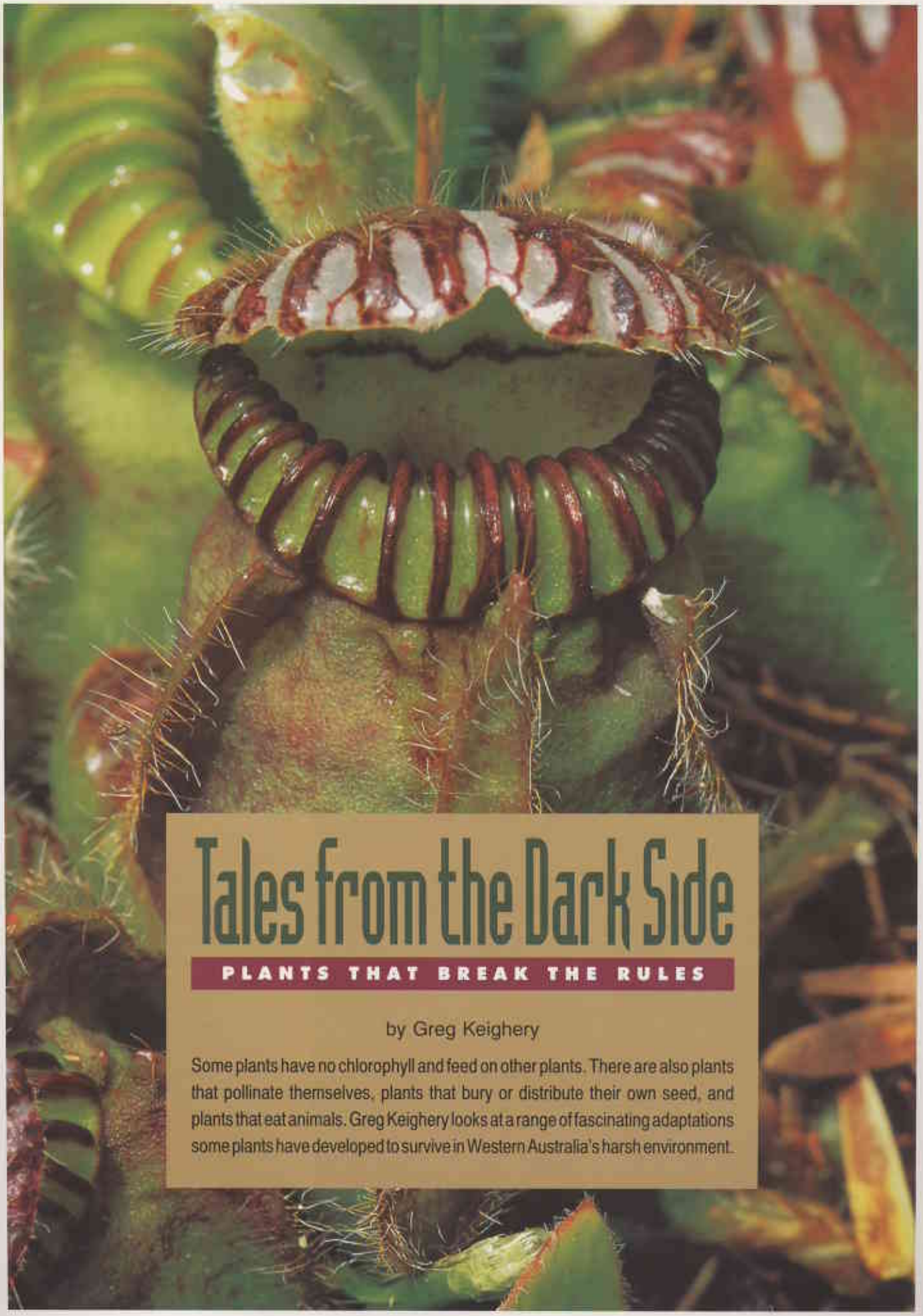

Tales from the Dark Side

PLANTS THAT BREAK THE RULES

by Greg Keighery

Some plants have no chlorophyll and feed on other plants. There are also plants that pollinate themselves, plants that bury or distribute their own seed, and plants that eat animals. Greg Keighery looks at a range of fascinating adaptations some plants have developed to survive in Western Australia's harsh environment.

Western Australia has an amazingly colourful, diverse and, to the European eyes of the early settlers, often bizarre flora. Even up to the mid-twentieth century, some European botanists were disputing the existence of bird-pollinated plants (such plants are absent from western Europe). In fact, Western Australia has the largest number of bird-pollinated plants in the world, contributing greatly to the colour and spectacle of its floral display. Our State flower emblem, the red and green kangaroo paw, is one of the most common plants that are bird-pollinated.

Generally speaking, flowering plants obey a series of 'rules'. For instance, they are green because they possess chlorophyll, which they use to convert the sun's energy to food. They have colourful flowers, which entice a variety of animals or other agents to disperse pollen from one plant's flower to the stigma of another. Flowers produce seed. Seeds are distributed by a wide variety of agents, since plants are not mobile. Plants also form the basis of the food chain for animals. However, all rules can be broken, including these five 'commandments'.

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Albany pitcher plant (*Cephalotus follicularis*) leaves are modified into a trap to capture and consume insects.
Photo - Jiri Lochman

Above: The stunning WA Christmas tree (*Nuytsia floribunda*) is a semi-parasite. Its roots make rings around nearby plants, and suckers within the rings extract water and nutrients from them.
Photo - M&I Morcombe

Far right: Unlike most European plants, Western Australia's floral emblem, the red and green kangaroo paw, is pollinated by birds.
Photo - Jiri Lochman

Below right: Pigface (*Carpobrotus* spp.) has small inconspicuous flowers that largely self-pollinate.
Photo - Greg Keighery

RULE 1: PLANTS POSSESS CHLOROPHYLL

Plants that don't possess chlorophyll parasitise other plants for their nutrients. Western Australia has a large number of partial parasites, which obtain some of their water and nutrients from other plants. They include the WA Christmas tree (*Nuytsia floribunda*) and WA sandalwood (*Santalum spicatum*). These plants have the green pigment, chlorophyll, in their leaves and can still make their own food. However, some plants have entirely lost the ability to manufacture their own food.

One of the most unusual is a genus of plants that exist entirely within other plants, known as endoparasites. Only their flowers, which burst through the stem of the host, are ever seen. Western Australia has two species of endoparasite, both in the genus *Pilostyles*. They are members of the family Rafflesiaceae, which includes the largest flower in the world, an Indonesian endoparasite called *krubut* (*Rafflesia arnoldii*), which translates as 'great flower'. These plants parasitise a number of species of native legumes of the genera *Daviesia*, *Gastrolobium*, *Jacksonia* and *Nemcia*. Other partly or wholly parasitic plants gain their nutrients from plant roots, or by way of the fungi associated with these roots, and only appear during flowering. They include the underground orchid (*Rhizanthella gardneri*) and the potato orchid (*Gastrodia lacista*). The Austral broom-rape (*Orobanche cernua* var. *australiana*) parasitises plant roots with its specialised roots that penetrate the host roots' food-bearing tissue. Several species of annual dodder (*Cuscuta* spp.) are stem parasites that use similar strategies. None of these plants uses chlorophyll to manufacture its own food, and the last two are often serious crop weeds in many overseas countries.

RULE 2: FLOWERING PLANTS HAVE VISIBLE FLOWERS

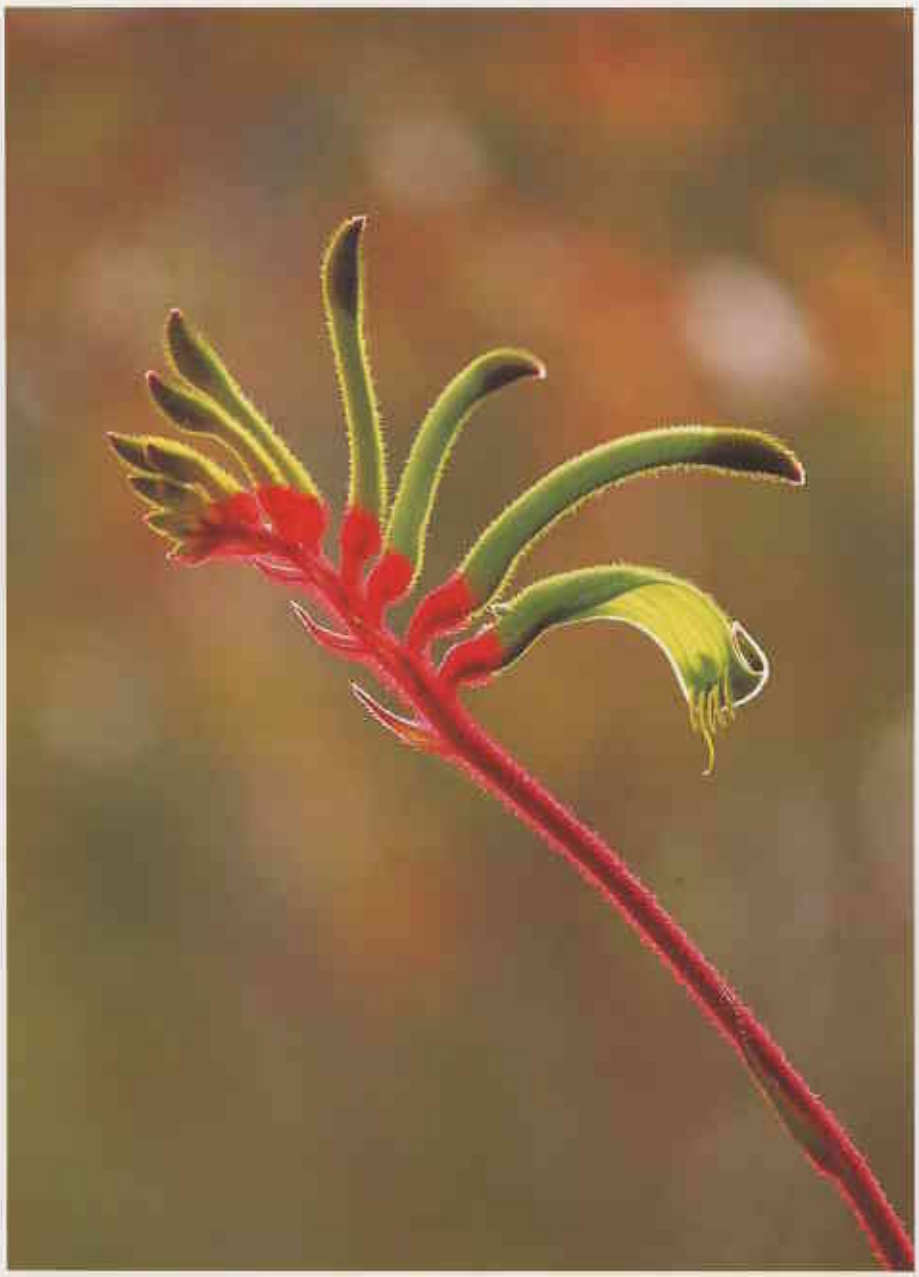
Plants pollinated by insects have flowers that also appeal to our senses because they are colourful, scented, openly displayed and offer a reward such as nectar, giving them a sweet smell.

However, there are exceptions to this rule. Because most plants are hermaphroditic (they have both sexes in the one flower) there are many examples of plants that can, and do, pollinate themselves. This may manifest itself in a population or an entire species. Often this occurs in marginal habitats, where pollinators may be absent, or in highly specialised habitats, where the population benefits from reducing the variability in their offspring to maintain their adaptation to the area.

Some species can set seed by self-pollination, whereas others have completely closed flowers (cleistogamy), where inbreeding is total. Most crop plants have been selected to be self-fertile to set the seeds the farmer requires.

A variety of inbreeding systems are known in our flora. In the most common system, plants bear small, inconspicuous flowers that largely self-pollinate. Pigfaces (*Carpobrotus* spp.) do this. Examples of plants with completely closed flowers that prevent any cross-pollination are the Nullarbor Plain populations of narrow thread petal

Above: Clover broom-rape (*Orobanche minor*) gets by without chlorophyll by parasitising other plants.
Photo - Greg Keighery



(*Stenopetalum lineare*) and the entire species of an unnamed bachelor button (*Gomphrena* sp.) from the Pilbara. Other examples are certain sun orchids such as the twisted sun orchid (*Thelymitra flexuosa*), blood roots (*Haemodorum* spp.), rushes (*Juncus* spp.), numerous grasses, swamp lilies (*Ottelia ovalifolia*), yams and their relatives (*Vigna* spp.) and native soy beans (*Glycine* spp.). These flowers may occur as single flowers on a plant (as with the underground flowers of *Vigna*), in a single population (as in the case of blood roots) or, more rarely, an entire species. The inbreeders are mostly annual or perennial herbs that grow in variable habitats, where such flowers ensure some seed is set, despite the vagaries of the environment.

Some plants set seed without pollination at all! This system is much rarer, but is found in the notorious weed blackberry and in some bottlebrushes (*Callistemon* spp.). These plants retain their normal flowers, which can only be discerned after detailed studies. Apparently such systems arise frequently, in response to local environmental conditions, to ensure the population is closely adapted to the area. However, when conditions change, these populations rapidly become extinct since they have lost the ability to respond, unlike the more variable offspring of their outbreeding cousins.

RULE 3: FLOWERING PLANTS PRODUCE SEEDS

Some species of flowering plant, such as duckweed (*Lemna* spp.) and many other aquatic plants, rarely flower. Instead, they reproduce mainly by suckering or by producing vegetative buds. Some plants almost never produce seed after flowering. These can be vegetatively produced crops such as taro (a wild form of taro, *Colocasia esculenta* var. *antiquorum*, is found along creeks in the Kimberley), or ornamentals such as the introduced coral tree (*Erythrina sykesii*). This common street tree is in fact a sterile hybrid and can be propagated only by cuttings.

Some serious weeds such as soursob (*Oxalis pes-caprae*) have had only part of their genetic variation introduced into Western Australia. Although they flower prolifically, they are a self-sterile clone, and can only reproduce either by dividing their bulbs or spreading by soil disturbance. Another group of plants, including bugle lily (*Watsonia bulbillifera*) and sisal (*Agave sisalana*), produce vegetative buds in place of seed capsules after flowering. As soursob and bugle lily are serious weeds, this is a very successful strategy, if short-term in evolutionary terms. A lack of variation will eventually doom these populations.

Generally, vegetative reproduction is a strategy to help plants spread rapidly once a chance seedling becomes established in a favourable habitat. For example, stringybark (*Eucalyptus tetrodonta*) establishes in basalt soil outcrops, escaping frequent fires, and reproduces vegetatively until food reserves can ensure stem production. Hence vegetative spread is most common in unstable habitats, such as beaches, rivers, the sea, swamps or desert dunes.

RULE 4: PLANTS NEED SEED DISPERSERS

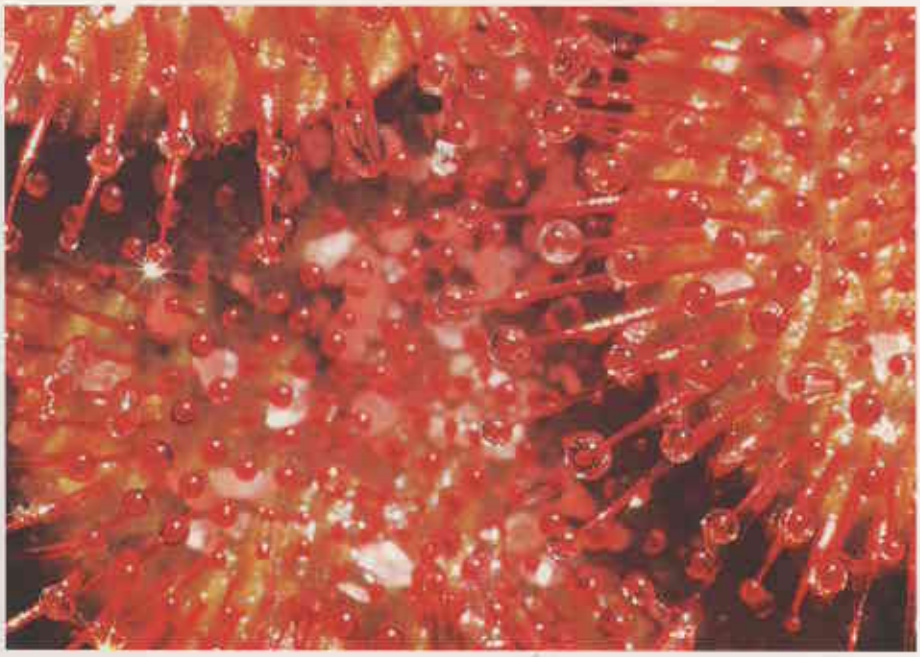
Western Australia's remarkable peanut plants bury their own seeds. For instance, all species in the genus *Tribulopis* have normal aerial flowers producing top-shaped fruits. The flower stalk curves, elongates and shoves the fruit into the soil. In the genus *Alexgeorgia*, which has just three species growing only in the south-west, the female flower is already underground. The stigma is produced above ground to catch the pollen produced by the aerial male flowers. The most extreme form of self-planting is found in native soy beans, yams and their relatives, and morning glory (*Polymeria ambigua*). As well as having normal above-ground flowers, these species produce whole flowers underground. The underground flowers are closed and self-pollinate. This ensures that some seeds are produced safely even if the normal flowers fail.

Another system of self-seed dispersal is found in the genus *Baxteria*, related to the grass trees. The sole species, cannon flower (*B. australis*), is found in

Top: This form of taro (*Colocasia esculenta* var. *antiquorum*), found on the Mitchell Plateau, doesn't need seeds - it reproduces by means of vegetative buds.
Photo - Greg Keighery

Below: The weed soursob (*Oxalis pes-caprae*) flowers prolifically but doesn't produce seeds and is a self-sterile clone.
Photo - Greg Keighery

Below right: Redcoats (*Utricularia menziesii*) have bladders that are hidden in the water-saturated soil. When an animal brushes against them, they suck water containing their prey into the bladders.
Photo - M&I Morcombe



Top left: The rainbow plant is another uniquely Australian carnivorous plant.
Photo - Greg Keighery

Top right: Instead of being eaten by animals, some plants have turned the tables. Sundews (*Drosera* spp.) use their sticky leaves and stems to trap unwary insects.
Photo - Jiri Lochman

the karri region of south-western Australia. The plant's tubular flowers form cannon-like fruits that fire out the seeds to a distance of several metres!

RULE 5: PLANTS ARE ANIMAL FOOD

Western Australia has very nutrient-poor soils, some of the least rich in the world. To cope with such conditions, some plants have evolved a series of remarkable solutions. Many have highly specialised root systems (such as roots with specialised fungal associates) to absorb the maximum amounts of nutrients from the soil. Some, like mistletoes and quandongs, parasitise other plants, while others digest animals to gain extra nitrogen.

In Western Australia, plants that have turned the tables on animals include about 100 species of sundew and rainbow plant (*Drosera* spp.), Albany pitcher plant (*Cephalotus follicularis*), about 60 species of bladderwort (*Utricularia* spp.) and two species of giant rainbow plant (*Byblis* spp.). Sundews and rainbow plants trap their prey with sticky leaves and stems. Bladderworts have active traps that, when triggered, suck in water containing the prey. The Albany pitcher plant has passive pitfall traps. The prey is broken down within the pitcher and then absorbed by the plants.

MAKING AND BREAKING THE RULES

This is a brief introduction to the numerous and wonderful ways in which plants cope with the vagaries of our environment. There are more than 12 000 species of flowering plants in Western Australia, and we know almost nothing about most of them. It seems that as soon as science establishes a new 'rule' we find a plant that is determined to break it, and we can be sure that there are even more remarkable tales from the dark side waiting to be told.

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LANDSCOPE

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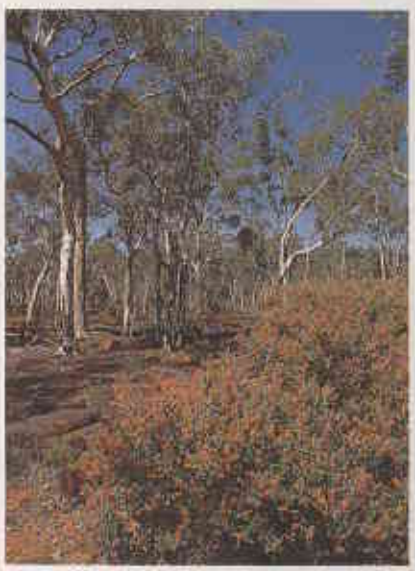
The hidden caves and tunnels of Cape Range National Park harbour several animals found nowhere else. Turn to page 22 to find out about these bizarre cave dwellers.



The characteristics that made WA inhospitable to the first Europeans are now helping us create new industries that can also repair the environment. See page 47.

The Pinnacles, in Nambung National Park, is one of the most photographed landscapes in the world. But there is another side to Nambung. See page 41.

Perth has at least 70 species of skinks, geckoes and other reptiles. Find out how to attract these fascinating creatures to your garden on page 28.

Devastation caused by the recent NSW bushfires has fuelled debate on the practice of prescribed burning. How do managers fight fire with fire? See page 35.

FEATURES

REGULARS

COVER

The bobtail (*Tiliqua rugosa*) is sometimes incorrectly called the 'bobtail goanna' but is actually a very large skink. They are common around Perth and often seen in gardens. During hot weather they can be seen basking on footpaths, verges or roadways. See our story 'Reptiles in the Garden' on Page 30.
The illustration is by Philippa Nikulinsky.

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