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EXPLORING WHEATBELT WOODLANDS

Mike Bamford

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

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ABOUT THIS BOOK

The wheatbelt region of southern Western Australia is a vast, grain-growing area from which most of the native vegetation has been cleared. This vegetation included woodlands of majestic trees like salmon gum and wandoo. These woodlands are now reduced to remnants scattered across the farming landscape. This booklet is about these woodlands and the life that can be found in them.

The introduction considers general features of woodlands and their history of decline. This is followed by sections on their flora and fauna. As it isn't possible to describe all the species of plants and animals that occur in the woodlands, the intention of these sections is to describe those elements of the flora and fauna that give the woodlands their character. Concluding sections deal with change in the woodland ecosystem, threats to woodland life and solutions for the conservation of woodlands.

Common names are used throughout, except where these are not available, as with some insects and spiders. Scientific names of all animals and plants mentioned in the text are listed in the Appendix. Common names are shown in bold type where an individual species or particular group is discussed in detail.

The information used in this booklet has, with the exception of some anecdotal information, been drawn from the books, articles and conference proceedings listed under the References and Further Reading section.

Not all of the native vegetation that once covered the wheatbelt was woodland. Other vegetation types, such as wodjil and kwongan shrublands and mallee, were also widespread. These types of vegetation and their wildlife will be considered in future booklets. The special environment created by the granite outcrops that dot the wheatbelt landscape has been described in the booklet *Exploring Granite Outcrops*, produced by the Department of Conservation and Land Management.

INTRODUCTION

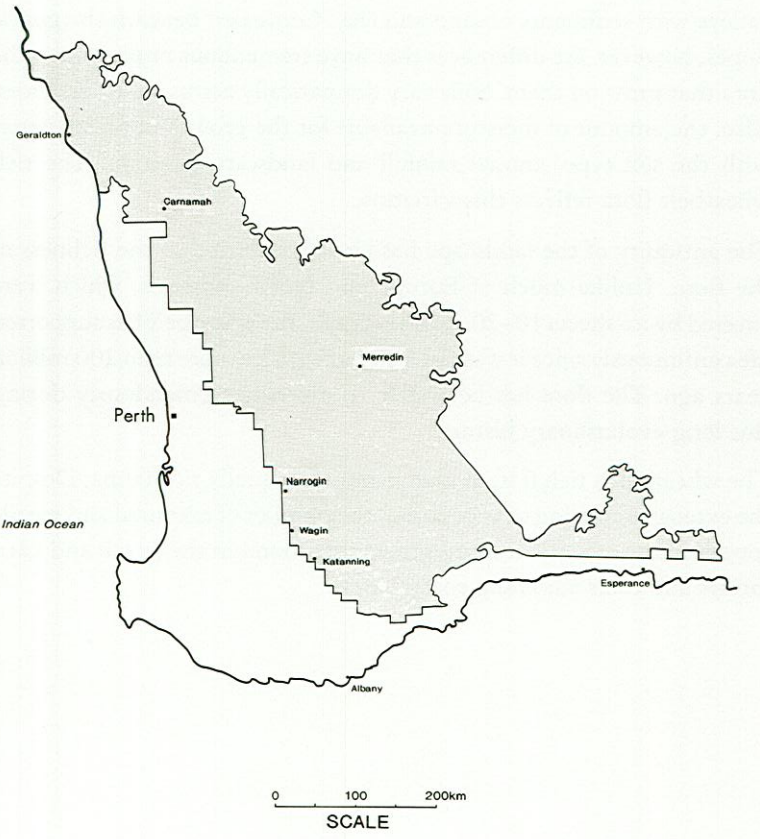
THE WHEATBELT

The wheatbelt region of Western Australia is that part of the State in which wheat is the major cereal crop. The region (see Figure) covers an area of more than 100 000 square kilometres, and in 1989–90 produced more than 30 per cent of Australia's wheat. The undulating landscape of the wheatbelt appears uniform, but appearances are deceptive. The landscape lacks mountains and steep valleys because it is ancient; so ancient that the mountains have eroded and filled the valleys with sediments of sand and clay. Concealed beneath the gentle slopes, however, are differences that have tremendous impact upon the flora that grow on them. Soils vary dramatically across short distances. Also, the amount of moisture available for the growth of plants varies with the soil type, annual rainfall and landscape position. The rich wheatbelt flora reflects this variation.

The antiquity of the landscape has also contributed to the richness of the flora. Unlike much of Europe and North America, which were covered by ice sheets 10–20 000 years ago, the wheatbelt has supported life continuously since it was last covered with ice more than 200 million years ago. The flora has been able to diversify tremendously during this long evolutionary history.

The wheatbelt's rich flora is matched by an equally rich fauna. Despite the extensive clearing of vegetation, the number of mammal and reptile species in the wheatbelt outnumbers that found in the jarrah and karri forests and their adjoining coastal areas.

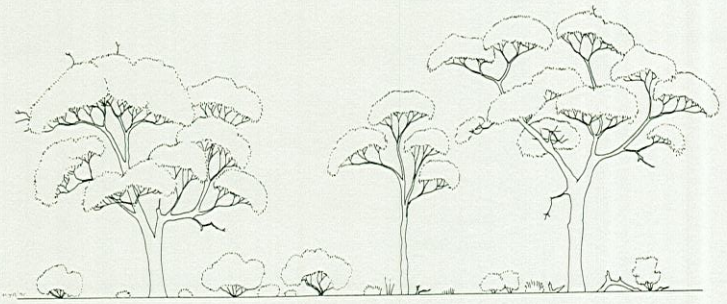
Wheatbelt of Western Australia



'wheatbelt' after D Murray from "Western Landscapes", edited by J Gentilli, published by UWA Press (1979)

THE WOODLANDS

A significant part of the wheatbelt was covered by woodlands. To many people, this term might convey an image of large, widely-spaced trees (see Box) with patches of shrubs beneath; a somewhat wooded park. To a botanist, the term applies to vegetation where the foliage of the trees shades 5–30 per cent of the ground at midday. Beneath the trees are shrubs of various heights, herbs and other plants, but these have no effect on the definition of the vegetation as woodland. In wheatbelt woodlands, such understorey vegetation tends to be sparse and patchily distributed, perhaps because the trees take up most of the seasonal and scanty rain.

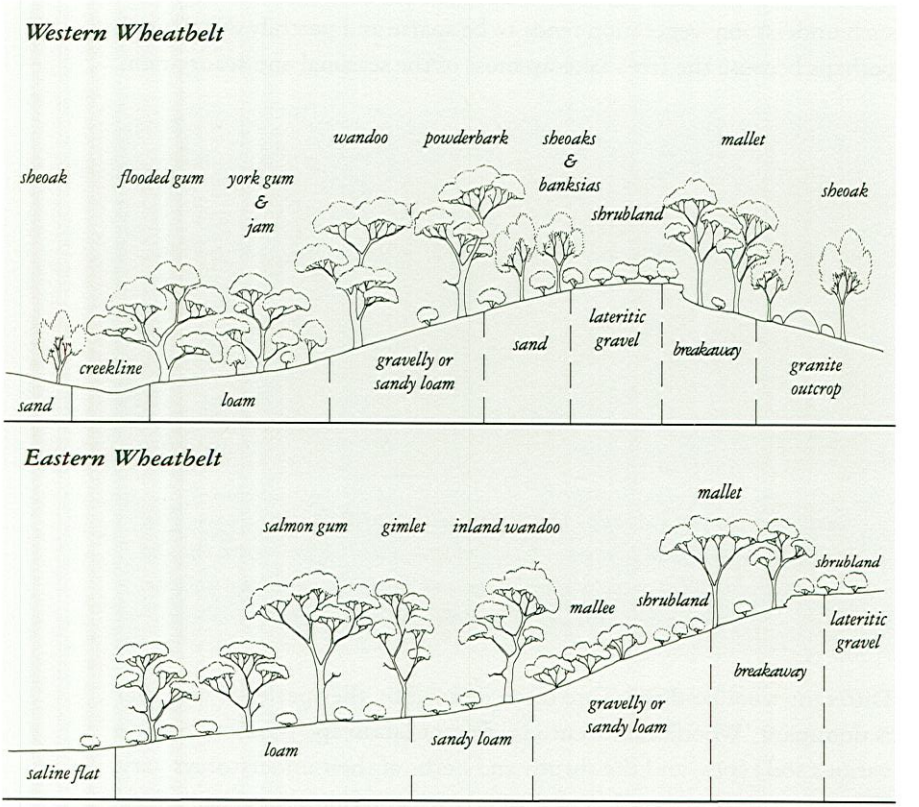


WOODLAND STRUCTURE

Woodland is composed of widely spaced trees with an understorey of shrubs. Trees are normally more than five metres high and have a well-defined trunk with no branches less than half a metre above the ground. Shrubs are normally less than five metres high and branch close to ground level.

Different woodland types are often defined by the species of tree that is dominant. Woodlands occur in different landscape positions and on various soil types, and the shrubs and herbs of their understoreys vary. These complexities result in a mosaic of vegetation types that affects the animals present. Wheatbelt woodlands have a richness of plant species not encountered in many parts of the world. An area of 100 square metres can support up to 75 species of plants; the same area in an English woodland supports up to 12 species of plants.

Wheatbelt woodlands not only vary across a valley, but differ from one region in the wheatbelt to another. Annual rainfall declines from 500 mm to 280 mm as one travels from west to east, and differences in the woodlands occur along this gradient. Trees and shrubs typical of the woodlands in the west give way to other species as one journeys east.



Landscape position and soils of woodlands and other vegetation types in the western and eastern wheatbelt. Major tree species are shown.

WHEATBELT WOODLANDS: A HISTORY OF DECLINE

In the nineteenth century the Swan River Colony of mostly English settlers struggled to become established on the generally infertile coastal plain. Attention soon shifted across the Darling Scarp to the valley woodlands of the western wheatbelt. These provided good grazing for stock and were the first wheatbelt areas used by settlers. The York gum and jam wattle woodlands, with their abundant herbs, were particularly attractive. By the late nineteenth century the more fertile soils, which occurred on the timbered valley floors, were being cleared for agriculture.

During the settlers' early struggle to become established in the wheatbelt, sandalwood cutting and mallet bark stripping (see pages 16 & 32) had a dramatic impact on specific woodlands. Woodlands were also logged for structural timber and fuel. The intensity of logging increased around the turn of the century, and woodlands along the goldfields pipeline were extensively cut to provide fuel for the steam engines that pumped water to the goldfields. Later, when petrol was rationed during World War II, timber from the woodlands provided fuel for the charcoal burners used in the production of gas.

As the twentieth century progressed, agriculture expanded in waves under the impetus of changes in technology and population numbers. The woodlands retreated before this expansion. Even the remnants of woodlands left on farms suffered, as domestic stock grazed understoreys and regenerating saplings, and as farmers attempted to destroy the haunts of rabbits.

By 1940, despite decades of clearing for agriculture, vast tracts of the woodlands remained. Clearing was slow, transport of produce was difficult and the area of land that one family could farm was restricted by the limitations of their machinery. All of this changed with the end of World War II.

Soldier-settlement schemes that followed World War II saw the development of many new farms, but the biggest impact was from technology. Surplus army bulldozers, trucks, tanks and four-wheel-drive vehicles were suddenly available and were put to use. Tanks and bulldozers, dragging huge steel balls and chains, revolutionised clearing.

In a mere 30 years, from the late 1940s to the late 1970s, as much land was cleared in the wheatbelt as had been cleared over the previous century. Much of this was mallee, wodjil and kwongan, but a lot was woodland.

Only about seven per cent of the native vegetation of the wheatbelt escaped clearing for agriculture. The figure is less than this in some shires: Tammin, 3.2 per cent; Corrigin, 4.2 per cent; Quairading, 4.6 per cent; Dowerin, 4.8 per cent; Wongan-Ballidu, 5.2 per cent and Goomalling, 6.0 per cent. Woodlands were selectively cleared as their soils were favoured for agriculture and some woodland types, like those of York gum and wandoo, were more than 97 per cent cleared. Undisturbed woodlands of York gum, jam wattle and salmon gum are now almost non-existent in the wheatbelt. If the wheatbelt is viewed from the air, the remnants of native vegetation lie scattered about like discarded jumpers on a football field, linked by the thin, dark threads of trees and bushes along roads.

The tiny proportion of woodlands that survived did so for various reasons. Patches on private land were sometimes retained on rocky areas, creeklines and other areas unsuitable for agriculture. Other areas were kept as protection for sheds and houses, or to supply firewood and fenceposts. Many remnants that contained poison plants survived stock grazing as they were well fenced.

Most of the woodlands that are in good condition were set aside in Crown reserves for special purposes. Examples include woodlands around townships, along roads and on land gazetted for purposes such as water supply, stopping places (for 'travellers and wayfarers' in the old days), gravel and timber. Valuable woodland reserves for nature conservation, such as those at Boyagin and Dongolocking, were originally reserved largely for timber and other forest products. Few reserves were originally gazetted for conservation except in those areas opened for agriculture since the mid-1960s. Most of these reserves are in the northern and eastern wheatbelt, which were the last areas to be cleared; the vegetation types within them tend to be mallee, wodjil and kwongan shrubland rather than woodland.

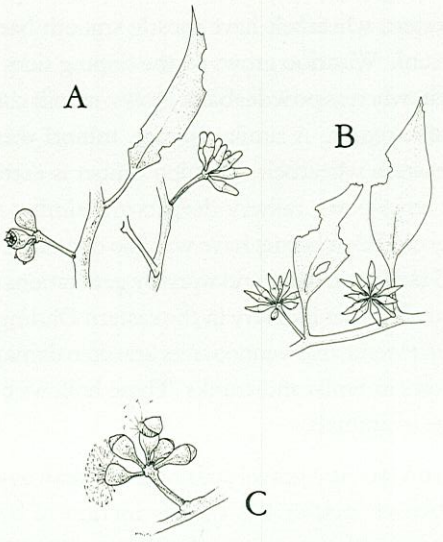
LIFE IN THE WHEATBELT WOODLANDS

WOODLAND PLANTS

The most obvious living things in woodlands are the trees, shrubs and other understorey plants. Together they provide the source of most food chains and the major supply of shelter. It would take many volumes to describe the diverse woodland flora. Here, we only have space to describe the more commonly encountered plants.

Trees of the wheatbelt woodlands

Most of the trees in the wheatbelt are eucalypts (gum trees). More than 50 species occur in the region, making it one of the richest areas for eucalyptus trees in Australia. Many more species of eucalypts occur in the wheatbelt in the form of mallees. These are multi-stemmed eucalypts arising from a lignotuber (called a 'mallee root').



Buds, flowers and fruit of: (A) brown mallet; (B) wandoo; (C) York gum. The operculum or bud-cap usually falls from the bud as the flower opens, as shown for the York gum. May Gibbs used the fallen caps of eucalypts as hats for the Gumnut Babies she created in her famous books.

Wheatbelt eucalypts include smooth-barked species that shed their bark in long strips each year as they grow, and other species with rough bark which flakes off throughout the year. Different species of eucalypt are often distinguished by their bark and by details such as the shape of the operculum (bud cap) and fruit. The different species often grow in different soil types and their distributions reflect the hidden variations in wheatbelt soils (see page 12).

York gum was once widespread in the fertile valley floors of the western wheatbelt and around rock outcrops. One of the eucalypts with rough bark, it is a low, spreading tree which often branches close to the ground. York gum woodlands were among the first to be developed for agriculture.

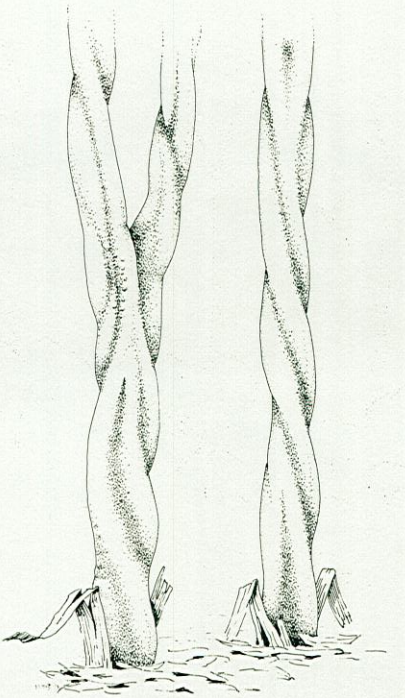
In contrast with York gum, the two other most common species of eucalypts in the central western wheatbelt have mostly smooth bark and usually a single, straight trunk. **Wandoo** grows on the sloping sides of valleys in the western wheatbelt, whereas **powderbark** grows on soils containing laterite (gravel) in the same region. A similar species, **inland wandoo**, grows in the central and eastern wheatbelt. Wandoo timber is extremely hard and was favoured for fence posts, railway sleepers and timber decking in carts and trucks. Many old Perth homes have wandoo doorsteps and even entire floors — the hard timber polished and worn by generations of feet. Wandoo still supports a small timber industry in the eastern Darling Scarp. Despite the hardness of their wood, live wandoo trees are often damaged by termites, which cause hollows in limbs and trunks. These hollows provide valuable shelter for a range of animals.

Growing mainly on lateritic gravel soils near breakaways in the western wheatbelt, the **brown mallet** has the distinction of being one of the first Australian trees to be grown in plantations. Its bark was used for the extraction of tannins, used in the tanning industry, before the development of synthetic substitutes in the middle of the twentieth century. A similar species, the **silver mallet**, is found on lateritic plateaux in the central and eastern wheatbelt.

The **salmon gum**, named for the salmon-pink colour of its bark in autumn, is the most widespread of wheatbelt trees and occurs throughout the wheatbelt, but is most common in central and eastern areas, in fertile valley soils. It is also one of the largest species, reaching a height of 20 metres and a trunk diameter of close to one metre. Although salmon gum woodlands have been mostly cleared for agriculture, large specimens often survive on roadsides and in paddocks; retained to provide shade for livestock or shelter for buildings.

A salmon gum retained in a paddock to provide shade for stock. This tree will eventually die and will not be replaced by natural regeneration.

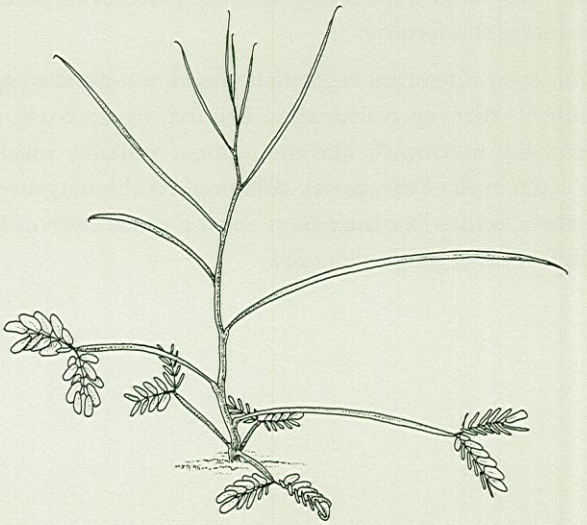
Other eucalypts of the central and eastern wheatbelt are **gimlet** and **morrel**. Gimlets grow in heavy valley soils and in some areas occur in dense stands of hundreds of slender stems packed tightly together. These may be areas regenerating after fire or after logging for firewood in the late nineteenth and early twentieth centuries. Large gimlets, up to half a metre in diameter at the base and 20 metres high, are a rarity. Morrel grows in clay soils of valley floors, often adjacent to natural salt lakes.



The elegantly fluted trunks of gimlets. The name gimlet comes from a carpenter's boring tool, which looks like a corkscrew.

Although eucalypt woodlands are widespread in the wheatbelt, woodlands dominated by other trees are common. One of these other trees is an acacia (wattle) which is called **jam** because its dry heartwood smells of strawberry jam when sawn. Jam may occur as an understorey tree beneath York gum or wandoo, or in a woodland of its own. It is an important host for sandalwood, which is a root parasite. Like most acacias, the jam has no true leaves and what appear to be leaves are actually flattened leaf-stalks called phyllodes. The true leaves consist of many small leaflets on a frond and are seen only on seedlings.

The timber of jam is hard and durable and has long been used for fence posts and also by craftsmen, as it is attractively marbled with swirls of dark and light wood. Jam has been proposed as a resource that could be planted and sustainably harvested from privately-owned woodland plantations.

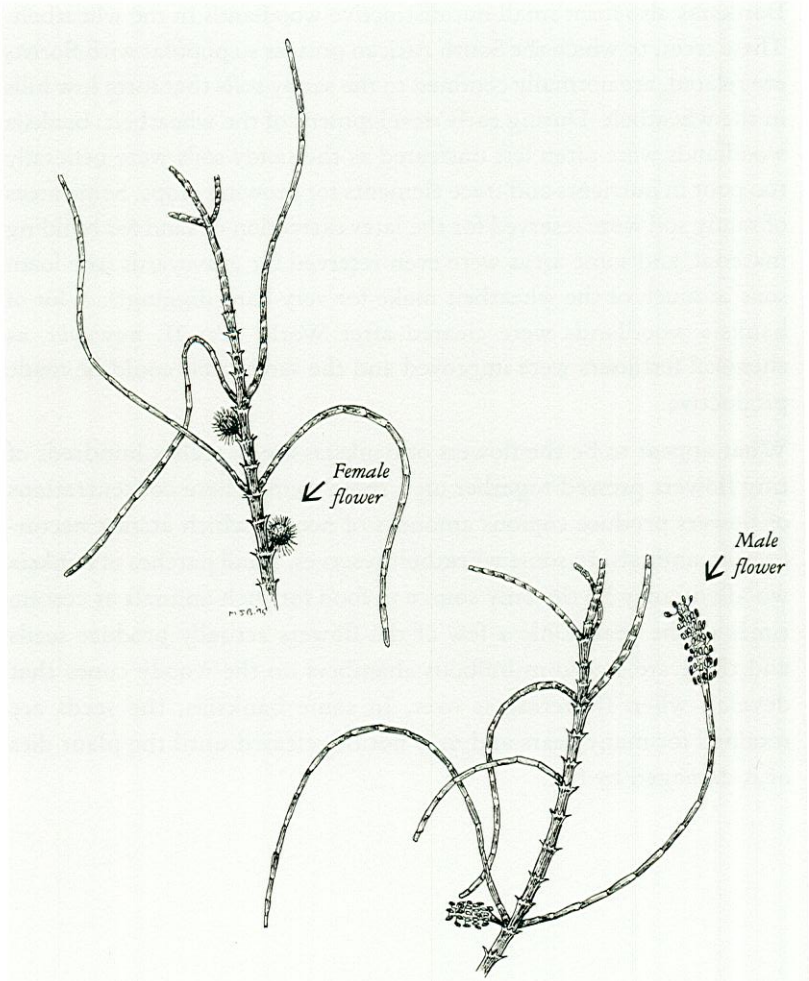


A jam seedling, showing the true leaves that are present only when the plant is very young.

Sheoaks (casuarinas) are another group of trees that form woodlands and sometimes small forests in the wheatbelt. The **rock sheoak** occurs in the thin soils around granite outcrops in the central and eastern wheatbelt, but is more widespread in western locations. The **swamp sheoak** forms whispery woodlands in seasonally-waterlogged soils close to brackish rivers and lakes. It sometimes grows with **paperbark trees** and **flooded gums**, particularly in the western wheatbelt. In areas where increasing concentrations of salt have killed many plants, the swamp sheoak may be the only native tree to survive. Sheoaks get their name because the English colonists considered their timber to be similar but inferior to that of European oaks, and had a sexist way of saying this!

Both sheoaks and wattles are capable of obtaining their nitrogen requirements from atmospheric nitrogen with the help of micro-organisms associated with their roots. This gives the trees access to this important nutrient and means that they can enrich the soil for other plants—just as nitrogen-fixing crops and pastures are used in agriculture to maintain soil fertility.

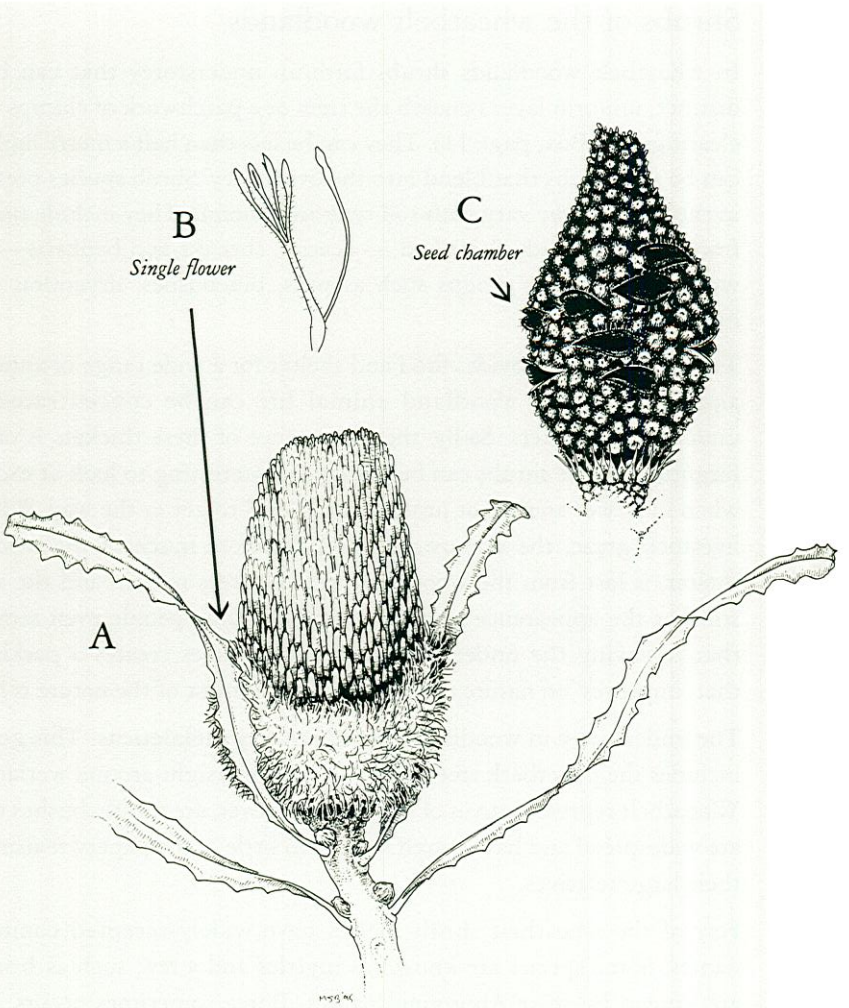
In some areas of remnant vegetation, sheoak woodland is expanding at the expense of other vegetation types. This may be due to the disappearance of browsing marsupials like the tammar wallaby, which would once have eaten most of the sheoak seedlings. As sheoak groves expand and age, their needle-like branchlets form a thick layer of litter through which few other plants can grow.



Male and female sheoak flowers occur on separate trees. Pollen from the flowers of male trees is carried to the female flowers by the wind.

Banksias also form small but distinctive woodlands in the wheatbelt. These trees, to which the South African proteas so popular with florists are related, are normally confined to the sandy soils that form low hills in the wheatbelt. During early development of the wheatbelt, banksia woodlands were often left uncleared as the sandy soils were generally too poor in nutrients and trace elements for growing crops. Some areas of sandy soil were reserved for the later extraction of sand for building material, and some areas were even reserved for graveyards (the loam soils of much of the wheatbelt make for very hard digging!). A lot of banksia woodlands were cleared after World War II, however, as chemical fertilisers were improved and the sandy soils could be made productive.

What appear to be the flowers of banksias are in reality hundreds of tiny flowers pressed together on a short stem. These concentrations of flowers produce copious amounts of nectar, which attract nectar-feeding animals. In some wheatbelt reserves, small patches of banksia woodland may be the only source of food for such animals at certain times of the year. Only a few of the flowers actually produce seeds and these are stored in bulbous chambers on the woody cones that develop when flowering is over. In some banksias, the seeds are retained for many years and may not be released until the plant dies or is damaged by fire.



The 'flower' of the acorn banksia (A) is actually a mass of tiny flowers (B). Only a few of the tiny flowers successfully develop seeds, which are contained in chambers on a cone (C).

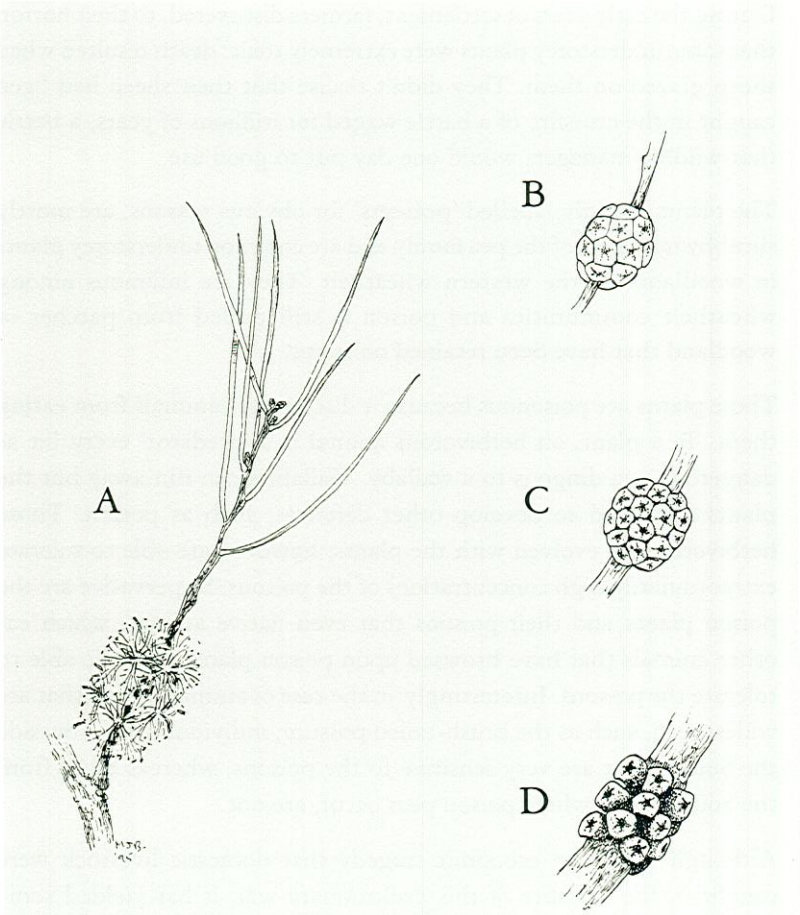
Shrubs of the wheatbelt woodlands

In wheatbelt woodlands shrubs form an understorey that can be a distinct, uniform layer beneath the trees or a patchwork of clumps and clearings (see Box, page 11). They can be less than half a metre high or can be tall shrubs that blend into the overstorey. Shrub species present in the understorey vary with soil type and rainfall. They include plants from groups already described — acacias, sheoaks and banksias — as well as from other groups such as peas, bluebushes, dryandras and hakeas.

The understorey provides food and shelter for a wide range of animals and much of the woodland animal life can be concentrated in understorey thickets. Sadly, the importance of these thickets is often forgotten, as the shrubs can be prickly, uninteresting to look at except when in flower and are at just the right level to get in the way. Where livestock graze, the understorey, and therefore much of the wildlife shelter, is lost from the woodland, but the trees remain and the area still has the appearance of being 'natural'. Some people even remark that removing the understorey and smaller trees creates a parkland that 'improves' on nature, little realising that most of the nature is lost.

The understorey in woodlands includes many **melaleucas**. This genus includes the paperbark trees that are a familiar sight around wetlands. Wheatbelt representatives of this clan, however, are mostly bushes that are widespread and have rough bark with little of the papery texture of their large relatives.

Few of the wheatbelt shrub species have widely-accepted common names. Some species are known as myrtles and a few, such as **boree**, are known by their Aboriginal names. Boree sometimes occurs as a dense understorey beneath salmon gums in the eastern wheatbelt. **Broombush** is a dense, shrubby melaleuca, so-named because its long branchlets were once cut and strapped to poles to make brooms.



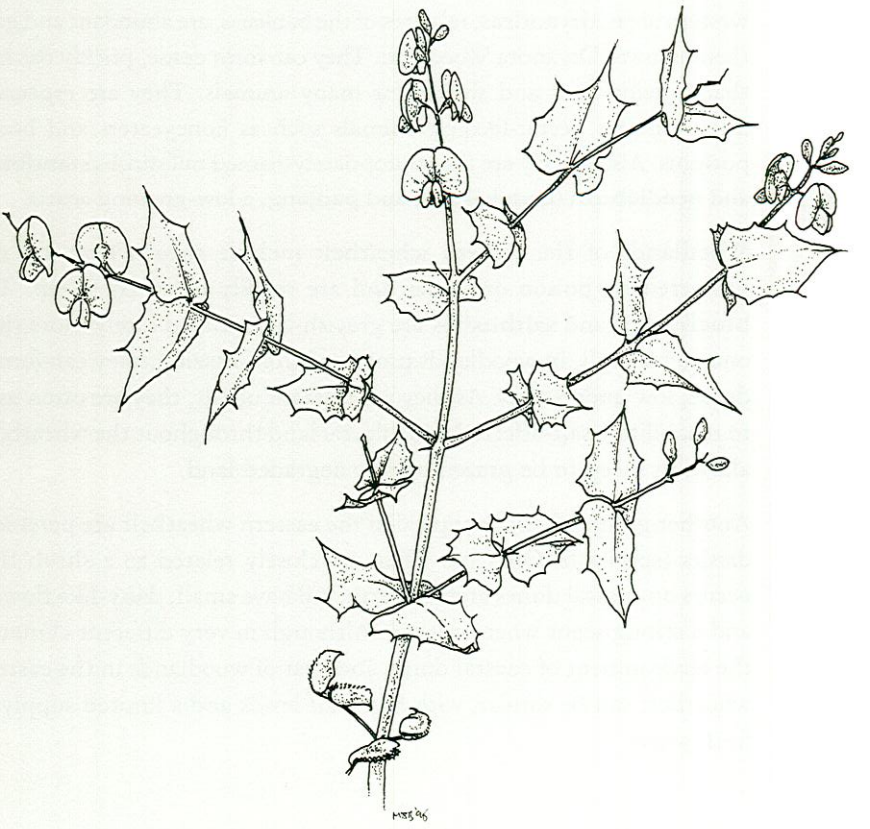
The flowers of the broombush, like those of most wheatbelt melaleucas, grow close together (A). When they develop into seed-capsules, these are also close together. They are retained on the stem for many years, however, and as the stem grows the capsules become separated, as shown in the sequence (B) to (D).

During the early years of settlement, farmers discovered, to their horror, that some understorey plants were extremely toxic; death resulted when sheep grazed on them. They didn't realise that their sheep had been caught in the crossfire of a battle waged for millions of years, a battle that wildlife managers would one day put to good use.

The plants, rapidly labelled '**poisons**' for obvious reasons, are mostly shrubby members of the pea family and are common understorey plants in woodlands in the western wheatbelt. They are infamous among wheatbelt communities and poison is still pulled from patches of woodland that have been retained on farms.

These plants are poisonous because it discourages animals from eating them. To a plant, an herbivorous animal is a 'predator' every bit as dangerous as a dingo is to a wallaby. Wallabies can run away but the plants have had to develop other defences, such as poison. Those herbivores that evolved with the plants, however, are able to tolerate extraordinarily high concentrations of the poisons. So pervasive are the poison plants and their poisons that even native animals which eat other animals that have browsed upon poison plants must be able to tolerate the poisons. Interestingly, in the case of animal species that are widespread, such as the brush-tailed possum, individuals from outside the South West are very sensitive to the poisons, whereas those from the South West, where poison peas occur, are not.

Although it was an economic tragedy that domestic livestock were caught in the crossfire of this evolutionary war, it has yielded some benefits for conservation. Woodland with dense patches of poison plants was sometimes fenced to protect stock, thus preserving some native vegetation. More importantly, perhaps, introduced animals such as foxes and cats are sensitive to the poisons. They often died through eating native grazing animals that had fed on poisonous plants. This limited their numbers in some areas and thickets of poison plants provided native animals such as numbats, woylies and tammars with shelter. Furthermore, the manufactured poison 1080 is very similar to the poison



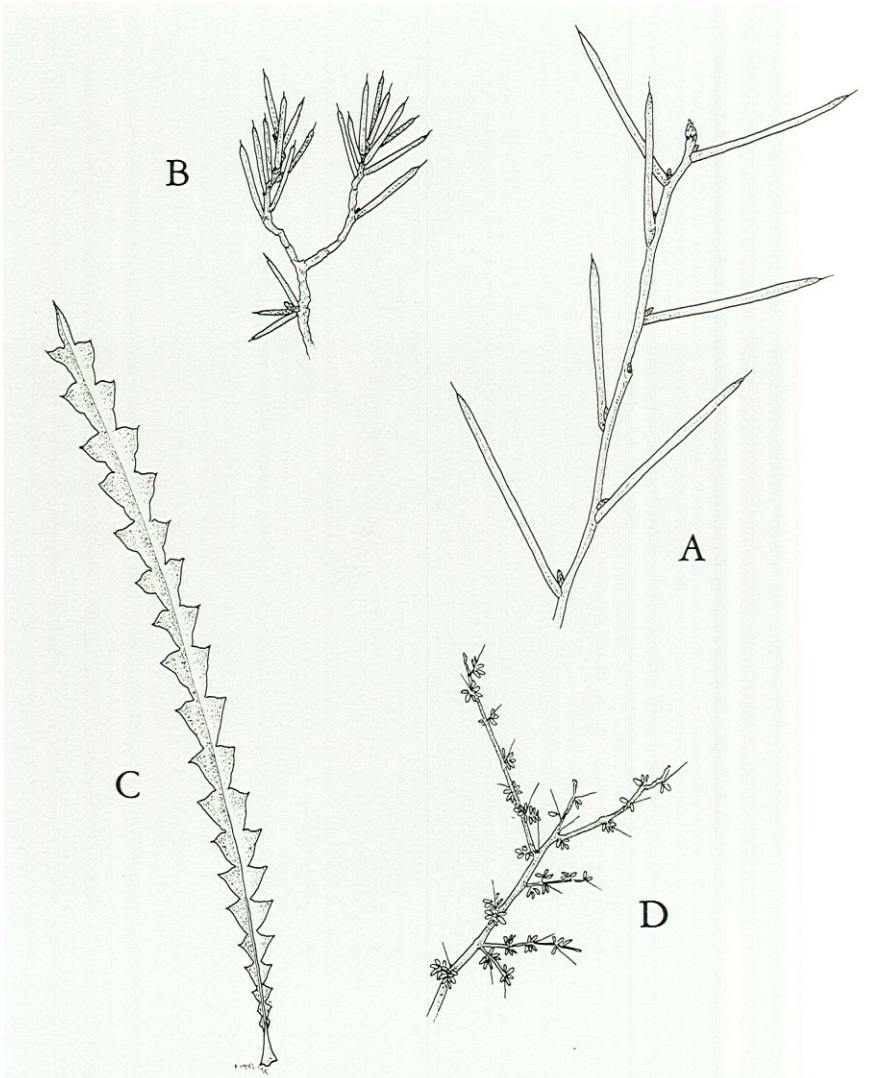
Prickly poison is a widespread poison plant which varies in appearance and toxicity according to locality.

in the plants, with the result that native animals have a high tolerance to it. Therefore, 1080 can be used to control introduced pests with little danger to native fauna.

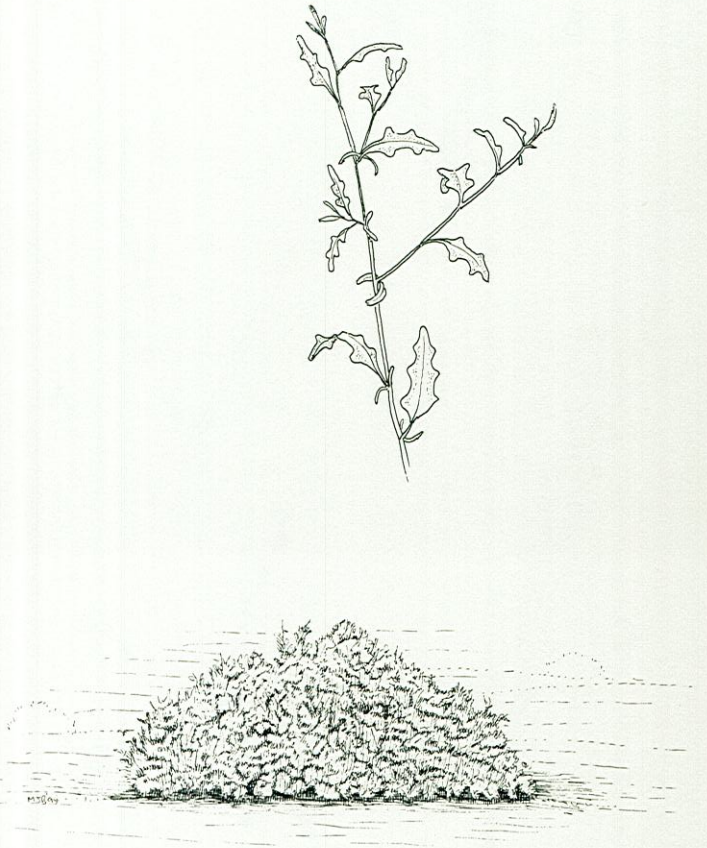
Many of the shrubs in the woodland protect themselves with spines. In western areas, **dryandras**, relatives of the banksias, are abundant and gave their name to Dryandra Woodland. They can form dense, prickly thickets that provide food and shelter for many animals. They are especially important for nectar-feeding animals such as honeyeaters and honey possums. Also prickly are the appropriately-named tall shrubs **standback** and **needlebush** (both hakeas), and **panjang**, a low-growing acacia.

Woodlands of the eastern wheatbelt include shrubs that are not protected by poison or spines and are readily eaten by sheep. The **bluebushes** and **saltbushes** are greyish-blue shrubs rarely more than one metre high. In woodlands protected from grazing, they can form a dense, low understorey. As they are tolerant of salt, they are often used to rehabilitate salt-affected agricultural land throughout the wheatbelt, allowing sheep to be grazed on this degraded land.

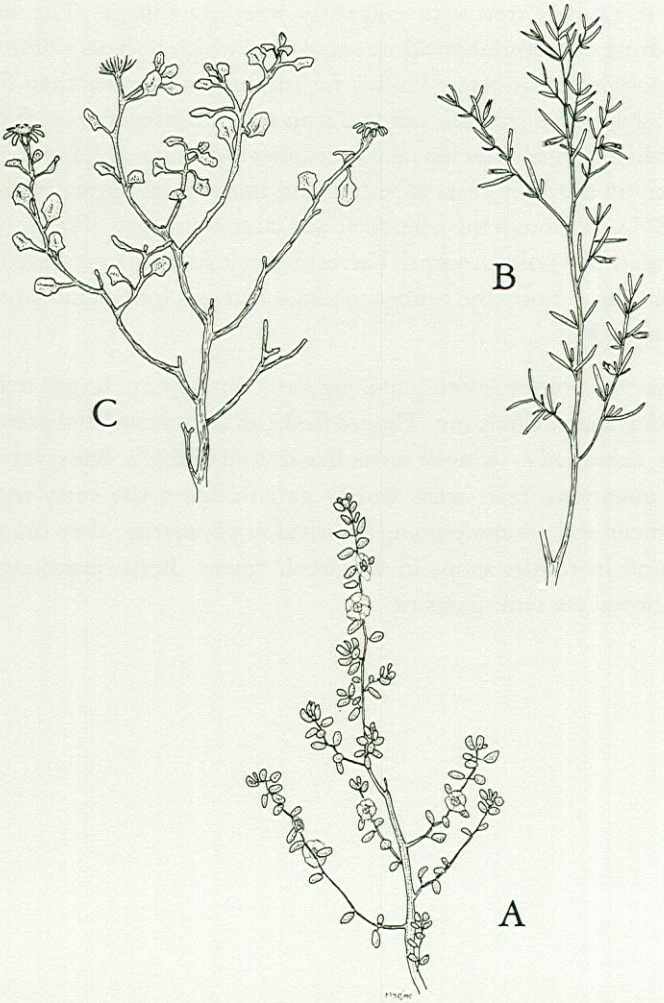
Another group of shrubs typical of the eastern wheatbelt are perennial daisies (species of **Olearia**). They are closely related to a shrub that occurs on coastal dunes around Perth. All have small, daisy-like flowers and a strong scent when crushed. Although in very different climates, the environment of coastal dunes and that of woodlands in the eastern wheatbelt can be similar, with high salt levels and a limited supply of fresh water.



Many shrubs of the wheatbelt woodlands protect themselves with prickles: (A) standback; (B) needlebush; (C) noble dryandra; (D) panjang.



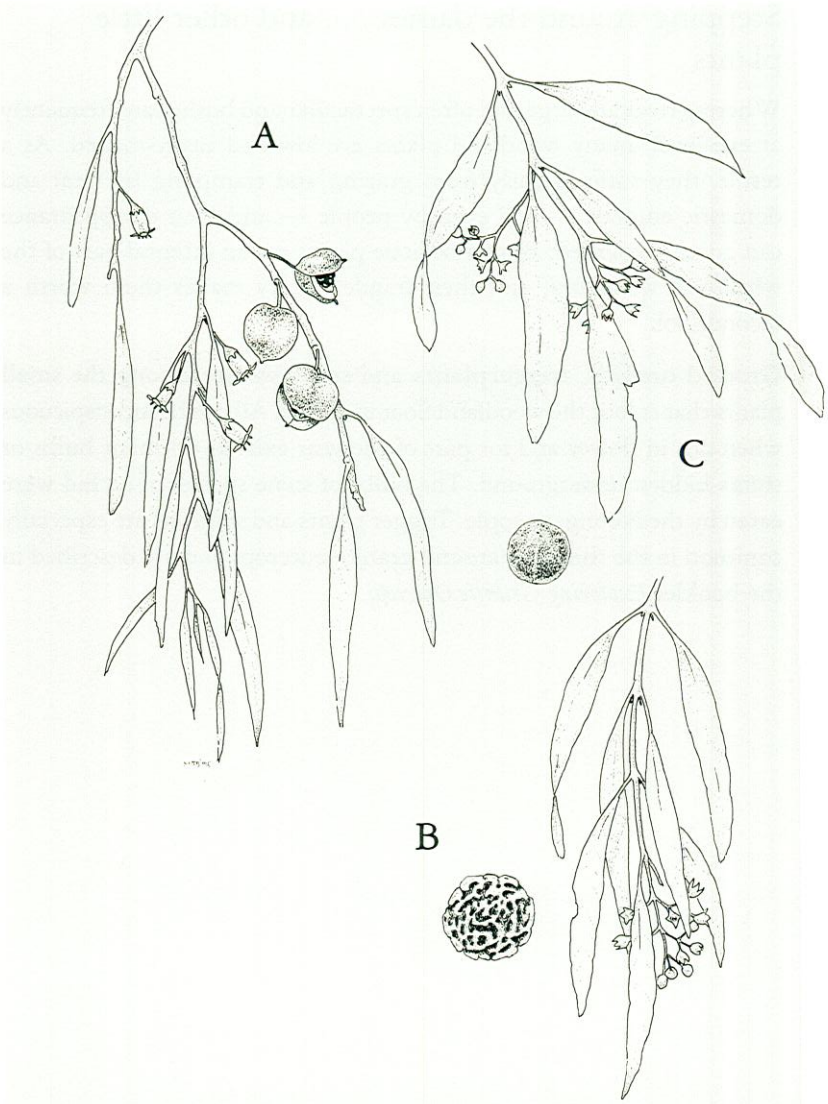
The swamp saltbush is a low, dense shrub that grows in moist, saline soils. These plants are palatable to sheep.



Bluebushes, such as the small-leaved bluebush (A), and perennial daisies such as Dampier's olearia (B) and Mueller's olearia (C), are common shrubs in the woodlands. Crushed olearia leaves give off a strong fragrance.

The **native apricot**, named for its orange but unfortunately poisonous fruit, is a small tree with elegantly weeping foliage. The **sweet quandong** and **sandalwood** are small trees which do have edible fruit. The sandalwood is better-known for its fragrant timber than for its nuts, which have little flavour and turn to the consistency of chewing gum when chewed. The sandalwood timber industry was a major export industry in the early years of settlement, until the discovery of gold in the 1890s. Although the wheatbelt was largely stripped of sandalwood by sandalwood pullers, a small harvesting industry still operates further inland. This exports the timber to Asian markets for products such as incense sticks.

The ripe fruit of the sweet quandong has a thin layer of bright red skin around a hard, wrinkly nut. The red flesh can be removed and preserved as jam, or stewed — when it tastes like stewed rhubarb. Preserves made from quandong fruit were widely eaten during the early days of settlement and are undergoing a revival in popularity; they can often be found in tourist shops in wheatbelt towns. Both quandong and sandalwood are semi-parasitic.

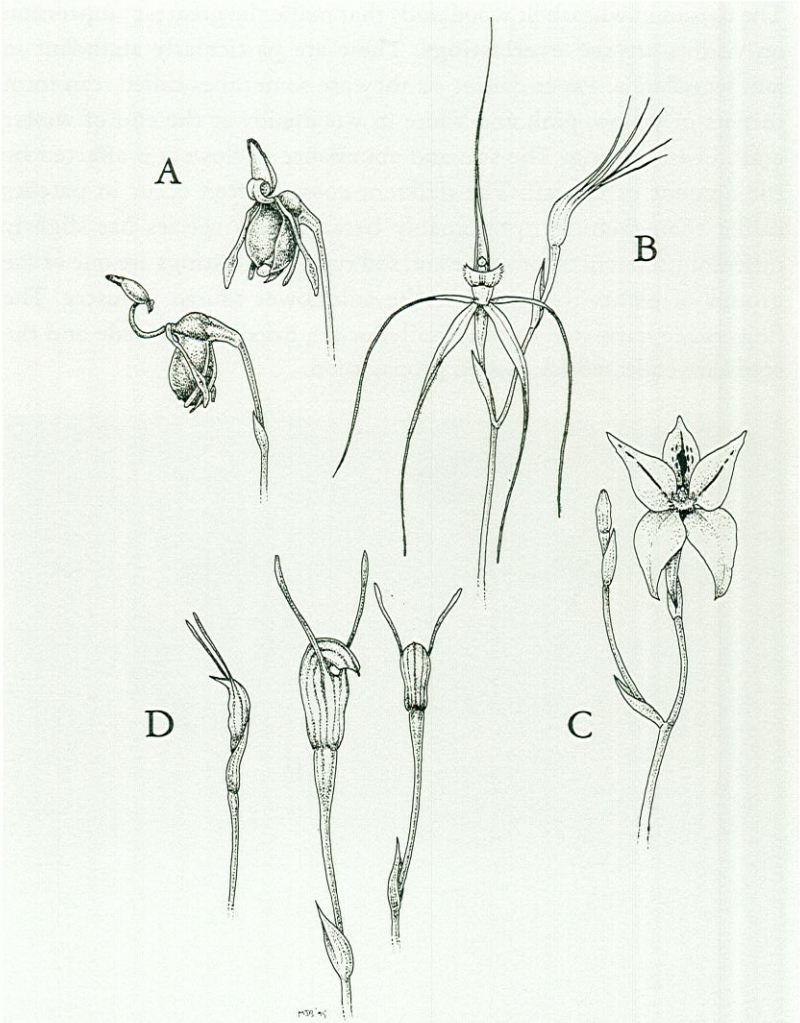


(A) Leaves, fruit and flowers of the native apricot. (B) Leaves, nut and flowers of the sweet quandong. (C) Leaves, nut and flowers of the sandalwood.

Stepping around the daisies . . . and other little plants

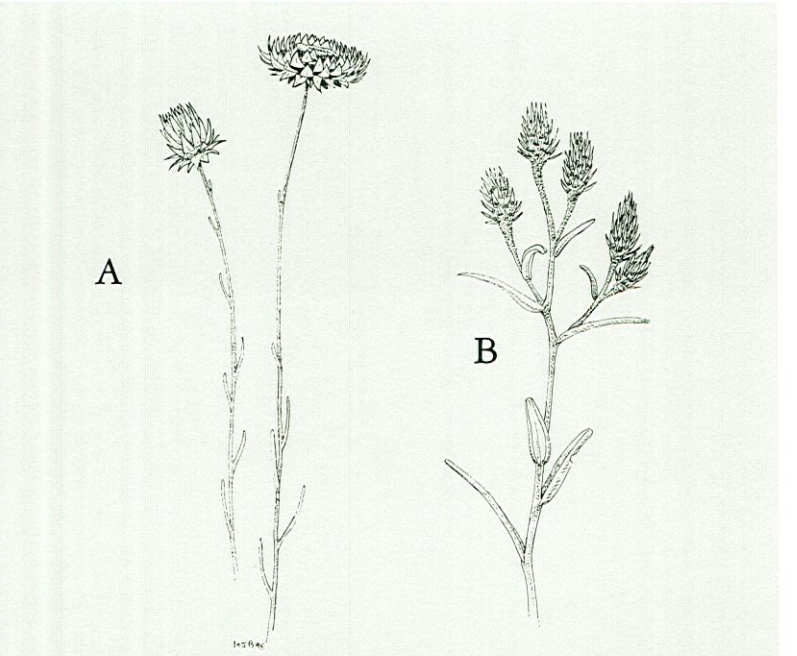
Whereas trees are large and often spectacular and bushes are frequently at eye-level, many woodland plants are low and easily-missed. As a result, they suffer greatly from grazing and trampling by feral and domestic animals — and even by people — and their disappearance can go un-remarked. But these little plants are an integral part of the wheatbelt woodland, and their fragile beauty makes them worth a second look.

Ground orchids, triggerplants and **sundews** are among the small plants that colour the woodland floor in spring. All can be inconspicuous when not in flower and for part of the year exist as dormant bulbs or stems hidden underground. The bulbs of some species of orchid were eaten by the Noongar people. Trigger plants and sundews are especially common in the thin soils around granite outcrops and are described in the booklet *Exploring Granite Outcrops*.



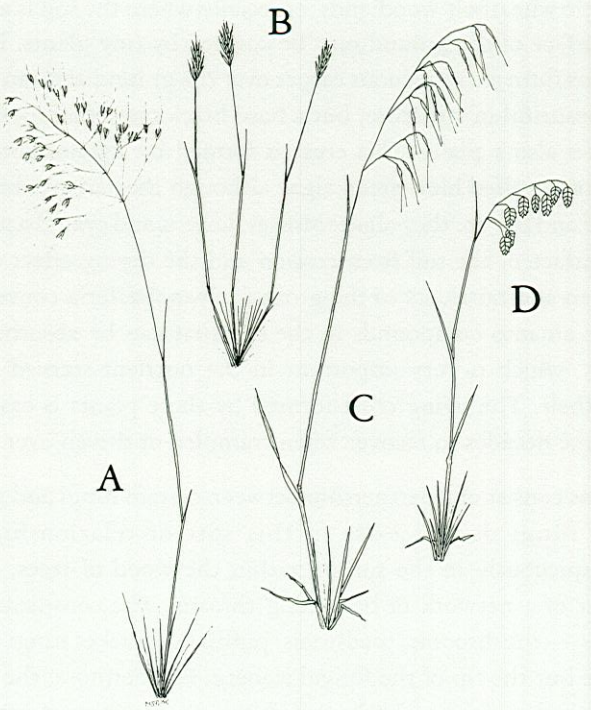
Some of the variety of orchids to be found in wheatbelt woodlands: (A) broad-billed duck orchid; (B) common spider orchid; (C) cowslip orchid; (D) greenhood or snail orchid.

The daisies in wheatbelt woodlands that make the greatest impression on visitors are the **everlastings**. These are particularly abundant in jam woodlands. Paper-daisies, as they are sometimes called, can form carpets of yellow, pink and white in woodlands at the end of winter and in early spring. The size and abundance of flowers is affected by the amount of rainfall. The different colours often occur in patches rather than mixtures, presumably because each species has slightly different preferences for shade and soil type. Everlastings are one of the groups of plants that support the wildflower tourist industry. The flowers are harvested commercially for the dried flower trade and the seeds are collected for garden propagation.



Everlastings that are common in the wheatbelt: (A) a species of Rhodanthe; (B) a species of Waitzia.

Grasses and grass-like plants are not a major component of the woodlands, although **wallaby grasses** and **speargrasses** can be conspicuous when they flower in late spring. One prominent species is the **elegant speargrass**, a spindly species which often grows up through bushes, its feathery flower-head emerging through the top of the other plant. While these grasses are thinly distributed, **sedges** can form dense, low stands, especially where water is concentrated beneath breakaways and in valley floors.

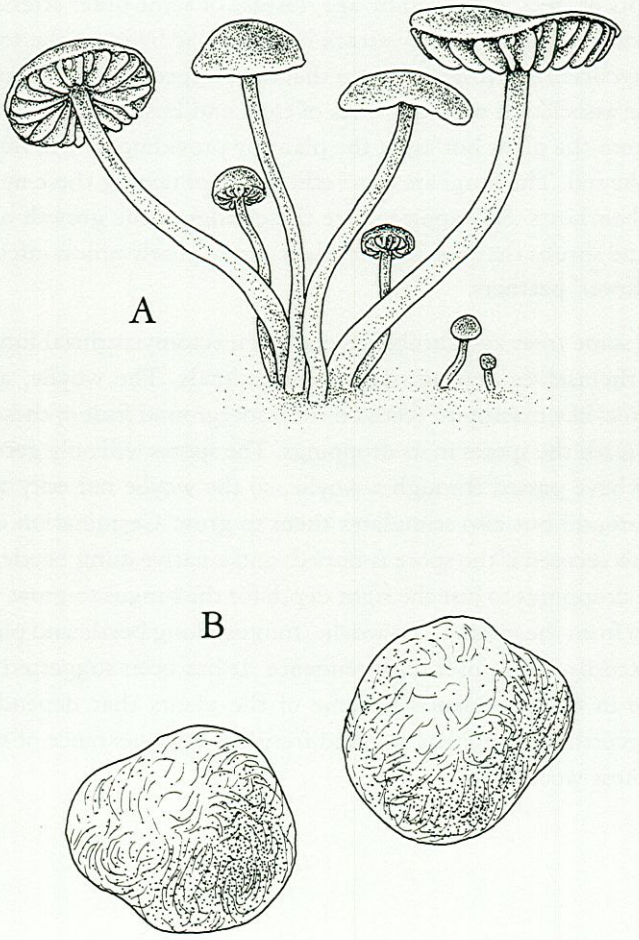


The flowers of grasses are often overlooked but can be very elegant. Native species include: (A) elegant speargrass; (B) wallaby grass. Introduced species include: (C) wild oats; (D) blowfly grass. Note that A-C are drawn to the same scale, whereas D is drawn larger in comparison.

Many of the grasses seen in wheatbelt woodlands are introduced species that invade woodland remnants from surrounding farmland. These may be crop or pasture plants or agricultural weeds such as **wild oats** and **blowfly grass**. These out-compete small native plants and, when dry, provide fuel for frequent fires which can adversely affect native vegetation. Other farmland plants, such as **lupins** and **capeweed**, can also spread into woodland. A small South African daisy, **ursinia**, is now so widespread that one could be forgiven for assuming that it is a native plant.

In some wheatbelt woodlands, especially where the soil is a hard loam, the surface of the ground may be covered by tiny plants. **Mosses** and **lichens** form a conspicuous carpet over the ground and can be complex and beautiful in structure, but a hard black crust that looks like dried paint is also a plant. This crust is formed by **cyanobacteria**, which were once called blue-green algae although they are not blue-green in colour and nor are they algae! Mosses, lichens and cyanobacteria protect the surface of the soil from erosion and the drying effect of the wind and can add nutrients to the ground. Cyanobacteria convert nitrogen in the air into compounds in the soil that can be absorbed by other plants, which is very important in the nutrient-starved soils of the wheatbelt. The living crust formed by these plants is easily lost and can take decades to recover when trampled or driven over.

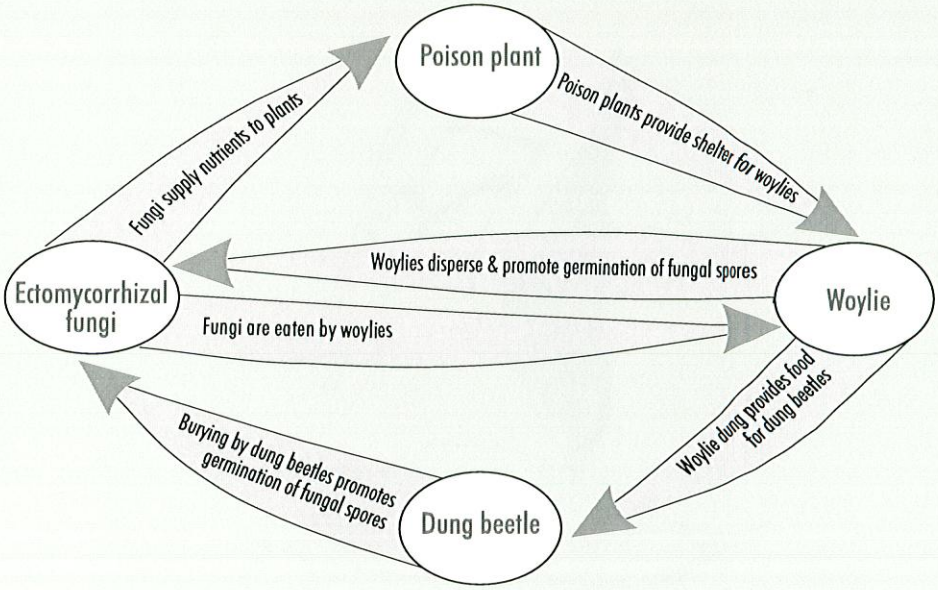
Lichens consist of a partnership between certain fungi and green algae. Most fungi do not exist in this sort of relationship and live inconspicuously in the soil or within the wood of trees, where they consist of a network of branching threads. The conspicuous fruiting bodies — mushrooms, toadstools, puffballs, bracket fungi and the like — are but the tip of the fungal iceberg. Furthermore, the majority of fungi produce fruiting bodies which remain underground and are never seen. There is more to fungi than we usually see.



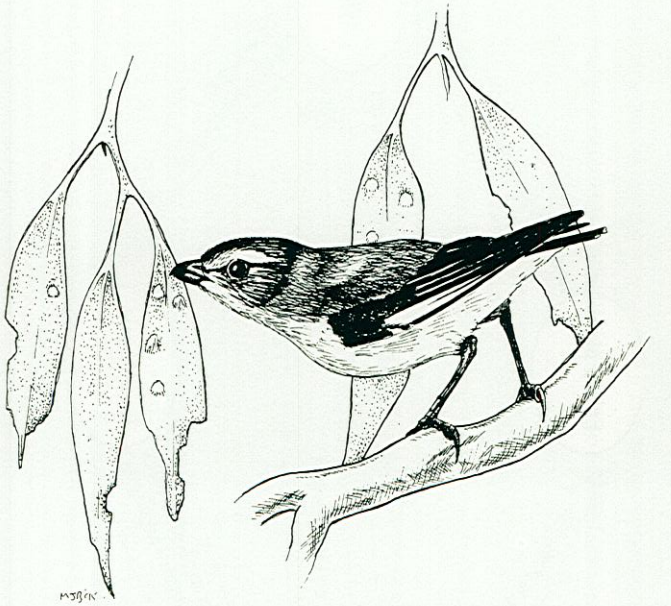
The ectomycorrhizal fungi include species with 6-cm-high, mushroom-shaped fruit (A) and others whose fruit are marble-sized, underground truffles (B).

Many fungi specialise in feeding on dead wood and therefore perform an important role in cycling nutrients in the woodland. Others invade the roots of trees weakened by age, disease or some other stress. Some are even 'predators', as they attack beetle larvae living in the soil. The **ectomycorrhizal fungi** are fungi that have a special lifestyle, growing in close association with the roots of trees and bushes. They get some food from the plant but assist the plant by providing it with nutrients from the soil. The fungi are more efficient at obtaining these nutrients than their hosts. So important are these fungi to the growth of some trees and shrubs that the 'higher' plants grow poorly unless infected by their 'lower' partners.

While some trees and shrubs depend upon ectomycorrhizal fungi, the fungi themselves depend upon some animals. The woylie, a small kangaroo-like marsupial, feeds on the underground fruit of these fungi and spreads the spores in its droppings. The spores will only germinate if they have passed through a woylie, so the woylie not only spreads them around but also stimulates them to grow. Germination is most likely to succeed if the spore is buried; and a native dung beetle buries woylie droppings to just the right depth for the fungus to grow. As can be seen from the picture, the woylie, fungus, dung beetle and plant are all linked by a web of interdependence. It has been suggested that a decline in the abundance of some of the plants that depend upon ectomycorrhizal fungi has resulted from the disappearance of woylies from most woodlands.



The interdependence between woylies, dung beetles, ectomycorrhizal fungi and poison plants.



WOODLAND ANIMALS

When scientists describe the living things that occur in an area, they start with the vegetation. Conveniently, plants stay still and most are easily observed. Animals are more elusive but are an integral part of the system; they depend upon the plants but the plants may also depend upon them (for example, see page 41).

The wheatbelt woodlands are rich in all sorts of animals, although many of them are small and shy. As with the plants, some are found nowhere else and wheatbelt woodlands are important refuges for some animals that are declining or have disappeared from other parts of Australia.

The spineless majority

Mention animals and most people immediately think of mammals: large and furry with two eyes and four legs. Given more time, their minds may turn to birds, reptiles, frogs and fish. These are all animals with internal backbones, or vertebrate animals. The majority of animals, however, have no backbones and are built 'inside-out'. A hard outer skin replaces the boney inner skeleton of the vertebrates. These invertebrates, the spineless majority, include spiders, insects, scorpions, centipedes and earthworms, to name a few. There are more than 30 000 different species of beetle alone in Australia, compared with just over 200 mammal species and 700 bird species. The invertebrates do everything that the larger vertebrates do — and more — they are just smaller and more numerous. In fact, their total weight in an area may be similar to or greater than that of vertebrates. A student working with Jonathan Majer (Curtin University) has estimated that, in a nature reserve near Kellerberrin, there are more than 30 kilograms per hectare of just one species of termite living in the soil. In contrast, Stephen Davies estimated the weight of kangaroos at only 4.2 kilograms per hectare across woodland remnants and farmland near Carnamah. In undisturbed woodland the figure is likely to be even lower, about half a kilogram per hectare.

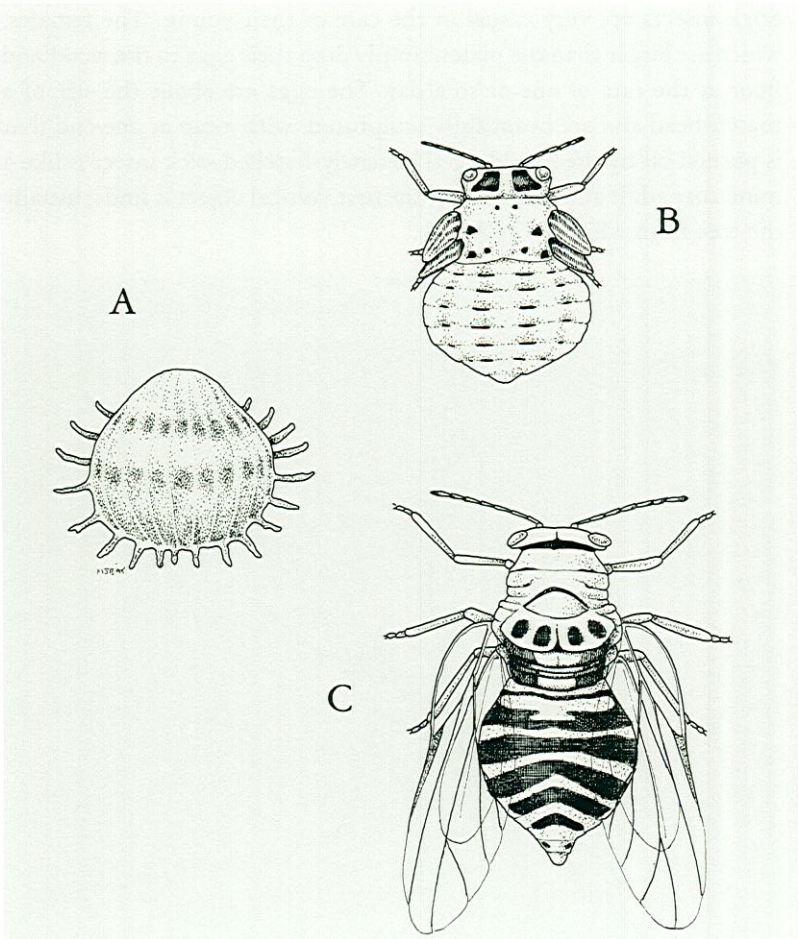
Plant suckers and chewers

Although the most obvious plant-eating animals are large mammals like kangaroos and wallabies, plants are mostly eaten by insects. Hundreds are crawling over every bush, thousands are crawling over every tree — boring into wood, sucking sap and nibbling at leaves.

So abundant are herbivorous insects that the leaves of eucalypts are rarely unblemished; it seems to be the fate of eucalypt leaves to be eaten. On some foliage, translucent scales like the shells of minute oysters may be found. These scales are known as **lerps** and are the protective cover of a sap-sucking bug. Protected by the shell they have secreted, the lerp-bugs move around on the leaf, sucking juices at one point and then another. The plant responds to these attacks by concentrating coloured, and presumably bad-tasting, chemicals at the damaged site, but the bugs just move on.

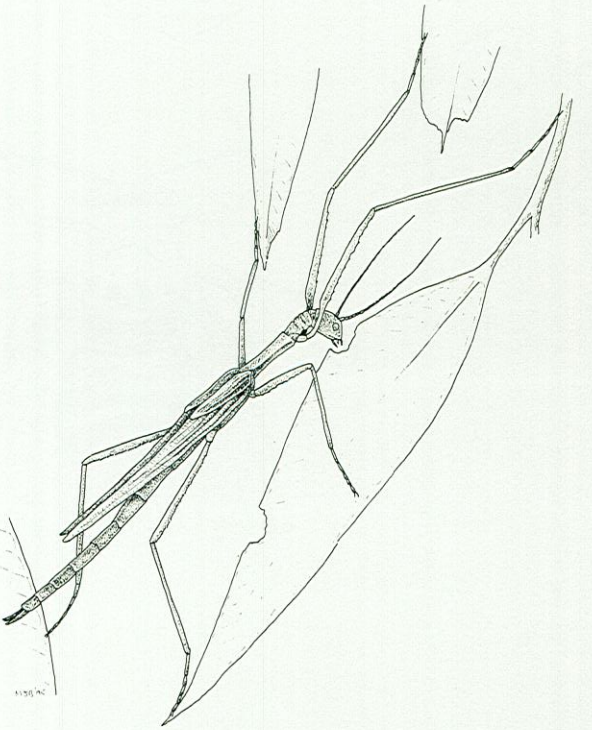
If there are large numbers of bugs, most of the leaves of a tree can be damaged. This has been recorded in some wheatbelt areas and such outbreaks may be related to the trees being stressed by salinity or to a lack of predatory insects. Birds, including honeyeaters and pardalotes (see page 76), feed on the bugs and sometimes they can be heard cracking the protective shells to get at the soft insect beneath. Some lerps are composed mostly of sugars and when infestations were heavy, the Noongar people scraped them from the leaves and ate them — like crunchy sherbet! The Noongar knew lerps as meenah, waumilyar or womela.

Lerp-bugs are a mere few millimetres in length, but some insects that feed on eucalypt leaves are relatively gigantic. **Stick insects**, as you might expect, resemble sticks and, although sometimes large enough to span your hand, can be hard to see. As they feed, their long bodies are rigid and they may sway slightly to give the illusion of a twig moving in the wind. Their head, however, swings backwards and forwards, the jointed mouthparts munching into the leaf a little further with each stroke.



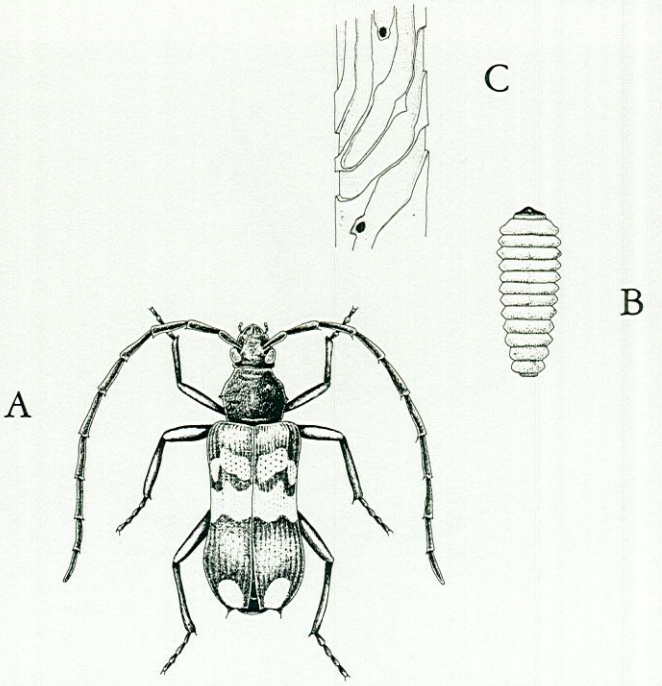
A common wheatbelt lerp (A) and the immature stage (B) of the bug that makes it. The adult (C) is also shown; it is about 4 mm long.

Stick insects are very casual in the care of their young. The females, which are larger than the males, simply drop their eggs to the woodland floor at the rate of one or so a day. The eggs are about the size of a match-head and are beautifully sculptured, with a cap at one end that is pushed off by the hatchling. The newly-hatched stick insect is like a miniature adult and it climbs up the first vertical object it finds; usually the tree from which its egg fell.



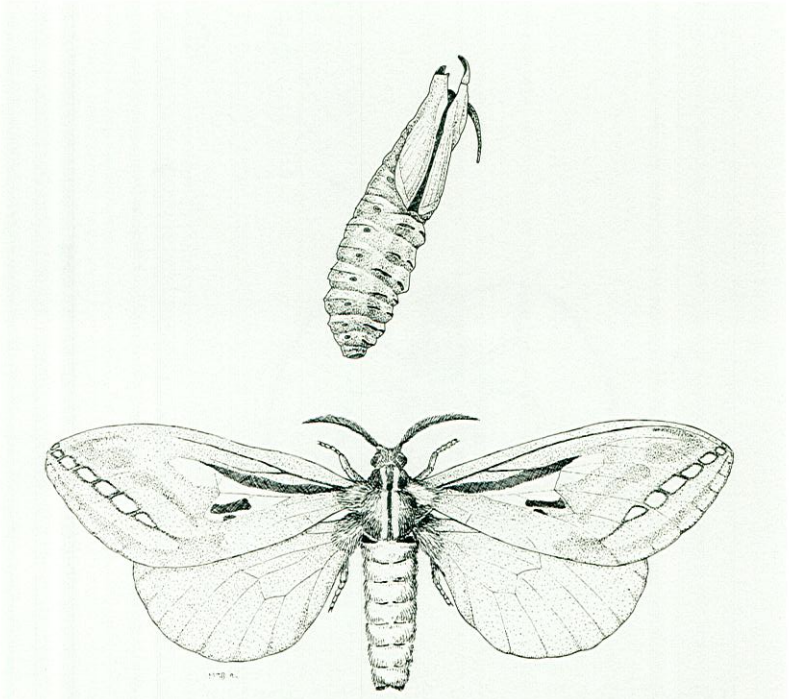
A stick insect feeding on eucalypt foliage.

Not only do insects chew and suck the leaves of plants, they attack their bark, wood and roots as well. The larvae of the **longicorn beetle** burrow through and eat the sapwood of trees. Piles of sawdust pushed out through small holes in the bark are often the only sign to indicate their presence, but they may be so numerous that they ringbark entire branches.

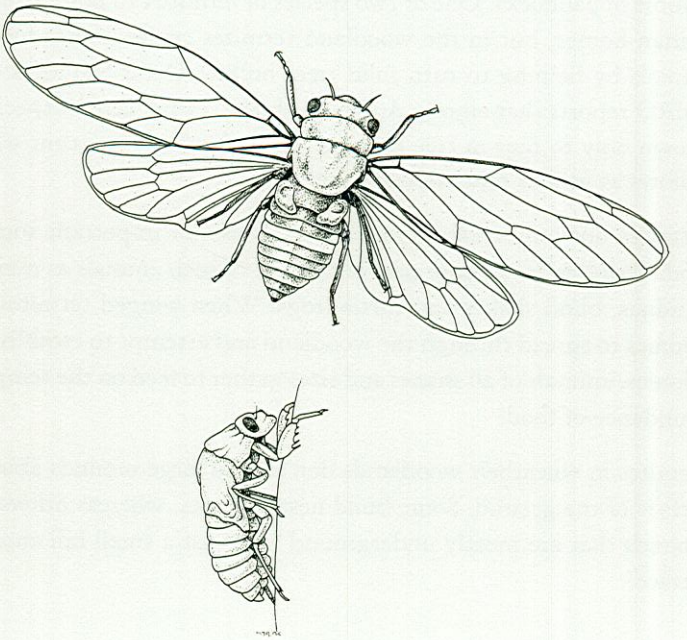


A longicorn beetle (A), its larva (B) and the pattern bored by the larva (C) through the sapwood of a branch. The beetle is about 30 mm long, not including its antennae.

Not all insects that bore into wheatbelt trees are beetles. In early winter, often after the first rains have softened the soil, holes containing the dry skin of an insect pupa may appear in the ground near jam trees. What emerged from the pupa was the large grey **ghost moth**, the sort that might be attracted to the lights of a nearby farmhouse. This moth started life as a larva (caterpillar) boring through the roots of the jam. Young **cicadas**, called nymphs, also live underground where they suck sap from the roots of trees. It takes many years for a cicada nymph to become mature, but the adults, whose calls are a feature of hot summer days, live for only a few months.



Ghost moth and its pupal case. The latter is often found on the ground in jam woodlands.

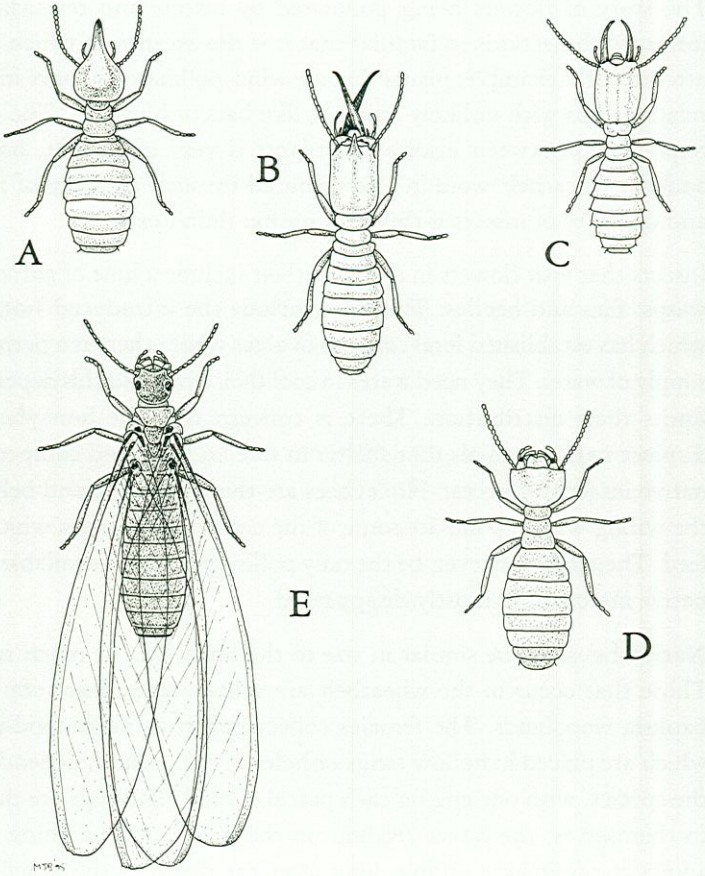


Cicada nymph and adult. The nymphs feed on plant roots and, when ready to emerge, dig their way to the soil surface and climb. Therefore the skins of nymphs are often found clinging to the trunks of trees.

Insects don't even leave plants alone when the plants are dead! Termites are the most familiar of the insects that feed on dead plants. Some species eat out the heartwood (which is dead material) of living trees, thereby creating hollows, others eat fallen, dead timber and others feed on twigs and leaf litter. The leaf litter species will even feed on wheat-stubble in paddocks. One or two species of termite can pose a threat to human homes, but in the woodland termites create homes for other animals by helping to turn solid trees hollow. Denis Saunders of the CSIRO reports that among Australian birds, 11 per cent of species are known only to nest in tree hollows, and a further 7 per cent will use hollows as well as other nesting sites.

Termites not only create homes but are also an important source of food. Termites are a major part of the diet of such animals as numbats, echidnas, blind snakes and turtle frogs. When winged termites leave colonies to spread through the woodland and attempt to establish new colonies, animals of all shapes and sizes gather to feed on the temporary abundance of food.

Termites in wheatbelt woodlands don't build large mounds above the surface of the ground. Some build nests in trees, whereas others build mounds that are mostly underground with just a small hill above the surface.



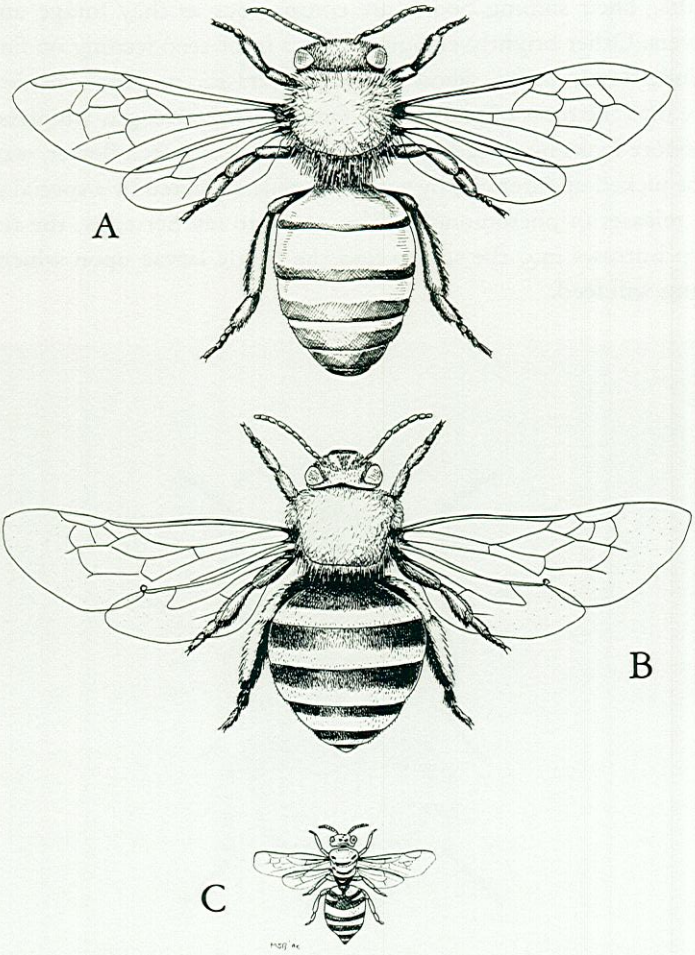
Soldier termites use their elaborately-shaped heads to defend their colony. The soldiers of different species can be very distinctive (A, B and C). Worker termites have chewing mouthparts for breaking up wood and other plant material (D). Winged termites (E) are young kings and queens and, in addition to wings, have well-developed eyes.

In a frenzy over flowers

The story of flowers being pollinated by insects and rewarding the insects with nectar is so familiar that it is the exceptions which attract attention, for example, plants that are wind-pollinated or have intimate relationships with unlikely animals, like bats or blowflies. The typical relationship between insects and plants is very important, however, and the wheatbelt wouldn't be coloured by such an array of flowers and diversity of insects if this relationship didn't exist.

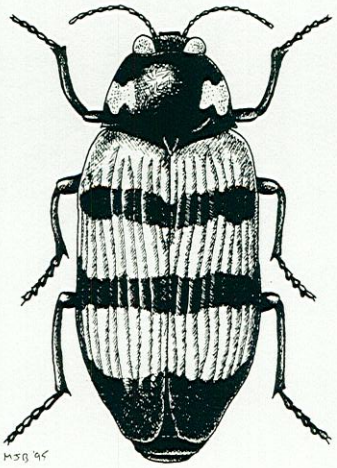
Insects that visit flowers in the wheatbelt include a host of native bees, wasps, flies and beetles. They also include the introduced **honeybee** which has established feral colonies in areas where there is a permanent supply of water. They need water to cool their hives and this dependence limits their distribution. There is concern that the honeybee may displace native animals that shelter in tree hollows, and compete with native insects for nectar. Honeybees are the wrong size and behave in the wrong way to pollinate some of the native plants upon which they feed. They may, however, be the only pollinating agent available where native insects have mostly disappeared.

Native bees can be similar in size to the honeybee, or much smaller. Those that occur in the wheatbelt are solitary and most common in banksia woodlands. The females collect pollen to make food-parcels which are placed in hollow twigs or holes in the ground, depending on the species, with one egg on each parcel of food. The eggs are then left to themselves, the larvae feeding on the pollen and hatching out as adults the following spring, long after the death of the female. The only involvement of the male in this procedure is to mate with the female. This he achieves by hanging around flowers that the female might visit as she collects pollen for the hampers of her future children. In some species, male bees defend the best flowers (those most likely to attract females) against other male bees, in the hope that a receptive female will visit 'their' flower.



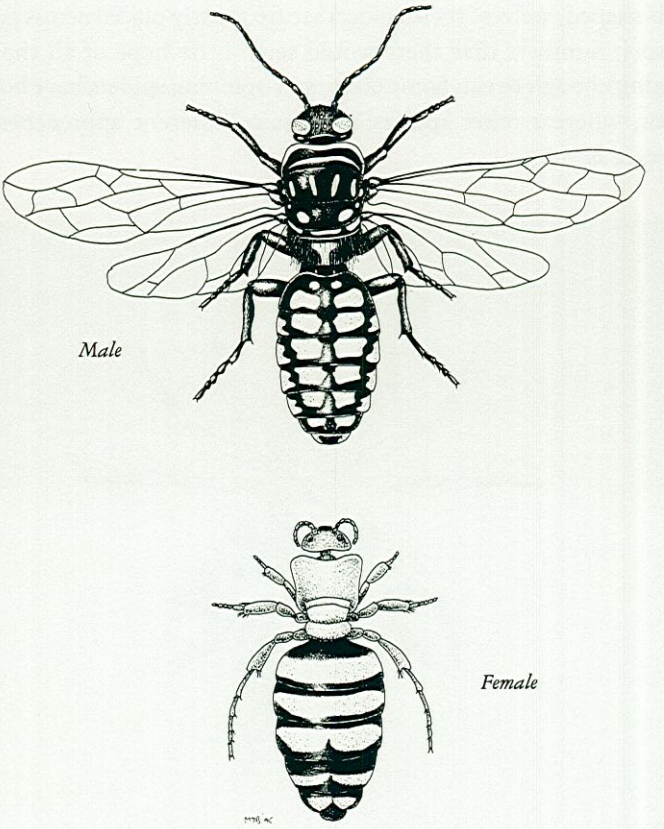
The introduced honeybee (A) and two species of native bee: the blue-banded bee (B) and the tiny gum-blossom bee (C). All are drawn to the same scale.

Jewel beetles spend years as square-headed, putty-coloured larvae munching their way through wood, but live on nectar and pollen as adults. Their shining bodies are conspicuous as they forage among flowers. Other brightly-coloured insects to be seen feeding on flowers include flower wasps, whose larvae are parasitic on beetle larvae that bore into the roots of plants. The female **flower wasp** is wingless and therefore looks like a rather lumpy ant as she sits on a flower, waiting to be picked up (literally) by a visiting male attracted by a special scent she releases (a pheromone). When ready to lay her eggs, the flower wasp burrows into the soil to find the beetle larvae upon which her young will feed.



A common jewel beetle. This species reaches a length of about 30 mm, but other species of jewel beetle range from less than 10 mm to more than 60 mm long.

In some agricultural areas of Australia, the deaths of trees in paddocks and remnants of woodland have been associated with outbreaks of leaf-eating and root-boring insects. The cause of these outbreaks is complex but one factor is the decline in abundance of insects with parasitic larvae. These parasitic larvae may have declined because the adults are unable to find flowering bushes on which to feed.

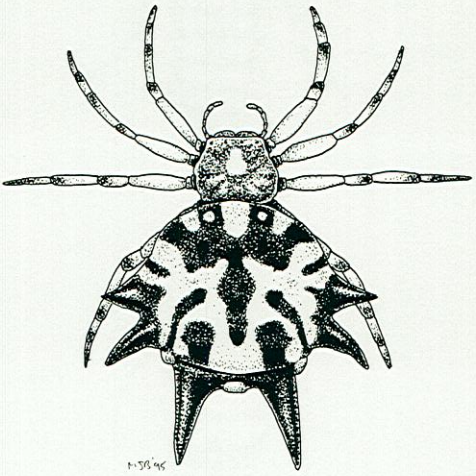


A male and female flower wasp. The female is about 25 mm long.

Wolves of the mini-world

The diversity of lifestyles found among the herbivores of the invertebrate world is reflected by the predators; they are very ingenious in finding ways of eating other invertebrates. Predators include spiders, scorpions, centipedes and a variety of insects.

Spiders of the wheatbelt woodlands include those that spin webs in the familiar spider manner, such as **orb-weaving spiders**. The circular (orb-shaped) webs of these spiders are frequently placed across pathways in such numbers that there would seem little hope of all the spiders getting enough to eat. Some other web-spinning spiders have horizontal webs, whereas other spiders have quite different approaches to the capture of prey.



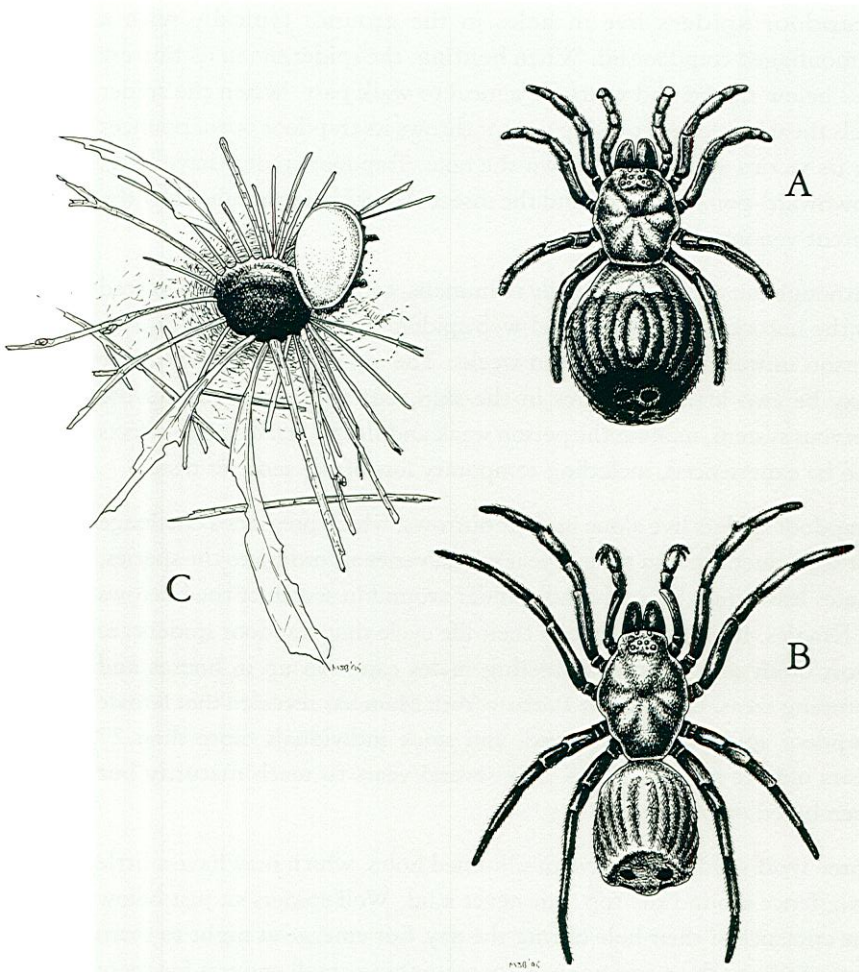
The Christmas spider is an orb-weaving spider that is especially common around Christmas.

Trapdoor spiders live in holes in the ground, typically with a camouflaged trapdoor lid. When hunting, the spider sits in its burrow just below the lid and waits for a meal to walk past. When the spider feels the vibrations of passing prey, it throws its trapdoor open, pounces on its victim and drags it down the hole. Trapdoor spiders have long, downward-pointing fangs and the insect is quickly immobilised by the potent venom.

Although not considered deadly to humans, trapdoor spiders are related to the notorious Sydney funnel-web spider, and their bite can make a person unwell for days or even weeks. The only visible sign of a bite may be two little punctures in the skin, but the venom affects the nervous system, making the person weak and sleepy. Strange side-effects can be experienced, including temporary loss of the sense of taste.

Trapdoor spiders live alone in their burrows, which presents a challenge for reproduction. At a time of year which varies according to the species, males leave their burrows and wander around in search of the burrows of females. It is at this stage in their life cycle that trapdoor spiders are most often seen, as the wandering males can turn up in houses and camping areas. Research by Barbara York Main has revealed that female trapdoor spiders are long-lived, and some individuals more than 27 years old are known. Males take several years to reach maturity but then breed only once.

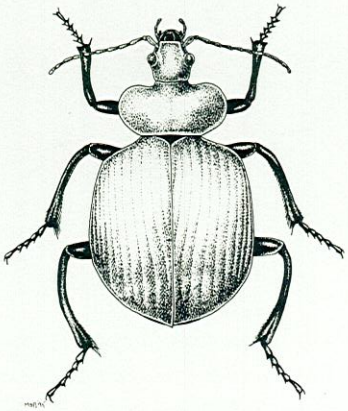
Some **wolf spiders** also live in silk-lined holes, which may have a little twig fence around the top, but never a lid. Wolf spiders sit just below the entrance of their hole during the day, but emerge at night to roam the woodland floor and pounce upon anything small enough for them to overpower. They have even been seen eating small frogs and lizards. They can be seen at night as their eyes (all eight of them!) will reflect the light of a torch very brightly. Female wolf spiders carry their eggs with them in a white, pea-sized egg case and, later, hunt with dozens of babies clinging to their back.



The female of the shield-back trapdoor spider (A) uses the hard, ridged plate on its back to block the entrance to its burrow when threatened by an intruder. The male shield-back trapdoor spider (B) may walk long distances in search of a mate and has longer legs than the female. The burrow of this species (C, with the trapdoor open) has twig-lines radiating from it to help the spider detect passing prey.

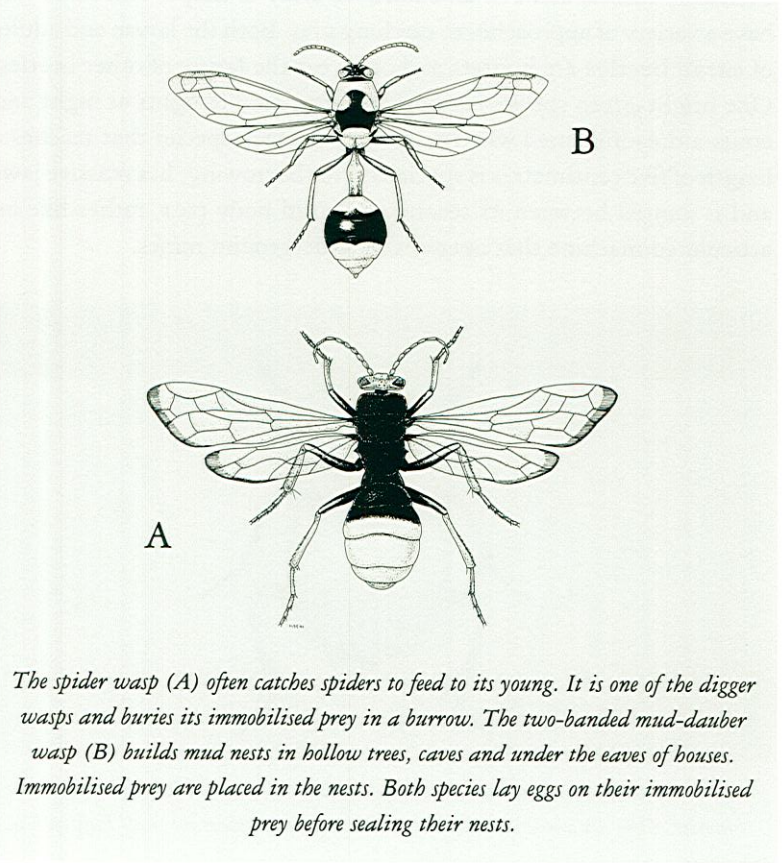
Scorpions and **centipedes** have a sinister reputation. Both are ferocious hunters of animals smaller than themselves, but although scorpion stings and centipede bites from wheatbelt species are painful to humans, they are not normally life-threatening. Both scorpions and centipedes forage at night and hide during the day under logs and rocks or, in the case of the sand scorpions, in deep burrows that spiral down into the soil. Female scorpions and centipedes tend their eggs and newly-hatched young, which are pale, miniature versions of the adults.

Predatory insects come in an enormous array of shapes and sizes, and have a variety of approaches to catching prey. Both the larvae and adults of **carab beetles** are hunters and often eat the larvae of other beetles. One bright-green species is commonly attracted to lights at night and emits a dreadful smell when disturbed. A black species that reaches a length of five centimetres is specialised for burrowing, has massive jaws and is jointed between its second and third body part, rather like an articulated machine that operates in underground mines.



Adults of the green carab beetle are bright green and may be attracted to lights in summer. They are about 25 mm long and release an unpleasant smell if disturbed.

Although many **wasps** feed on nectar as adults, all wasps are predators at some stage in their life. In some small species, the eggs are laid on a living caterpillar and the larvae eat the caterpillar from the inside, avoiding vital organs so that their meal keeps living! Another approach is for the adult to paralyse a caterpillar or a spider and put the paralysed meal in a hole or mud-nest with an egg. In spring, it is common to see a wasp returning from a successful hunting expedition and dragging an immobilised spider or caterpillar across the ground.



The spider wasp (A) often catches spiders to feed to its young. It is one of the digger wasps and buries its immobilised prey in a burrow. The two-banded mud-dauber wasp (B) builds mud nests in hollow trees, caves and under the eaves of houses. Immobilised prey are placed in the nests. Both species lay eggs on their immobilised prey before sealing their nests.

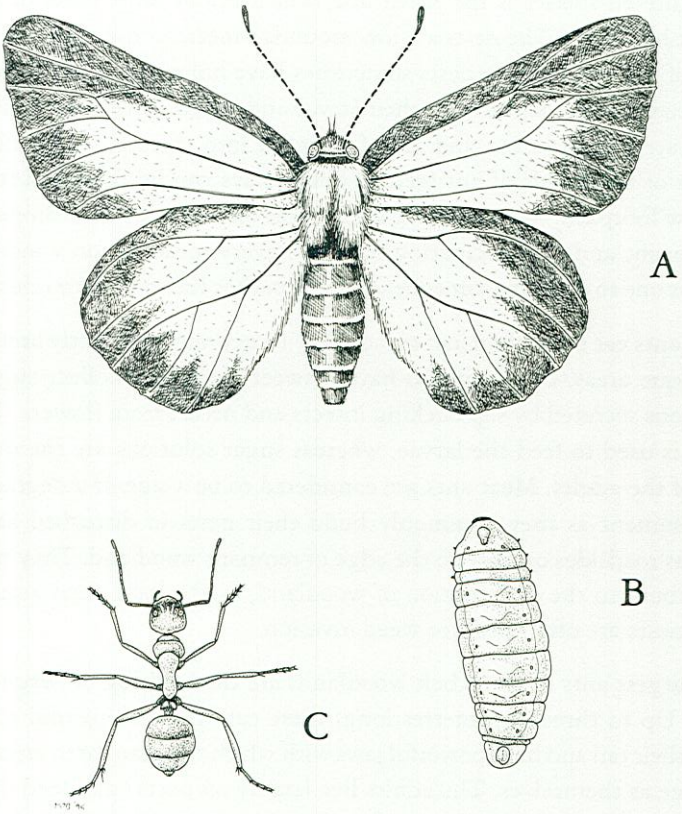
Frantic ants

In wheatbelt woodlands, there seem to be ants wherever you go (and sometimes where you wish they weren't). One of the most often encountered species is the **meat ant**, which builds large nests linked by ant highways. The nests are low mounds a metre or more across and bare of vegetation. The nests sometimes have holes dug into them by echidnas, which eat the ants, their larvae and pupae. The highways are also bare of vegetation and are often worn into the soil by the daily action of thousands of ant feet. The highways can be mistaken for a narrow footpath — but not for long. Meat ants defend their property vigorously, and it is fascinating to watch every meat ant on a mound turn as one to confront someone who approaches the mound too closely.

Meat ants eat more than just meat. They forage very efficiently around barbeque areas, but they also have a sweet tooth and collect sugary solutions secreted by sap-sucking insects and nectar from flowers. The meat is used to feed the larvae, whereas sugar solutions are the main diet of the adults. Meat ants are considered to be a sign of a degraded environment as they commonly build their nests in disturbed areas such as roadsides or close to the edge of remnant woodland. They may contribute to the degradation of woodland, as the bare areas around their nests are often sites for weed invasion.

The largest ants in wheatbelt woodlands are the **bulldog** or **sergeant ants**. Up to three centimetres long, these can deliver a painful sting from their tail and have powerful jaws with which they can catch animals as large as themselves. The adults live largely on nectar and feed their prey to their larvae (grubs). Bulldog ants live in small colonies of only a few hundred insects. The nest has a large entrance like a little volcano and the ants rush out very aggressively if this is disturbed.

The majority of woodland ants are not as large as bulldog and meat ants, but they can be very numerous. Species which eat seeds are so abundant that they have great impact on the production of seedlings by some plant species. When winged ants undertake their breeding



Most blues are small butterflies with a wingspan of only 20–30 mm (A). The caterpillars (B) are flattened and hard-skinned, and are cared for by ants such as the honey ant (C).

flights, often after summer thunderstorms, there can be so many of them that a vast array of other animals, from insects and tiny lizards to large birds of prey, are able to get a feed.

Ants can be predators or prey of other insects, but also have more complicated relationships. Small blue butterflies, commonly known as **'blues'**, lay their eggs near the nests of some ants. The ants build a shelter over the eggs, protect the caterpillars when they feed at night on plants, and allow the caterpillars to hide in their nest during the day. In return, the ants collect a sugary secretion from the caterpillars.

The sanitation department

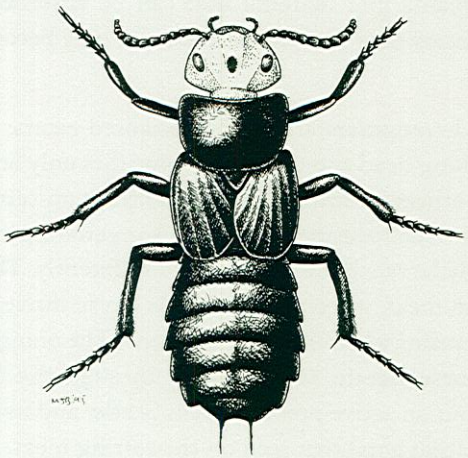
Bushflies and **blowflies** are the most conspicuous and, to humans, annoying of the large group of woodland invertebrates that eat dead plants and animals. Although humans may not be fond of them, the larvae (maggots) of bushflies and blowflies are important members of the group of scavengers and decomposers that turn the dead remains of animals and plants into material that can be absorbed by living plants. In the process they feed themselves, and may become food for something else.

Scavengers and decomposers are often specialised eaters; they won't feed on just anything dead and decaying. Some flies only lay their eggs on rotting fruit, others on rotting meat and others on certain sorts of animal droppings. The roadside carcass of a kangaroo may be teeming with beetle and fly larvae, but they feed on it differently. The fly larvae eat relatively fresh meat, whereas some beetle larvae thrive on the sun-dried skin that remains when the flies have gone. The orange and black **devil's coach-horse beetle** seen pushing through the fur is not a scavenger at all but an active predator. This beetle, and its larvae, feed on the fly larvae (maggots) that feed on the rotting meat.

In the soil, minute invertebrates such as **springtails** (tiny, wingless insects) and soil **mites** help in the recycling process. Unseen, these gnaw away at material such as the fragments of plant material that fall

from trees and bushes and the crumbly remains of the droppings of larger animals. These tiny animals are rarely seen, but larger scavengers and decomposers such as **millipedes** and **cockroaches** are more familiar.

Animal droppings are an ideal source of food for the young of insects such as bushflies and dung beetles, but Australian species are adapted to the pellets produced by kangaroos and wallabies. The native **dung beetles** cannot handle the vast amounts of food produced by sheep and cattle, however, and the abundance of bushflies in the wheatbelt has been attributed to an over-supply of dung. The flies breed in this dung, but it is hoped that a programme to introduce dung beetles from Africa will see a reduction in the supply of dung, and therefore of flies. The African dung beetles have evolved to handle large quantities of dung because of the many large grazing mammals in Africa.



The devil's coach-horse beetle has a distinctive orange head and black body. It is usually seen on the corpses of animals, hence its sinister name.

Vertebrates of the wheatbelt woodlands

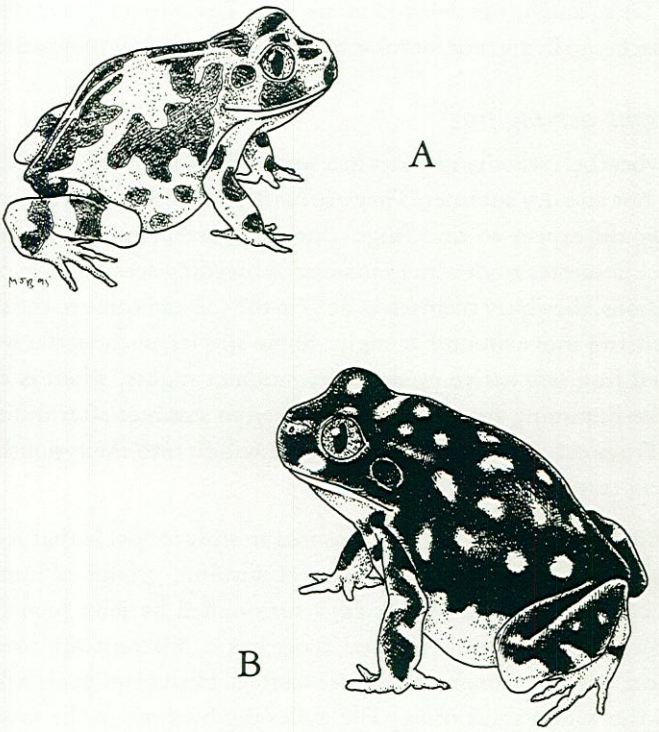
The vertebrates, those animals with an internal skeleton, are greatly outnumbered by the invertebrates, but they still attract most people's attention. From an objective viewpoint, the pygmy possum, with soft grey fur, a short, twitchsome nose and big, dark eyes, is no more or less important than a trapdoor spider, which may also be furry but has large fangs and altogether too many legs. The two just have different approaches to living, but for most humans the possum is more attractive.

Drought-defying frogs

The wheatbelt woodlands exist in a seasonally arid environment with a long, hot and dry summer. They are hardly the place, therefore, where one would expect to find frogs. But frogs are present, and can live many kilometres from water outside the breeding season. To avoid dry conditions, they bury themselves deep in the soil and come to the surface to feed and move around at night. Some species, such as the western spotted frog, are active even on dry summer nights, whereas others, like the humming frog, may only be seen in summer after infrequent rain. Frogs eat anything that moves and will fit into their mouth; ants are very commonly eaten.

The **humming frog** breeds in seasonal freshwater pools that form on clay soils. After the first good rains of autumn, groups of humming frogs can be found and black eggs surrounded by jelly soon fill the shallows. The **western spotted frog** has a different approach. In autumn, the frogs congregate where seasonal freshwater pools will form when the winter rains come. The males dig burrows in the moist soil and each male attracts a female to his burrow with a persistent hooting call. The eggs are laid in the moist soil at the bottom of the burrow and the adults then leave, plugging the entrance of the burrow with soil to protect the eggs. With the winter rains, a pool forms and the burrow eventually floods, by which time the eggs have usually hatched. The tadpoles then swim away from their nursery. This strategy protects

the eggs and young tadpoles from predators such as herons and some aquatic insects. Unfortunately, the introduced fox has learnt to excavate the nests of spotted frogs to eat the eggs and young tadpoles.



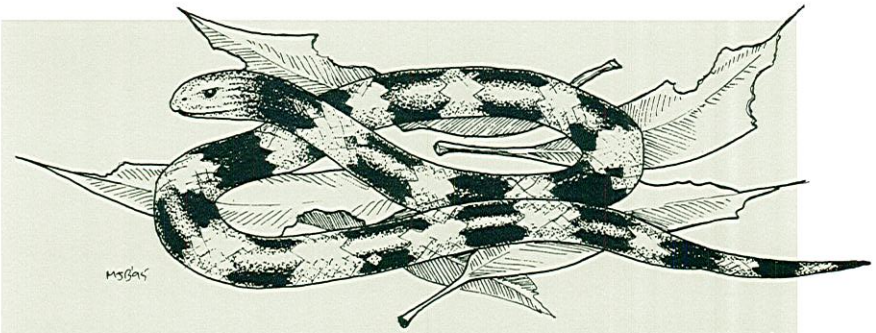
The humming frog (A) and western spotted frog (B) are two of more than 10 frog species that have adapted to the seasonally arid woodland environment.

Reptiles large and small, by day and by night

To many people, the mention of reptiles brings to mind snakes and, with that thought, the subject is quickly changed. This is a shame as reptiles, including snakes, are a diverse and successful group of animals which are well represented in wheatbelt woodlands. There are reptiles that burrow, reptiles that scurry, reptiles that climb, reptiles that are out by day and reptiles that are out by night. There are small reptiles that weigh only a few grams and live for a couple of years, and there are big reptiles that weigh many kilograms and live for decades.

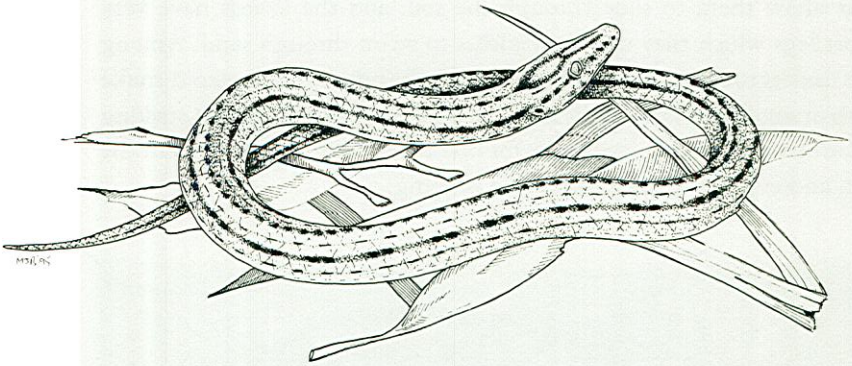
Reptiles found in the woodlands belong to a small number of distinctive groups: geckos, legless lizards, dragon lizards, goannas or monitor lizards, skink lizards, blind snakes, pythons and elapid (venomous) snakes.

Some skink lizards, the blind snakes and some of the small elapid snakes spend the bulk of their lives underground. They have smooth scales that allow them to slide through the soil, and the lizards have very short legs which they use like paddles to swim through sand. Among the underground reptiles is **Jan's bandy-bandy**, a small elapid snake with orange and black bands around its body. It is thought this striking colour pattern makes it difficult for predators to tell the head from the tail, and even which way the snake is going.



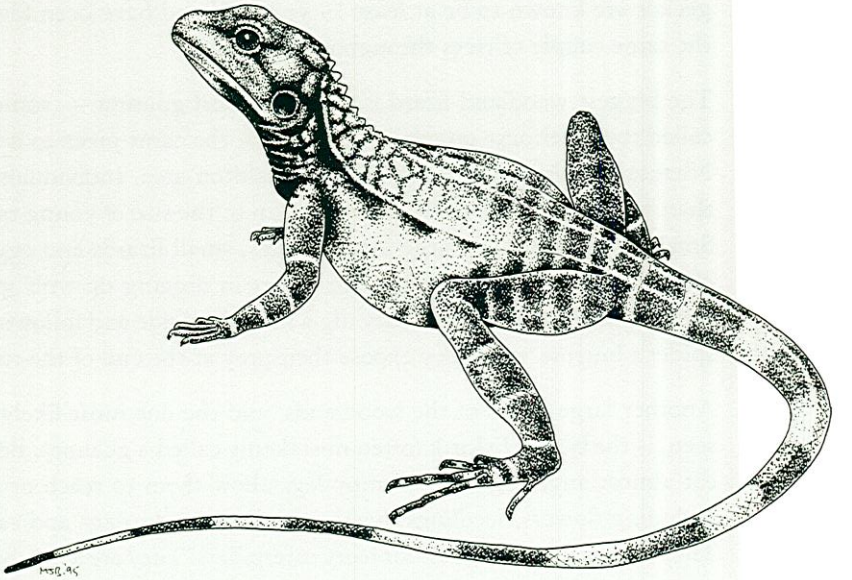
Jan's bandy-bandy is a strikingly-marked burrowing snake which is usually active at night.

When walking through the woodland, it is common to hear rustling and scurrying noises among the leaf litter. Small skinks make their homes where leaves pile up against logs and even in roadside ditches. **Burton's legless lizard** specialises in feeding on such skinks and is frequently to be seen on tracks, basking in the late afternoon sunshine. It has a distinctive pointed nose and varies greatly in coloration. Many individuals are striped with dark lines along the body (none of the snakes in the wheatbelt has stripes like this).



Burton's legless lizard is distinguished from wheatbelt snakes and other legless lizards by its pointed nose. The features usually recommended for distinguishing legless lizards from snakes, such as the presence of ear-openings and leg-flaps, require close examination that could be dangerous if the specimen is a venomous snake.

Dragon lizards also run through the leaf-litter — dashing across patches of clear ground and sheltering under bushes. The **crested dragon** is common in eucalypt woodlands and is usually seen only as it sprints across a clearing.



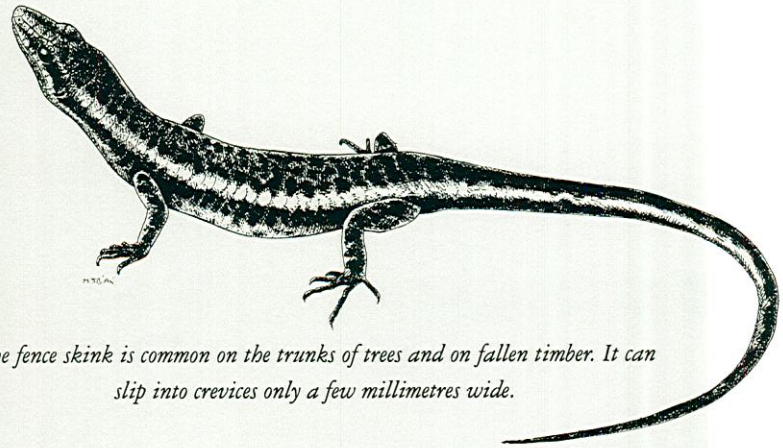
The small crest of the crested dragon belies its name. The entire animal does not exceed 40 cm in length. This is larger, however, than most other dragons.

Lizards also live in trees. During the day the **fence skink** may be seen basking on the trunks of trees or on fallen timber. It is a common sight on old picket fences in wheatbelt towns and urban areas. It is a very flat little skink, which enables it to slip into crevices in the wood.

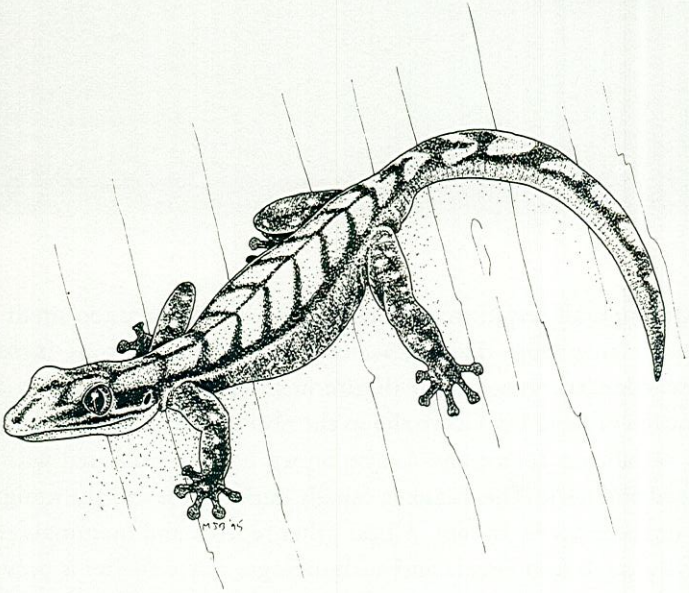
The **salmon gum gecko** is a tree-dwelling lizard restricted to eucalypt woodlands of the wheatbelt. It shelters by day in crevices and hollows of trees, and forages at night by clinging to the trunks of smooth-barked eucalypts such as salmon gum and gimlet, waiting for invertebrates to wander past. Salmon gum geckos are very faithful to their trees and are long-lived. In one long-term study, some of the geckos are known to be at least 19 years old and have been found on the same couple of trees throughout that time.

The biggest woodland lizard is **Gould's sand goanna** — sometimes called the **racehorse goanna** or **bungarra**, the name given to it by the Nhanta (or Nannda) people of the Geraldton area. Individuals more than one metre long will take animals up to the size of young rabbits. Smaller specimens eat large invertebrates, small lizards and eggs and chicks from birds' nests. They are expert in digging up wolf spiders. With their powerful claws, they dig a hole alongside and following the spider's burrow, until they expose their prey at the end of the tunnel.

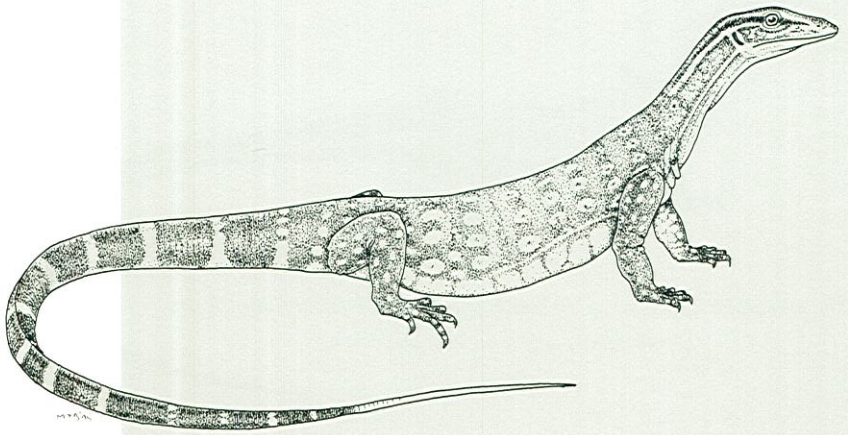
Another large lizard of the woodlands, and the one most likely to be seen, is the **bobtail skink** (often mistakenly called a goanna). Bobtails eat almost anything their stumpy legs allow them to reach or catch, including flowers, seedlings, beetles, nestling birds, eggs and carrion. They show a great fondness for hairy caterpillars! They are a live-bearing species, bearing one or two young in March or April. Bobtails don't breed until in their third year, and large animals may be well over 20 years old. Spring is the time of year when bobtail-trains may be found: a female with one, two or more hopeful males plodding along behind. Because bobtails stay in the same general area throughout their lives, the same pairs are often seen together spring after spring, giving the impression of a monogamous couple.



The fence skink is common on the trunks of trees and on fallen timber. It can slip into crevices only a few millimetres wide.



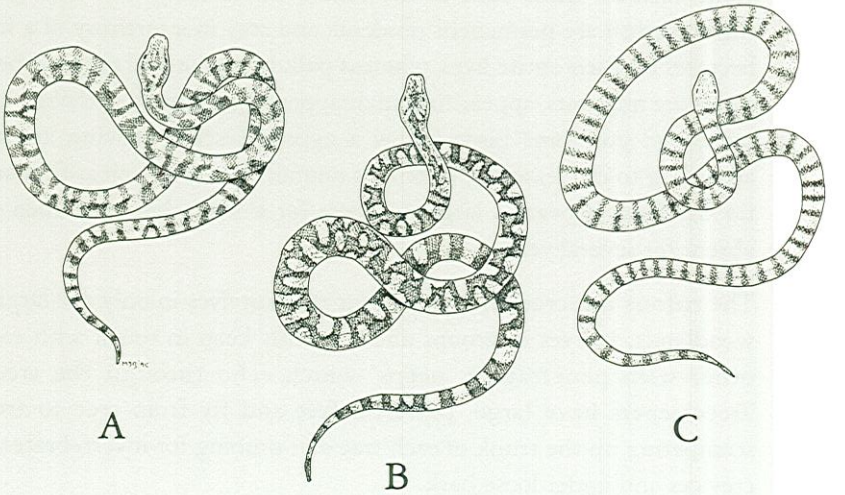
The salmon gum gecko shelters under bark during the day and feeds at night.



Gould's goanna is one of the largest native predators in the woodland.

Although all elapid snakes are venomous, most are too small to be a threat to people. Large species which are dangerous include the **gwardar**, the very similar **dugite** in the southern wheatbelt, and the **mulga** or **king brown snake** in the northern wheatbelt. The gwardar is variable in colour and can be brown or even brick red with a dark head and neck. The dugite is usually dark brown and the mulga snake a uniform tawny brown. All eat other reptiles and mammals and may live around farmhouses and outbuildings, where shelter is provided by firewood and sheets of corrugated iron and food is present in the form of house mice.

The only other large snakes in the wheatbelt are the pythons. These are rarely encountered as they are shy and often active late in the day and even at night in summer. The **carpet python** is encouraged by some farmers because it is harmless and eats rats and mice. Pythons can detect the body heat of their prey through special sensory pits on their lower jaw. They are also unusual in that they brood their eggs, rather than simply burying them under a log or similar object as do other egg-laying snakes.



Three species of python occur in the wheatbelt. Stimson's python (A) may grow to 0.9 m. Larger pythons are the carpet python (B), which can reach 2.4 m, and the 2.3-metre-long woma (C). The woma is now extremely rare and any sightings of a large, faintly banded python should be reported to CALM.

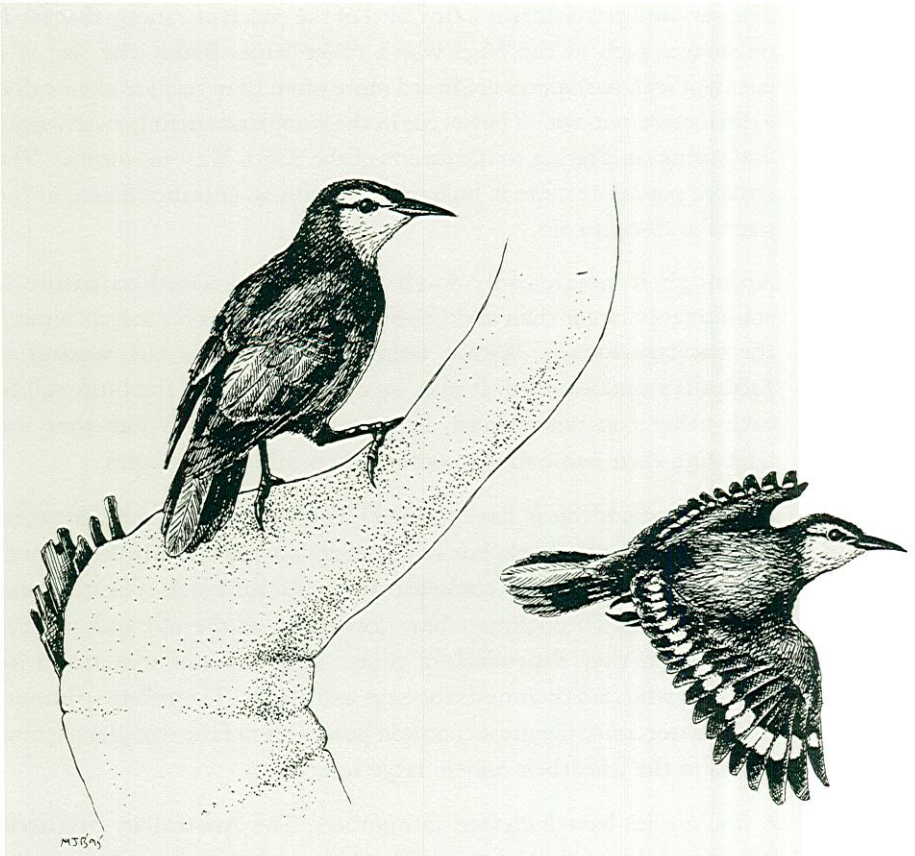
An abundance of birds

Much of the wildlife of wheatbelt woodlands is not easily seen, but this can not be said of the birds. Parrots adorn the trees, eagles soar overhead, honeyeaters fly in noisy mobs among blossoms, and a background chorus of birdsong is ever-present.

More than 120 species of birds occur in the woodlands and they live in a variety of ways. Pigeons and parrots eat seeds and fruits. Honeyeaters eat invertebrates as well as nectar and pollen. Many birds forage for invertebrates on the ground, in the bushes or trees, and there are large predatory birds such as eagles, kites and falcons. There are also nocturnal predators: boobook owls, tawny frogmouths, owlet nightjars and bush stone-curlews. Birds such as the blue-breasted fairy-wren and grey shrike-thrush are permanent residents and stay in a territory of a few hectares for their entire lives, whereas pallid cuckoos and rainbow bee-eaters are migrants, appearing and disappearing annually as the seasons come and go. Some birds follow a gypsy lifestyle, moving around according to the seasons, patterns of rainfall or events such as fires and floods. They appear in large numbers for a while but may then be absent for several years.

The **rufous treecreeper** is a resident that survives in only the largest woodlands. It lives in groups and the birds keep in touch with each other with penetrating 'peeps' which echo through the trees. Treecreepers have large, powerful feet and fly from tree to tree, scampering up the trunk of each tree and probing for invertebrates in crevices and under loose bark.

Another resident bird typical of wheatbelt woodlands is the **rufous whistler**. Males defend their territory against other males with a vigorous song which begins with a very rapid 'pee-pee-pee', changes to a rapid 'joey-joey-joey' and ends with one or a series of whip-crack whistles: 'e-chong, e-chong'. The bird does not seem to need to pause for breath when calling. One male gave 39 repetitions of the 'joey' call as part of his territorial defence.



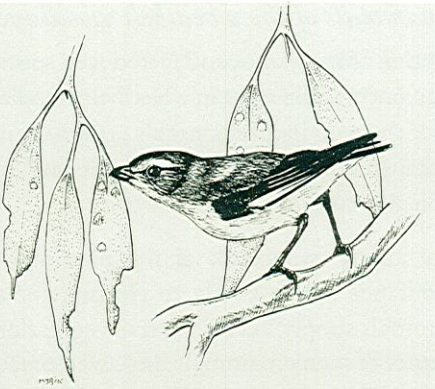
The rufous treecreeper lives in family groups and nests in hollow trees. Family members may brood the eggs and raise the young of the dominant pair.

The **striated pardalote** is a tiny bird of the eucalypt canopy that feeds on insects such as the bugs which make lerps. Barely the size of a eucalypt leaf, pardalotes are heard more often than seen, as their call is a distinctive 'wit-wit'. They occur in the woodlands mainly over winter and spring, migrating to the forests of the South West in summer. The striated pardalote nests in hollow limbs with an entrance diameter the size of a 20-cent coin.

Although it weighs only 9–10 grams, the striated pardalote is considerably larger than another bird which forages for insects among the eucalypt foliage. With a weight of 5–6 grams, the **weebill** is Australia's smallest bird. It lives in small groups and the birds call to each other constantly; with imagination, it sounds like they are repeating their name to each other in breathless little voices.

Many woodland birds have declined in abundance in the wheatbelt because of loss of habitat, but some species are particularly threatened. The **short-billed black-cockatoo** (white-tailed black-cockatoo) and **Major Mitchell's cockatoo** have lost many of the old hollow trees upon which they depended for nests. They are also threatened by poachers who raid their nests for eggs and chicks. The **yellow-plumed honeyeater**, once the most common honeyeater of the woodlands, now occurs in the wheatbelt only in large reserves.

A few species have increased in numbers. The **Australian ringneck** (**twenty-eight parrot**) is favoured by the open landscape with scattered trees, as are **Australian magpies**, **magpie larks** and **willie wagtails**. The **galah** and **crested pigeon**, which now occur throughout the wheatbelt, did not originally occur in the region and invaded from further north. They are still increasing in abundance in some areas. These species have been favoured by cereal cropping and permanent water in farm dams. The Australian ringneck and galah nest in hollow trees in woodland, but can damage native vegetation by ring-barking trees and eating the shoots of bushes. They may also severely damage plants in revegetation projects.



The striated pardalote clambers and flits through the eucalypt foliage where it feeds on invertebrates including the bugs that make lerps.

Many nectar-feeding birds are either migrants (recorded at the same place in the same season each year) or nomads (recorded irregularly). Such lifestyles suit the food source, as plants flower seasonally but the flowering may be good one year, such as after heavy winter rains, then poor the next. In the central wheatbelt, banksia woodlands are particularly important for nectar-feeding birds and tiny patches of this habitat act like magnets to the birds. The **purple-crowned lorikeet** is a small, nectar-feeding parrot that can invade the wheatbelt in large numbers when the eucalypts flower heavily. The lorikeets feed noisily in the eucalypt canopy and shriek as they fly between the trees, but are very hard to see.

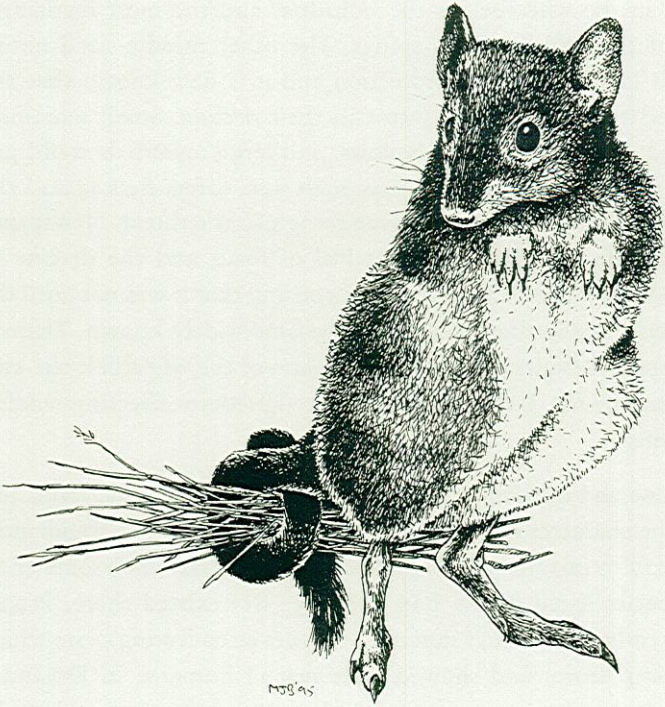
The woodland is not only filled with the noise of birds during daylight hours, for nocturnal birds also rely on sound to declare their territories and communicate with their mates. The eerie wail of the **bush stone-curlew** was once a common wheatbelt sound, but it has declined because of clearing and foxes, to which it is vulnerable as it nests on the ground. Its survival in remnant woodland seems to depend upon the availability of fallen timber for shelter.

Mysterious mammals of the wheatbelt woodlands

With the exception of kangaroos and introduced species such as rabbits, mammals are an uncommon sight in wheatbelt woodlands. This is partly because most of the woodland mammals are small, nocturnal and shy, but it is also because many species have become rare or have disappeared from the region this century.

The decline of about two thirds of the mammal species found in wheatbelt woodlands is due partly to clearing for agriculture. Over vast areas, mammals simply have no native vegetation in which to live. The disappearance of many mammals, however, preceded the intensive period of clearing that took place after World War II. Furthermore, there are accounts from the turn of the century of mammals which are now close to extinction being abundant in areas that were already partly developed for agriculture. The **woylie**, a rabbit-sized, kangaroo-like marsupial, was considered to be a pest because it dug up vegetable gardens. It was even trapped alive and sold in markets to be used as a lure in training greyhounds! The **tammar**, a small wallaby, was common on farms into the 1930s, and many farming families dined on tammar more often than sheep. Children even had a poem to honour the tammar, recorded by Angela Sanders:

Tammars young and tammars old,
Tammars hot and tammars cold,
Tammars tender and tammars tough,
Tammars; thank God we've got enough.



The woylie, a small relative of the kangaroos, weighs up to 1.6 kg. It gets its name from the Noongar word Wurlie, meaning a shelter. Woylies build wurlies for themselves under bushes, using grass, leaves and twigs, which they carry in their prehensile tail.

Most of the mammals that declined in the wheatbelt are of the size of the woylie or tammar. Very small (mouse-sized) and very large (kangaroo-sized) mammals have generally survived, at least where suitable habitat remains. The only middle-sized native mammal still common in the wheatbelt is the **echidna**, and the most distinctive feature of the echidna is its spines. The other middle-sized native mammals lack this sort of protection and it is now known that the introduced **fox** was a major factor in their decline. Small mammals could shelter in burrows and hollows, and large mammals could put up a fight, but the middle-sized mammals were defenceless against the new predator which they didn't even recognise as a threat. Newspaper reports at the time linked the arrival of foxes and the decline in abundance of woylies. It is therefore surprising that it was not until the 1980s that the importance of the fox became widely known. There is good anecdotal evidence that in some parts of the wheatbelt the **cat**, rather than the fox, is the major introduced predator affecting wildlife populations.

The decline and disappearance of so much of the mammal fauna has altered the character of the woodland. When standing in woodlands, it is difficult to imagine what it would have been like when some or all of the species listed in the Box (see page 81) existed there. People camping early this century described woylies as endearing pests which raided camp stores and showed little fear of humans. In Dryandra Woodland, they were so scarce in the late 1970s that it was thought they had died out. By the late 1980s, after only five years of fox control, they were so abundant that they were living under the cottages and were accepting food from visitors.

Extinct and Threatened Mammals of Wheatbelt Woodlands

Abbreviations for the status of the species are as follows:
S, secure; T, threatened; E, extinct; NA, species not recorded outside the wheatbelt.

SPECIES		STATUS	
		WHEATBELT	ELSEWHERE
banded hare-wallaby	*Lagorchestes fasciatus*	E	T
big-eared hopping-mouse	*Notomys macrotis*	E	NA
bilbie or dalgyte	*Macrotis lagotis*	E	T
black-footed rock-wallaby	*Petrogale lateralis*	T	T
boodie	*Bettongia lesueur*	E	T
broad-faced potoroo	*Potorous platyops*	E	NA
brush-tailed possum	*Trichosurus vulpecula*	T	S
brush wallaby	*Macropus irma*	T	S
heath rat	*Pseudomys shortridgei*	T	T
long-tailed hopping-mouse	*Notomys longicaudatus*	E	E
numbat	*Myrmecobius fasciatus*	T	T
pig-footed bandicoot	*Chaeropus ecaudatus*	E	E
quenda	*Isoodon obesulus*	T	T
red-tailed phascogale	*Phascogale calura*	T	E
rufous hare-wallaby	*Lagorchestes hirsutus*	E	T
stick-nest rat	*Leporillus* species	E	T/E
tammar wallaby	*Macropus eugenii*	T	T
western barred bandicoot	*Perameles bougainville*	E	T
western mouse	*Pseudomys occidentalis*	T	NA
western ring-tailed possum	*Pseudocheirus occidentalis*	E	T
woylie	*Bettongia penicillata*	T	T
wurrung or nailtail wallaby	*Onychogalea lunata*	E	E

Woylies feed on the fruits of fungi, bulbs and insects and they forage by digging small pits in the ground. Where they are abundant, the ground looks as though it has been attacked by a mad gardener with a hoe. The impact of this digging must be great. Soil and leaf litter are turned over and mixed, while the spores of fungi are spread and stimulated to grow (see page 41). One can only guess at the long-term impact of the cessation of this sort of activity by woylies and other middle-sized mammals in the wheatbelt woodlands.

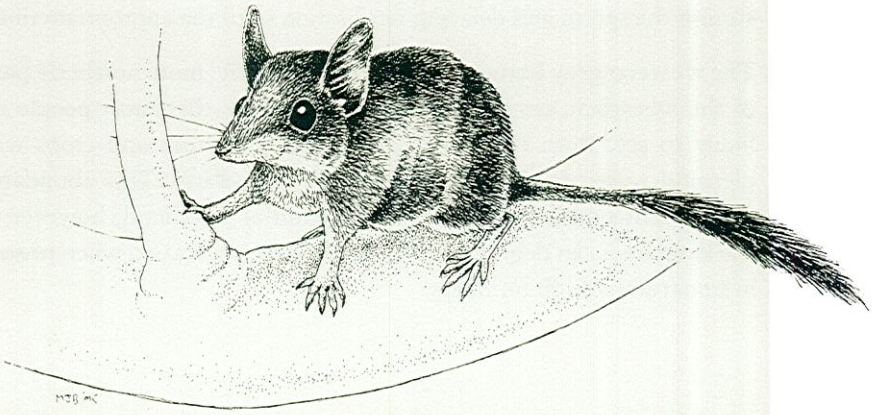
The decline of middle-sized mammals in the wheatbelt is part of an Australia-wide phenomenon. Roughly 10 mammal species of southern or central Australia are believed to be extinct, and a further five species have disappeared from the mainland but survive on islands. The South West region, including the wheatbelt woodlands, is the mainland stronghold for several more species that were once widespread.

The **numbat**, Western Australia's mammal emblem, was once found right across southern Australia, from close to Perth in the west to inland New South Wales in the east. The contraction of its range to a few locations in the western wheatbelt and adjacent jarrah forest was influenced by the spread of the fox, but clearing in the wheatbelt hastened its decline. It was still widespread in the wheatbelt until the early 1960s when habitat was made so fragmented by clearing that few reserves were large enough to support viable populations of numbats. Habitat fragmentation may have made the numbat more vulnerable to fox predation and it is unlikely that numbats would have survived to the end of this century without the control of foxes.

Unusually among marsupials, the numbat is active during the day (diurnal), and its bright coloration actually helps to camouflage it in dappled shade and against a mottled background of leaf litter and logs. It exists almost solely on termites, and feeds on them when they are in the narrow feeding channels that some termites construct near the surface of the soil. Termites are only in these channels during the day (except on the warmest of summer nights), which explains the

diurnal nature of the numbat. The numbat is not strong enough to break into termite mounds.

The **red-tailed phascogale** or **wambenger** is now confined to larger reserves in the wheatbelt, where it favours rock sheoak woodlands with some wandoo. It is known historically from locations as far apart as the southern Kimberley, central Northern Territory and inland New South Wales. The red-tailed phascogale is very agile in trees but also forages on the ground and seems to be most abundant in woodland that has not experienced fire for a long time. It breeds in spring and males may die shortly after mating, which gives them a life-span of just under a year. Females may survive for two years.



The red-tailed phascogale is a nocturnal predator which eats invertebrates, small birds and mammals.

Not all of the woodland mammals have undergone a catastrophic decline in abundance. Small insect-eating bats are still common, even where little native vegetation remains. They can sometimes be seen foraging around lights at night. Bats found in the wheatbelt range in weight from five to 35 grams, and roost by day in hollow limbs, under bark and even under logs and rocks, to emerge at night and catch insects on the wing. Very rarely do any of the wheatbelt bats form large colonies.

The **white-striped mastiff-bat** is the largest wheatbelt bat species and makes an audible ticking noise as it flies. The sounds of other species are beyond the range of human hearing. The mastiff-bat tends to fly high and quickly, whereas the **long-eared bats** fly slowly and can sometimes be seen in the evening, fluttering close to eucalypt foliage as they search for insects. Baby bats (usually twins) are born in spring and are carried around by their mother until they weigh too much for her to fly. They are then left in a shelter while she forages. Mating occurs in autumn and the female determines when her babies are to be born by storing the sperm and delaying fertilisation until the appropriate time.

The **western grey kangaroo** and the **euro** in the more northerly parts of the wheatbelt are the only native mammals that most people are likely to see. Both thrive in a landscape of pasture and crops with plentiful water and scattered patches of woodland. This abundance can present problems for the conservation of woodland, however, as the kangaroos can degrade remnants of native vegetation when present in unnaturally high numbers.

THE EVER-CHANGING WOODLAND

The wheatbelt woodlands are dynamic. Animals and plants grow and die, and infrequent dramatic events such as storms, fires, floods, locust plagues and drought may wreak broadscale change. Changes, from the growth of a sapling into an old tree to the apparent devastation wrought by a bushfire, are such a part of the woodland that they have been incorporated into the life cycles of plants and animals. Changes, both subtle and dramatic, help to mould the character of the woodland. When standing in a woodland, one is in an environment that appears permanent and enduring. This impression is deceptive. The woodlands of today owe their structure and character to events that may have occurred decades, or even hundreds of years, ago.

For example, salmon gum woodlands often consist of trees of the same age and size, whose cylindrical trunks and spreading crowns create a cathedral-like atmosphere. Such woodlands are testimony to dramatic events in the past. The flowers of salmon gums are small and numerous. Colin Yates of Murdoch University has found that one large tree may carry more than 400 000 tiny seeds, and these rain onto the woodland floor at the rate of 5–10 seeds per square metre per month. Seedling salmon gums are rare, however, as most of the seeds are eaten by ants. Seedlings are usually only found in areas that have been recently burnt or have suffered severe storm damage. After such events, the trees drop most of their seeds and the ants can't eat them all. Although many of the adult trees may be killed by the storm or fire, the young trees will grow to replace them.

Seedlings need space in which to grow. An observant bush walker will find many seedlings — including those of hard-seeded species such as acacias and peas — growing in space created by the death of a tree or shrub. However, intense regeneration is usually stimulated by large-scale disturbance such as fire, flooding or storm damage.

Fire is an important factor in the life cycles of many woodland plants. Not only salmon gums but a range of plants — including banksias, dryandras and some of the poison peas — produce more abundant seedlings after a fire. In some cases, plants which were not apparent

before a fire will appear afterwards, as their seeds may have lain dormant in the soil for decades. Fires differ, however, in the area burnt, the intensity, the time of year and the time since the last fire. Growth of seedlings after a fire can be affected by these factors, and the weather after the fire is also important. Regeneration after a fire can fail if drought conditions prevail, or can be vigorous if unusually heavy rains fall. The interplay of factors such as fire and climatic extremes contributes to the natural patchiness of the woodlands.

Woodland animals are affected by fire in a variety of ways. They display a remarkable ability to survive fire, but the first few weeks afterwards can be critical if food and shelter are lost. Animals depend upon plants, and therefore the impact of fire and weather upon plants is also important for animals. There are animals which increase in abundance in the first few years after a fire, as they feed on the fresh new growth of plants (or on animals that feed on this growth). There are also animals which are most abundant in vegetation unburnt for many years. Such animals may favour the deep leaf litter and dense understorey that take many fire-free years to develop.

A combination of events can have dramatic results. In the spring of 1990 and the following summer, locust plagues swept the wheatbelt. There was some crop loss, lawns in country towns were denuded and birds such as magpies learnt to pick locusts from the grills of cars at service stations. The locusts damaged plants in woodland remnants and were particularly destructive of sheoaks, most of which regenerated in the following winter. In one case locusts ate and killed all the sheoak seedlings stimulated by a prescribed fire. Here, the combination of the fire and the locust plague has changed, on a small scale, the character of a woodland site.

Not all change is on the grand scale of fires, storms and droughts. Plants which produce an abundance of seedlings after a fire will produce the occasional seedling between fires, particularly when space is created by the death of a single tree. An echidna scratching in the ground can stimulate the germination of seeds, and the relentless chewing of termites can create the hollow limbs and logs upon which so many animals depend.

THE FUTURE OF WHEATBELT WOODLANDS

CONSERVATION ISSUES

Although broad-scale clearing of wheatbelt woodlands no longer occurs, woodland remnants are not secure. Conservation issues stem from three main factors: clearing and fragmentation of the original vegetation, the impacts of pest plants and animals, particularly exotic species, and the attitudes and values of humans.

Clearing and fragmentation

Fragmentation of woodlands by clearing for agriculture has created a new landscape. Before agricultural development, the flora and fauna of the wheatbelt woodlands lived in vast areas of continuous native vegetation. Now, the woodlands are reduced to scattered remnants and the survival of species in this fragmented landscape poses special problems.

The decline and loss of plant and animal populations has been the most noticeable effect of clearing natural vegetation. Some plants and animals have become completely extinct, while others have disappeared from particular shires and regions. The local loss of species continues today as a result of clearing and fragmentation. Many species are threatened by extinction.

Fragmented populations will slowly disappear if their death rate exceeds their birth rate — such populations are considered 'not reproductively viable'. This process may be hastened by a large wildfire or other disturbance that temporarily destroys all, or most, of a remnant. In many cases the lack of corridors of native vegetation between the remaining remnants makes it difficult, or impossible, for recolonisation to occur when a population disappears. For example, the disappearance of resident birds like the rufous treecreeper and yellow-plumed honeyeater (see pages 74 & 76) from woodland remnants occurs when the remnants are too small to support a viable population, and too isolated for the birds to recolonise from other areas.

Other effects of clearing the native vegetation are less apparent, although no less dramatic in their long-term results. For example,

clearing the native vegetation has changed the hydrology (water relationships) of the landscape. This has resulted in rising saline water tables and other problems that threaten both woodland remnants and agricultural lands (see Box). Salty groundwater reaching the roots of plants, often combined with waterlogging, may lead to the rapid death of many trees and shrubs. There is great concern that a substantial proportion of woodland remnants will be irreparably lost to salt over the next few decades.

The isolation of remnants within a sea of agricultural land also exposes them to degradation by exposure to farm practices such as use of pesticides and fertilisers. The fertilisers may even poison plants adapted to the naturally low level of soil nutrients in the wheatbelt. More obvious is the invasion by weeds, rabbits and livestock — all 'pest' species when it comes to protecting natural vegetation.

Pest species

For woodland remnants and their wildlife, pest species include introduced species such as exotic weeds, rabbits, cats, foxes and domestic stock, and native species that have either greatly increased in numbers or invaded as the wheatbelt environment has changed.

Individual pest species are a testing problem for the woodland manager, and their combined effect is a serious challenge. Interactions between exotic species greatly compound conservation problems. For example, grazing by rabbits and livestock may seriously degrade remnants. At the same time, the introduced herbivores spread weed seeds and disturb the ground. This makes it easier for weeds to become established. Weeds compete with small native plants for water, nutrients and space, and can alter the behaviour of fire in woodlands. Weeds can form a dense layer of fuel close to the ground that can affect the survival of native plants during a fire, and the germination of their seeds after it. Native animals are threatened by the consequent loss of habitat that occurs and by introduced predators such as the fox and, in some cases,

Salt and an Ancient Landscape

Soils of the wheatbelt contained salt long before clearing of vegetation for agriculture occurred. Rainwater contains minute traces of salt, and the western wheatbelt can receive 50 kilograms of salt per hectare each year. The amount of salt in rain is higher near the coast than inland, but much of the rain that falls near the coast finds its way back to the sea and takes its salt with it. Further inland, most of the rainwater is taken up by plants and evaporated through their leaves. Little water flows back to the sea, so the salt remains in the soil.

Accumulation of salt has been especially great in wheatbelt soils because the landscape has been very stable for some 200 million years and the climate has been getting gradually more arid over the past 15 million years. This stability means that no major movements of the earth's crust and no formation of glaciers has occurred to change patterns of drainage, scour old soil from the valleys and rejuvenate the landscape. The increasing aridity means that, over the millenia, there has been progressively less water available to flush through the soil and carry salt down the rivers and out to sea.

In the wheatbelt, salt occurs naturally deep in the soils and in salt lakes. In these situations, the salt does no harm to plants because salt-tolerant plants can grow around the salt lakes and the natural vegetation higher in the landscape receives the moisture it needs through the annual rainfall, and is unaffected by the salt deep below the surface. But once the land is cleared for agriculture, much of the rainfall is not absorbed by plants, as crops and pastures, unlike the native vegetation, have shallow roots and use only some of the annual rainfall.

Because of the extensive clearing in the wheatbelt, more water than in the past now reaches the watertable that generally lies deep below the soil surface. As more water accumulates in the soil, the watertable rises towards the soil surface. As it rises, it dissolves the salt stored in the soil and brings this closer to the soil surface. In some places the salty water has reached the roots of plants that cannot tolerate high salt levels and they have died, often from water-logging as well as high salinity. Salty water is even seeping out of the ground in some places, and large salt pans sometimes develop. As early as 1916, the appearance of salty water in low-lying paddocks around Northam was reported by Jim Masters. The connection was made with clearing, but the implications were not appreciated until well after World War II. By 1993, half a million hectares of agricultural land in the South West were severely affected by salt, and a further million hectares were moderately affected. It is estimated that, by the year 2040, as much as 30 per cent of agricultural land in the wheatbelt may be badly affected by salt. The clearing of native vegetation ignited the fuse of a bomb which is now exploding.

Not only is agricultural land being lost, but remnant woodland, first in low-lying areas but later also on higher ground, is dying or under threat. The race is now on to save agricultural and conservation lands alike. Solutions to the problem of salt in the wheatbelt require management of the total landscape and are discussed by Hooper and George (see References and Further Reading).

competition with invading native species. Although these threats occur throughout the South West, their impact on remnant bushland is dramatic.

Human values

In the end, the survival of wheatbelt woodlands will depend on human values, knowledge and interests. Do we fully understand the value of our woodlands, and do we want to save them? Our answers and responses to these questions will decide the fate of our woodlands. Indeed, in a broader sense they affect the fate of our wildlife and our agricultural lands as a whole.

CONSERVATION SOLUTIONS

Conservation of the wheatbelt woodlands is about effective management in a changed landscape. This booklet is about one aspect of management: information. People need to know about the woodlands, woodland life and woodland issues. From understanding comes action, and there are management actions that can be taken to conserve the woodlands. The management of remnant vegetation is described in detail by Penny Hussey and Ken Wallace in *Managing Your Bushland*, and advice on revegetation is contained in the *Revegetation Guide to the Central Wheatbelt* by Ted Lefroy, Richard Hobbs and Lyn Atkins.

Management actions can be divided into protection and habitat expansion.

Protection

Ignorance of the value of woodland and the ways in which it may be protected is a major issue. Everyone, including those without a direct role in managing remnant vegetation, can help to ensure that ignorance does not threaten our remnants. The more people who understand and have an interest in our wheatbelt bushland, the greater the likelihood of its long-term protection.

Actions to protect remnant vegetation include a wide range of activities such as fencing, control of pest species, rehabilitation and regeneration. On a larger scale, revegetation and other actions to control rising groundwater may directly or indirectly help to protect woodland remnants. Combined actions such as protection of remnant vegetation, revegetation for commercial values, and revegetation for soil conservation may interact to better protect both wildlife and agricultural values. Such integration of different goals in complementary ways is crucial for the long-term protection of our agricultural landscapes and land use.

There is an urgent need to develop effective means of integrating the goals of agriculture and nature conservation to the benefit of each. In

some cases, such as the more effective use of fertilisers and pesticides, changes to farm practice may decrease costs and also decrease impacts on remnant woodlands. For their part, the woodlands have a role to play in combatting land degradation, and they are likely to supply other benefits including local seed for revegetation.

A current trend is for community groups to become involved — for example, through land care committees — in the management of either bushland or particular species, such as the **malleefowl**. Other people work through catchment groups and local government to better protect the woodlands of their districts. These trends provide community members with new ways to become involved in the management of their districts.

Expanding habitat

The greatly reduced habitats available in woodland remnants may be improved by expanding their effective size. The main avenues for achieving this are to rehabilitate degraded areas, expand existing remnants or to link remnants with corridors of native vegetation.

Those interested in revegetation and rehabilitation to expand remnant woodlands will find general information in *Managing Your Bushland*. References in the same book provide access to more comprehensive sources of revegetation information.

The problem of fragmentation of remnants can be reduced by linking remnants with corridors of native vegetation. In a study of undeveloped road reserves in the Shire of Dumbleyung, Stephen Davies found that the narrow reserves often supported a variety of flora and fauna. They were of conservation value in their own right and also served to link larger areas of remnant native vegetation. In the Shire of Kellerberrin, Denis Saunders and Perry de Rebeira found that small birds travelled between remnants not in direct lines, which would have taken them over paddocks, but along strips of trees adjacent to roads. Often,

corridors such as these are degraded and need fencing, weed control and revegetation if they are to be useful in linking remnants of vegetation.

Conclusions

Appropriate management of wheatbelt woodlands will ensure the survival of their diverse flora and fauna. With more than 90 per cent of the woodlands cleared and the remnants threatened by factors such as rising salinity, grazing and fragmentation, the challenge of management is enormous. As the task of developing the wheatbelt for agriculture was achieved tree by tree and hectare by hectare, so the task of conserving the remnants can be achieved fencepost by fencepost and seedling by seedling.

Success in this task, and the long-term protection of our woodland values, is in our hands.

APPENDIX

COMMON AND SCIENTIFIC NAMES OF ANIMALS AND PLANTS MENTIONED IN THE TEXT

For many of the animals and plants described in this booklet, there are no widely accepted common names. For others, the common name may vary from one location to another. The bobtail lizard, for example, is known variously as the shingleback, stumpytail and sleepy lizard. Therefore, scientific names ensure that there is no doubt as to the species or group of species being described. The scientific names used in this list are taken from current publications of the WA Museum and the WA Herbarium.

Names are listed under the following categories:

PLANTS
ANIMALS
Invertebrates
Vertebrates
Frogs
Reptiles
Birds
Mammals.

Within each of these categories the names are listed alphabetically under group names, such as eucalypts, banksias, ants, spiders.

COMMON NAME	SCIENTIFIC NAME
PLANTS	
acacia (wattle)	*Acacia* species
jam	*Acacia acuminata*
panjang	*Acacia lasiocarpa*
banksias	*Banksia* species
acorn banksia	*Banksia prionotes*
bluebush	*Maireana brevifolia*
daisies	Asteraceae
capeweed	*Arctotheca calendula*
everlastings	*Waitzia* and *Rhodanthe* species
olearia	*Olearia dampieri* and *O.muelleri*
ursinia	*Ursinia anthemoides*
dryandras	*Dryandra* species
noble dryandra	*Dryandra nobilis*
ectomycorrhizal fungi	
fruit mushroom-shaped	*Laccaria* species
fruit a truffle	*Defcomyces* species
eucalypts (gum trees)	*Eucalyptus* species
brown mallet	*Eucalyptus astringens*
flooded gum	*Eucalyptus rudis*
gimlet	*Eucalyptus salubris*
morrel	*Eucalyptus longicornis*
salmon gum	*Eucalyptus salmonophloia*
silver mallet	*Eucalyptus argyphea*
wandoo	*Eucalyptus wandoo*
York gum	*Eucalyptus loxophleba*
grasses	Poaceae
blowfly grass	*Briza maxima*
elegant speargrass	*Stipa elegantissima*
wallaby grass	*Danthonia* species (for example, *D. setacea*)
wild oats	*Avena fatua*
ground orchids	Orchidaceae
broad-billed duck orchid	*Paracaleana triens*
common spider orchid	*Caladenia varians*
cowslip orchid	*Caladenia flava*
snail orchid	*Pterostylis* species

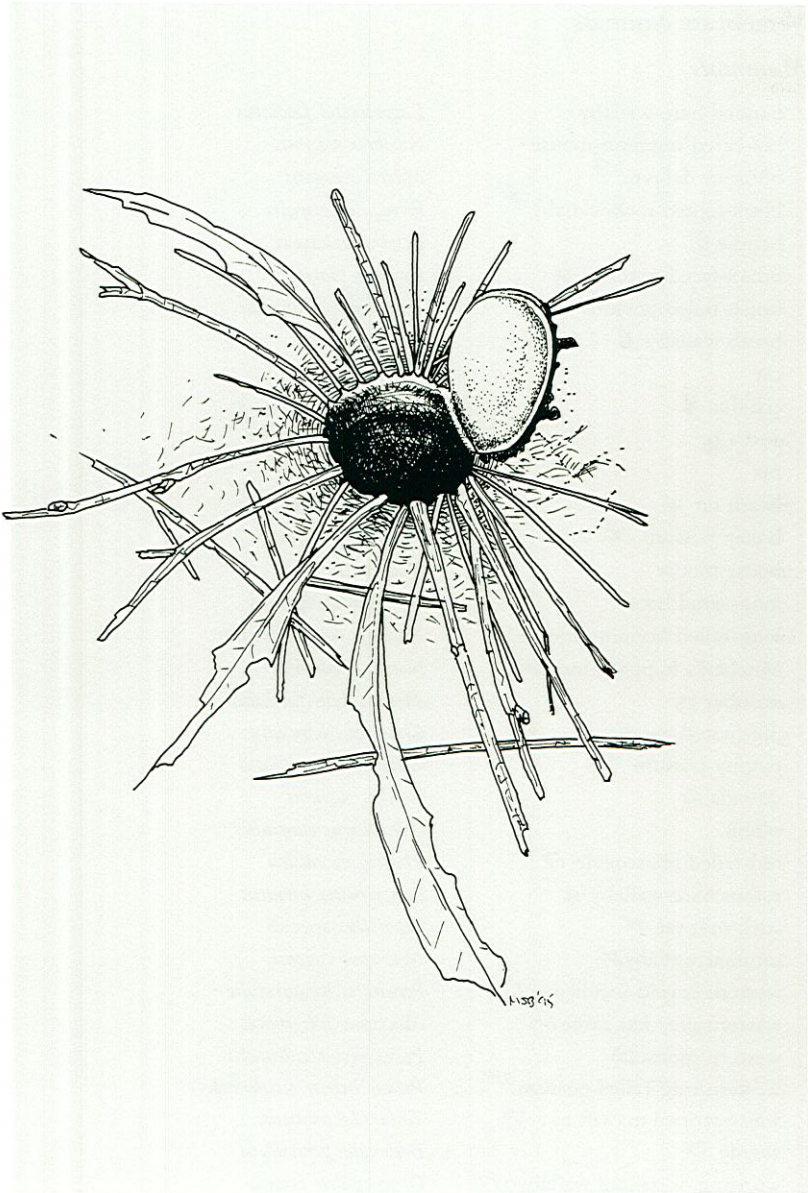
COMMON NAME	SCIENTIFIC NAME
PLANTS	
hakeas	***Hakea* species**
needlebush	*Hakea preissii*
standback	*Hakea recurva*
melaleuca	***Melaleuca* species**
boree	*Melaleuca pauperiflora*
broombushp	*Melaleuca uncinata*
paperbark trees	*Melaleuca rhaphiophylla* & *Melaleuca hamulosa*
native apricot	*Pittosporum phylliraeoides*
peas	**Papilionaceae**
lupins	*Lupinus* species
poison (example, prickly poison)	*Gastrolobium* species (example, *G. spinosum*)
quandong	*Santalum acuminatum*
saltbush (example, swamp saltbush)	***Atriplex* species** (example, *A. amnicola*)
sandalwood	*Santalum spicatum*
sedges	**Restionaceae and Cyperaceae**
sheoaks	**Casuarinaceae**
rock sheoak	*Allocasuarina huegeliana*
swamp sheoak	*Casuarina obesa*
sundews	***Drosera* species**
triggerplants	***Stylidium* species**

COMMON NAME	SCIENTIFIC NAME
ANIMALS	
Invertebrate Animals	
Ants	Formicoidea
meat ant	*Iridomyrmex purpereus*
bulldog or sergeant ant	*Myrmecia* species
honey ant	*Camponotus* species
Bees	Apoidea
blue-banded bee	*Amegilla pulchra*
gum-blossom bee	*Xanthesma* species
honeybee	*Apis mellifera*
Blowfly	Calliphoridae
Blue butterflies	Lycaenidae
blue	*Candilides hyacinthina*
Bushfly	Muscidae
Carab beetles	Carabidae
green carab	*Calosoma* species
Cicada	Cicadidae
Devil's coach-horse beetle	*Crephilus erythrocephalus*
Dung beetle	Scarabaeinae
Ghost moth	Hepialidae
Jewel beetles	Buprestidae
jewel beetle	*Stigmodera conspicillata*
Lerp-bug	*Cardiaspina jerramungae*
Longicorn beetle	***Phoracantha*** species
Mite	Acarina
Spiders	Araneae
orb-weaving spiders	Araneidae
Christmas spider	*Gasteracantha minax*
Springtail	Collembola
Trapdoor spiders	Idiopidae (and other families)
shield-back trapdoor	*Idiosoma nigrum*
wolf spiders	Lycosidae
Stick insects	Phasmatidae

COMMON NAME	SCIENTIFIC NAME
ANIMALS	
Invertebrate Animals	
Termites	
A	*Heterotermes paradoxus*
B	*Termes persimilis*
C	*Occasitermes occasus*
Wasps	
flower wasp	*Hemithynus* species (Thynninae)
mud-dauber wasp	*Delta bicinctus* (Eumenidae)
spider wasp	*Cryptochielus tuberculatus* (Pompilidae)
Vertebrate Animals	
Frogs	
humming frog	*Neobatrachus pelobatoides*
turtle frog	*Myobatrachus gouldii*
western spotted frog	*Heleioporus albopunctatus*
Reptiles	
Blind snakes	Typhlopidae
Dragon lizards	Agamidae
crested dragon	*Ctenophorus cristatus*
Elapid snakes	Elapidae
dugite	*Pseudonaja affinis*
gwarder	*Pseudonaja nuchalis*
Jan's bandy-bandy	*Vermicella bertholdi*
king brown or mulga snake	*Pseudechis australis*
Geckos	Gekkonidae
salmon gum gecko	*Oedura reticulata*
Goannas or monitor lizards	Varanidae
Gould's goanna (racehorse goanna or bungara)	*Varanus gouldii*
Legless lizards	Pygopodidae
Burton's legless lizard	*Lialis burtonis*
Pythons	Boidae
carpet python	*Morelia spilota*
Stimson's python	*Morelia stimsoni*
woma	*Aspidites ramsayi*

COMMON NAME	SCIENTIFIC NAME
ANIMALS	
Vertebrate Animals	
Skink lizards	Scincidae
bobtail skink	*Tiliqua rugosa*
fence skink	*Cryptoblepharus plagiocephalus*
Birds	
Australian magpie	*Gymnorhina tibicen*
Australian ringneck (twenty-eight parrot)	*Barnardius zonarius*
blue-breasted fairy-wren	*Malurus pulcherrimus*
boobook owl	*Ninox novaeseelandiae*
bush stone-curlew	*Burhinus magnirostris*
eagles	Accipitridae
falcons	Falconidae
galah	*Cacatua roseicapilla*
grey shrike-thrush	*Colluricincla harmonica*
honeyeaters (example, yellow-plumed honeyeater)	Meliphagidae (example, *Lichenostomus ornatus*)
kites	Accipitridae
magpie lark (mudlark or pee-wee)	*Grallina cyanoleuca*
Major Mitchell's cockatoo	*Cacatua leadbeateri*
malleefowl	*Leipoa ocellata*
owlet-nightjar	*Aegotheles cristatus*
pallid cuckoo	*Cuculus pallidus*
pigeons (example, crested pigeon)	Columbidae (example, *Ocyphaps lophotes*)
purple-crowned lorikeet	*Glossopsitta porphyrocephala*
rainbow bee-eater	*Merops ornatus*
rufous treecreeper	*Climacteris rufa*
rufous whistler	*Pachycephala rufiventris*
short-billed black-cockatoo (white-tailed black-cockatoo)	*Calyptorhynchus latirostris*
striated pardalote	*Pardalotus striatus*
tawny frogmouth	*Podargus strigoides*
willie wagtail	*Rhipidura leucophrys*

COMMON NAME	SCIENTIFIC NAME
ANIMALS	
Vertebrate Animals	
Mammals	
banded hare-wallaby	*Lagorchestes fasciatus*
big-eared hopping-mouse	*Notomys macrotis*
bilbie or dalgyte	*Macrotis lagotis*
black-footed rock-wallaby	*Petrogale lateralis*
boodie	*Bettongia lesueur*
broad-faced potoroo	*Potorous platyops*
brush-tailed possum	*Trichosurus vulpecula*
brush wallaby	*Macropus irma*
cat	*Felis catus*
echidna	*Tachyglossus aculeatus*
~~euro~~	*Macropus robustus*
fox	*Vulpes vulpes*
heath rat	*Pseudomys shortridgei*
honey possum	*Tarsipes rostratus*
house mouse	*Mus musculus*
long-eared bats	*Nyctophilus* species
long-tailed hopping-mouse	*Notomys longicaudatus*
Mitchell's hopping-mouse	*Notomys mitchelli*
numbat	*Myrmecobius fasciatus*
pig-footed bandicoot	*Chaeropus ecaudatus*
pygmy possum	*Cercartetus concinnus*
quenda	*Isoodon obesulus*
rabbit	*Oryctolagus cuniculus*
red-tailed phascogale	*Phascogale calura*
rufous hare-wallaby	*Lagorchestes hirsutus*
stick-nest rat	*Leporillus* species
tammar wallaby	*Macropus eugenii*
western barred bandicoot	*Perameles bougainville*
western grey kangaroo	*Macropus fuliginosus*
western mouse	*Pseudomys occidentalis*
western ring-tailed possum	*Pseudocheirus occidentalis*
white-striped mastiff bat	*Tadarida australis*
woylie	*Bettongia penicillata*
wurrung or nailtail wallaby	*Onychogalea lunata*



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