'clubs' which are the spore-bearing cones, rather like those on *Selaginella*. However, in *H. squarrosa* the fertile spore-bearing leaves are the same as the normal leaves, a characteristic considered very primitive and indicative of its ancient lineage.

Related to the tassel ferns is a vigorous scrambling ground-creeping version (*Lycopodium cernuum*) which is common along sunny roadsides. It looks like a tiny pine tree with little cones on the erect branches.



Epiphytic ferns

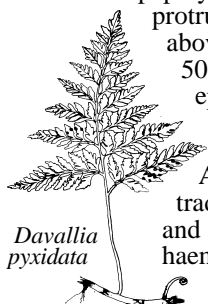
Many ferns types grow on other plants, using them as perches but not stealing any nutrients from them. A number of ferns specialise in this lifestyle in tropical rainforests because the forest floor is too gloomy for them to survive and their only alternative is to perch on the trunk or branches of a tree. They can also survive on rocks and on the ground if there is sufficient light but away from the forest edge it is the spores which land high in a tree which flourish.

Brown sterile leaves hold basket, elkhorn and staghorn ferns in place while the green leaves photosynthesise and produce spores. Trapped dead leaves and other debris provide nutrients.

Hare's foot fern

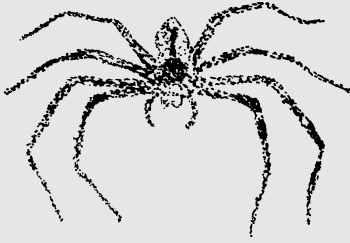
This fern (below) is named for the brown rhizome, or stem, covered with brown papery scales which may protrude from the clump, above the ground, for up to 50cm. It tends to be an epiphyte, growing on rainforest trees, on rocks or on the ground.

Aborigines have traditionally boiled the roots and stems to treat haemorrhaging.



Questions & Answers

Q How dangerous are huntsmen spiders?



A They are largely harmless. Although sometimes referred to as tarantulas, they are not. Huntsmen spiders prefer to avoid people and will invariably run away if they come into contact with them. They will bite if trapped in shoes or clothing but in most cases, although the bite might be quite painful, it does not cause any severe symptoms. (It is always important to remember that individual sensitivities vary so some people may react more severely — but it is very unusual.) The exception is the group of *Neosparassus* species (previously known as *Olios*) — the shield, or badge, spiders. Their bites can cause illness.

The bodies of most huntsmen spiders are flattened, their long legs stretching out crab-like to the side giving some a leg-span of 10cm or more. Their shape enables them to fit into tiny cracks and they often hide under bark. They move very quickly, often sideways. Generally flecked brown or grey, they are usually well-camouflaged. Badge spiders get their name from the 'shield' pattern of two or three colours, including black, yellow, red, orange and white, underneath the body. They are yellow-brown above and are not as flat as the other types. By day most huntsmen hide

under bark and at night hunt over tree trunks and the ground, possibly coming inside houses. Badge spiders, however, are more common in foliage.

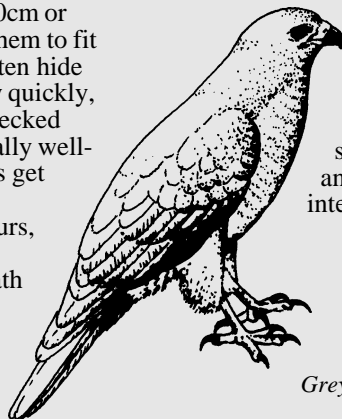
Huntsmen spiders do not spin webs but, as their name suggests, hunt their prey by running it down. The female (which, unusually in the spider world, does not eat her mate) creates a pure white egg sac which she guards, or carries with her. The little spiderlings stay with her until ready to disperse.

Although harmless, on the whole, huntsmen spiders may have been responsible for scaring some people to death — by appearing in a car and giving the driver such a fright that he or she has crashed the car.

Q How can I stop goshawks from attacking the birds in my aviary?

A Cover it at the top. This will first of all prevent your birds from being able to see the goshawk, which will prevent them from panicking. Birds of prey such as goshawks, particularly young inexperienced ones, will be attracted to the flapping movements which could, in their

eyes, indicate an injured and vulnerable bird. A cover also prevents the goshawk from seeing the birds and taking an interest in them.



Grey goshawk

Facts and stats

Worldwide, there are 26 900 named species of algae, 15 000 known species of lichens, about 20 000 species of mosses and liverworts, over 12 000 species of ferns and about 800 species of gymnosperms (the conifers, cycads and the ginkgo).

In Australia there are 390 native species of ferns, 47 species of fern allies, 38 species of conifers (39 of them endemic) and 69 species of cycads — all of them endemic.

The Wet Tropics is home to 65 percent of Australia's fern species, 37 percent of its conifer species and 21 percent of its cycad species.

Epiphylls can bio-accumulate metals. Some in New Caledonia are known to accumulate nickel, concentrating it from traces in host plants growing in nickel-rich soils.

The spore of a clubmoss fern may take as long as seven years to germinate and may not produce sex cells for another 15 years.

Conifers evolved about 280 million years ago.

The twin kauris at Lake Barrine are bull kauris (*Agathis microstachya*). A rare species, the bull kauri is found only at 150-1200m within a maximum geographic range of less than 100km. This species has a coarse flaky bark.

Kauri pines get their name from the Maori name of the related New Zealand species.

The Wollemi pine

The discovery of the Wollemi pine (*Wollemia nobilis*) has been called the botanical find of the century. This tree, previously known from fossils, was thought to have died out more than 50 million years ago — until October 1994 when a National Parks and Wildlife Service staff member found a stand of the trees growing in a rugged and inaccessible area of the Wollemi National Park. Although less than 200km from Sydney, in the northern sector of the Blue Mountains region, these green dinosaurs were growing in a remote gorge almost never visited by people. Nevertheless, a second stand of the pines was found the following year. Only 38 adult trees and about 150 young ones are known to exist in the wild. However, this plant has now been extensively propagated and will soon be available to the public.

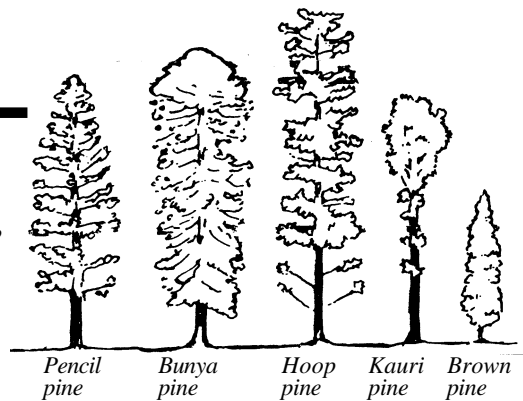
The Wollemi pine is thought to belong to a genus previously known only from fossils found in Tasmania and New Zealand.

Tourist talk

ENGLISH	GERMAN	JAPANESE	
algae	Algen	sourui	藻類
fungus	Pilz	kinrui	菌類
lichen	Flechte	chi	地衣
moss	Moos	koke	苔
fern	Farn	shida	羊齒
conifer	Nadelbaum	kyuka shokubutsu	毬果植物
spore	Spore	houshi	孢子
fossil	Fossil	kaseki	化石
epiphyte	Scheinschmarotzer	chakusei shokubutsu	着生植物
generations	Generationen	sedai	世代
cone	(Tannen-) Zapfen	kyuka	毬果

Conifers

The word conifer usually conjures up a vision of cold northern forests of Christmas trees. However, back in Mesozoic Era (250-65 million years ago), when dinosaurs were alive and well, along with cycads they dominated the vegetation of a warm wet world. Although the newcomers, the flowering plants, eventually took over the dominant position, conifers were not overwhelmed. The new dry cool conditions which followed their heyday may not have suited them, but they live on, side by side with their more successful cousins. Indeed, they often tower above them.



The Wet Tropics contains the most ancient lineages of the conifers. Thirty-seven percent of Australia's species are found here and five of the 14 species are Wet Tropics endemics, meaning that they are found nowhere else. Unfortunately many trees have been removed by loggers for their valuable timber.

Conifers in the Wet Tropics tend to grow best in the more inhospitable terrain and are more common in dry rainforest. However, they are sensitive to fire, so have persisted best in protected gorges, on steep slopes and rocky outcrops or coastal islands, sometimes creating large stands. Fond of ridge tops, some indulge in 'cloud-stripping' — grabbing moisture from passing clouds.

Many of the tropical species defy the conventional image of a conifer by having relatively broad leaves. In this respect, they closely resemble the ancient leaves which have been found as fossils; in some cases they are almost identical. Broad leaves allow their owners to make the most of poor light when, as young trees, they are shaded by others in the forest.

Creating the cones

Cycads, conifers and their fellow gymnosperms finally eliminated the need for alternate generations — and a dependence on water — when they evolved seeds which could be fertilised when attached to the parent plant. However, one did not develop from the other. They represent different evolutionary experiments with similar results.

Whereas cycad plants are either male or female, most conifers bear both male and female cones which makes wind-blown pollination more efficient. When a pollen grain reaches the female cone it may take as long as a year to grow a tube to the egg. The male sperm is then drawn down the tube (unlike cycad and ginkgo sperm it cannot swim). The fertilised seed spends up to a further year in the cone as food supplies and a waterproof coating are built around it. When it is ready, the cone dries and opens to release the seeds. Conifer cones are quite different to, and more complex than, cycad ones.

The **hoop pine** (*Araucaria cunninghamii*) has gained its name from the long-lasting bark which persists in large hoops after the centre of a fallen tree has rotted away. Growing to 50m and even 70m in height, it emerges above other trees — although it could have taken 200 years to get there. Hoop pines tend to reproduce at intervals of up to eight years at which time one tree is capable of producing 500 cones, each containing about 800 seeds. Hoop pine timber is valuable and these trees are now grown in plantations in southern Queensland.

Bunya pines (*Araucaria bidwillii*) are found in three areas of Queensland — the Bunya Mountains in the south-east and in isolated pockets in the Wet Tropics at Mt Lewis and Millaa Millaa. Growing to 40m in height, these trees have dense rounded crowns with clusters of leaves on the end of numerous horizontal branches. Large female cones, weighing up to 10kg, are produced at the top of the tree. The nuts provided abundant food for traditional gatherings of Aboriginal people, held every three years when the crops were heaviest.

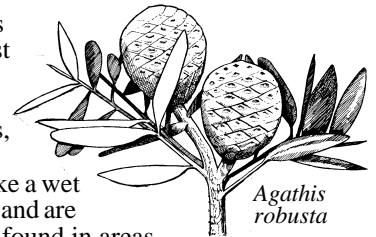
The brush cypress pine

(*Callitris macleayana*), the most 'primitive' of the pencil pine group, is found in rainforest margins, mainly on the Mt Windsor and Atherton Tablelands in the Wet Tropics (as well as in south-east Queensland and NSW). It can grow to almost 40m in height with needle-like stems and woody cones which attract sulphur-crested cockatoos to gobble the seeds.

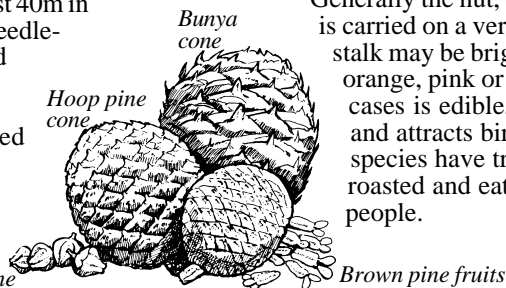


The **kauri pines** (*Agathis* species) rival the hoop pine in height. Unfortunately many of the most magnificent specimens, some of which were over 600 years old, have been cut for timber. The twin kauris at Lake Barrine are 50m in height with diameters of over 2m. They are thought to be over 1000 years old.

Perhaps the most tropical of conifers, kauri pines like a wet climate and are usually found in areas where there is more than 2000mm of rain a year and no pronounced dry season. *Agathis*, the scientific name, means 'ball of thread' in Greek and refers to the appearance of the female cone. Trunks of these trees are surprisingly cool — try hugging one on a hot day.



The Wet Tropics is a centre of diversity for various species of podocarps, often referred to as **brown** or **black pines**. They tend to grow on dry ridges or in sandy areas. It is difficult to spot these trees as conifers. Not only are their leaves relatively broad, but the male reproductive units resemble tiny fuzzy 'flowers' and they produce fruits rather than cones. These fruits have earned the name 'plum pine' for several species. Generally the nut, enveloped in flesh, is carried on a very swollen stalk. This stalk may be brightly coloured, orange, pink or red, and in most cases is edible, though not tasty, and attracts birds. Seeds of some species have traditionally been roasted and eaten by Aboriginal people.



Pencil pine cone

Brown pine fruits

Tour-op tip

Visitors, particularly from the northern hemisphere, who have a fixed idea of a conifer with needle-like leaves, are often surprised by our relatively broad-leaved conifers. Identify a kauri pine or a podocarp on your route and point it out. Explain that these conifers are relicts of the earliest 'dinosaur' conifers and that pine trees are a more recent evolutionary development. Casuarinas, on the other hand, have needle-like stems (with tiny scale-like leaves), insignificant male flowers and cone-like fruits — but they are flowering plants, not pines!

Bookshelf

Australia's Gondwanan Heritage

Interpreting the evolution of Australia's Wet Tropics flora
Compiled by Tony Roberts
Flecker Botanic Gardens/Cairns City Council

This booklet is designed to compliment the excellent interpretive walk which is next to the Flecker Botanic Gardens, on the corner of Collins Avenue and MacDonnell St, Edge Hill, Cairns. The walk, which starts opposite the side gate to the Gardens, on MacDonnell St, is divided into seven zones. Each zone has a sign describing each step in the evolution of plants and is surrounded with examples of the appropriate species. The booklet reproduces these signs along with details of the associated plants and gives some background on Gondwana. It is available from the office at the Gardens.

Tree ferns of the Wet Tropics

Mike Trenerry
Wet Tropics newspaper Dry season 1998

This article provides information on the seven species of tree ferns found in the Wet Tropics.

Ferns of Queensland

A handbook to the ferns and fern allies
S.B Andrews
Queensland Department of Primary Industries (1990)

With fine drawings this is a detailed guide aimed at the botanist.

The Nature of Hidden Worlds

Mary E. White
Reed Books (1993)

The Greening of Gondwana

Mary E. White

Reed Books (1993)

Both these books focus on the fossil history of Australia, the second with an emphasis on the ancient plants.

It is always worth looking at children's books in your local library. They are often a useful and colourful source of information. Two such books are:

Ferns

Theresa Greenaway
Green World series
Heinemann (1991)

Lichens

Heather Angel
Junior Nature Series
Angus & Robertson
(1980)



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While all efforts have been made to verify facts, the Department of Environment and Heritage (EPA) takes no responsibility for the accuracy of information supplied in *Tropical Topics*.

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Environmental Protection Agency

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**WET TROPICS
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