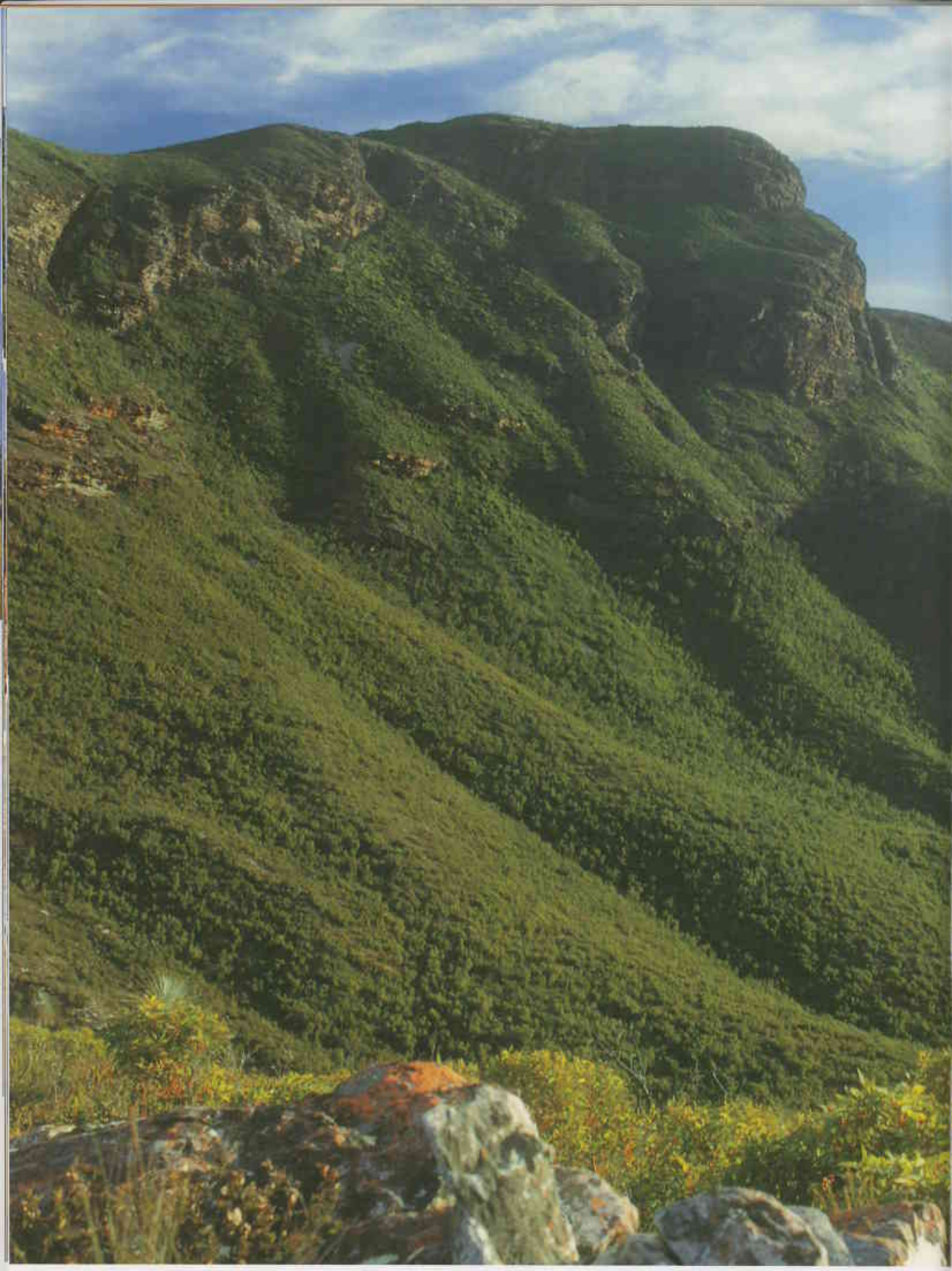

The feather-leaved banksia

Disease, fire and a long juvenile period have brought this striking species close to the brink of extinction

by Anne Cochrane, Sarah Barrett and Sandra Gilfillan

South-western Australia has a remarkably rich flora, even by world standards. More than 70 per cent of its plants are endemic to Western Australia. *Banksia*, in the family Proteaceae, is a well-known and important genus of the South West, and is conspicuous in heath and woodland. There are more than 60 banksia species in south-western Australia and the feather-leaved banksia (*Banksia brownii*) is perhaps one of the most endangered of these.

From the mountains to the sea

Feather-leaved banksias occur in a number of small, isolated populations over a range of about 90 kilometres from the Stirling Range south to Cheyne Beach. Plants grow in a variety of habitats from Stirling Range mountain tops and slopes, in mallee thicket on rocky sandstone soils, to mallee heath and woodland communities on lateritic ridges or granite slopes in southern populations near Albany. In the Stirling Range, the plants form low spreading shrubs. In more sheltered coastal sites, plants may form an openly-branched small tree to six metres. The associated vegetation is rich in proteaceous (*Banksia, Dryandra, Lambertia, Isopogon, Hakea, Adenanthos*) and myrtaceous (*Eucalyptus, Agonis, Kunzea, Beaufortia*) species.

The bark of the feather-leaved banksia is smooth and greyish-brown and its leaves have an almost feather-like appearance, giving rise to the common name. The flowering candles consist of a dense spiral of hundreds of individual flowers. Parts of the flower are pale brown and cream and the metallic red styles have a cream tip, but the overall appearance of the flowering spike is reddish. Many follicles, or valves, are fused together to form the woody fruit, and this species is one of only a few banksias to produce only one seed per follicle. A papery black wing on the seed assists with wind dispersal. The number of flowering spikes that set fruit—and the proportion of flowers that develop into follicles—is low in feather-leaved banksia, a characteristic of most hermaphroditic plants.

Two forms of feather-leaved banksia are recognised. A northern form confined to the Stirling Range has short, thin, hard leaves and a southern form, with long, wide, soft leaves, occurs in the Albany-Cheyne Beach area. Genetic testing planned for the future should be able to settle whether these constitute separate subspecies. The feather-leaved banksia is closely related to the swamp banksia (*Banksia occidentalis*), which has smaller, deep red flowers and narrow, sparsely-toothed leaves.

The first specimen of feather-leaved banksia was collected from near Albany by William Baxter in 1829. Baxter was collecting seeds and roots of Australian plants on behalf of the Sydney Botanic Gardens. In a letter from King George Sound on 25 March 1829 to Mr Fraser, Colonial Botanist, Baxter reported:

> 'I have sent you a few of some [*Banksias*] I collected a good distance inland, but not having near enough to eat I am not able to carry but a small quantity of each sort... I mean to collect *Banksias* and other large seeds in large quantities on my return'.

It is possible that Baxter was collecting from the Stirling Range. The species was named after botanist

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Main Late afternoon view of Pyungoorup Peak and The Arrows.
Photo – Rob Olver
Inset Feather-leaved banksia growing on mountain slopes in the Stirling Range National Park.
Photo – Sarah Barrett/CALM

Left Feather-leaved banksia.
Photo – Rob Olver

Above Bush rats are believed to pollinate the feather-leaved banksia.

Right New Holland honeyeaters are among the main pollinators of the plant.
Photos – Jiri Lochman

Robert Brown, who accompanied Matthew Flinders to Australia on a voyage of discovery in 1801.

Feather-leaved banksia has been declared as rare flora since 1980 under the Wildlife Conservation Act, and is currently ranked critically endangered. The species was previously considered to be endangered, but was upgraded because of recent population extinctions and a projected decline in population size of more than 80 per cent over the next three generations.

Furred and feathered pollinators

Like many other Australian members of the Proteaceae family, feather-leaved banksia flowers for many months, with freshly-opened flowering spikes most abundant during winter. Flowering has been recorded from March to August. The major pollinators are honeyeaters, such as New Holland honeyeaters and red wattlebirds, and small nocturnal mammals, such as the bush rat (*Rattus fuscipes*) and the honey possum (*Tarsipes rostratus*). Nectar from this species may provide an important food source for some or all of these pollinators.

Fire adaptation

Feather-leaved banksia is killed by fire and does not resprout, relying entirely on seed for regeneration. It holds its fruits in the canopy of the plant, with seed reserves accumulated in woody fruits that release en masse when the parent is burnt. The fruit is a woody cone-like structure containing numerous follicles. The average number of seeds per fruit varies between plants, and between

Above Only two feather-leaved banksia seedlings survive in a population south-east of Ellen Peak in the Stirling Range in 2003, after fires in close succession in 1991 and 2000. Although 270 young plants had regenerated in 1995 after the 1991 fire, the combined effects of frequent fire and *Phytophthora cinnamomi* brought this population to the verge of extinction.

Left Feather-leaved banksia plants dying from aerial canker at Vancouver Peninsula near Albany.
Photos – Sarah Barrett/CALM

populations, and is directly related to the size of the fruit and indirectly to soil nutrition, moisture and the amount of time that has elapsed since the last fire. Levels of seed predation can also vary, with boring insects often destroying more than 50 per cent of the seed crop in some fruits.

In the climate of south-western Australia, hard woody fruits may be an adaptation to high intensity fires. These protective coverings, and the outer fruits, are often very large in relation to the small seed held within them. Fruits of feather-leaved banksia may take up to a year to mature. The seed is little affected by the passage of fire because the dense woody material protects it from the extreme heat. Limited seedling recruitment can occur between fires, but fire is necessary to trigger mass seed release.

Botanists collecting seeds to ensure the long-term survival of the species first need to lightly burn the fruits so that the follicles open. They then alternately wet and dry the fruits to accelerate the seed release. Fresh seed is highly viable and no treatment is required to aid germination.

Tenuous existence

A population of feather-leaved banksia exists only as seeds immediately after a fire, and virtually no seeds are stored in the soil until the next fire. If seedlings fail to establish, the population may become locally extinct.

Like many long-lived woody perennials, this banksia takes a long time to flower and produce fruit. Differences in aspect and topography, soil depth, moisture and nutrient status can affect flowering and fruiting success. Plants in southern populations may reach reproductive maturity after five to six years, but those in mountain populations take much longer. In one upland population, only three plants out of 20 had commenced flowering eight years after a fire, and no plants had yet produced fruits. The fire regime is therefore very important in conservation management of this fire-sensitive species. Scientists have suggested fire frequencies of at least 18 years or more are required for adequate seed banks to accumulate in upland populations of feather-leaved banksia.

Above *Phytophthora cinnamomi* is killing susceptible species in a population of feather-leaved banksias on the south-east ridge of Yungermere Peak. Small 'spot' infestations rapidly spread and coalesce to cover entire mountain slopes.
Photo – Sarah Barrett |CALM

The killer disease

Feather-leaved banksia is highly susceptible to dieback, a disease caused by the soil-borne water mould, *Phytophthora cinnamomi*, with more than 80 per cent of plants dying after being artificially inoculated with the disease in the greenhouse. In fact, it is one of the most highly susceptible plant species in Western Australia. People, vehicles, and even native and feral animals act as vectors of *Phytophthora*, aiding the wide and rapid spread of the pathogen through transport of infected soil, particularly when tracks and roads are wet and muddy. The pathogen also spreads directly through root-to-root contact with infested plants, and as a result of movement of spores in water flow. Another disease caused by the aerial canker fungus (*Zythiostroma*) causes banksia deaths in some populations, and this spreads through windblown spores.

The fungicide phosphite is the only treatment currently available to control *Phytophthora* in native vegetation. The fungicide does not eradicate the disease, but is thought to enhance the plant's defence responses, as well as having a direct fungicidal effect. The Department of Conservation and Land Management (CALM) has directed considerable resources into applying phosphite to threatened flora and monitoring the resultant effects on plant survival. This includes aerial spraying trials and hand application of the fungicide. In the case of feather-leaved banksia, aerial phosphite spraying has significantly enhanced the survival of plants in certain populations and reduced the ongoing spread of the pathogen throughout the population. However, at other sites, the pathogen continues to spread relentlessly, particularly in hillside situations, where *Phytophthora* spores may be readily carried down slopes during rainfall events. Unfortunately, phosphite remains the only tool available to slow the rate of population extinction in this extremely susceptible species. Hopefully, ongoing research may improve phosphite application techniques and produce alternative control methods.

No formal research has been done on the relationship between fire and disease in feather-leaved banksia habitat, but field observations suggest that the impact of the disease is exacerbated after fire, due to altered hydrology and increased surface run-off. Changes in vegetation structure and floristics caused by the dieback pathogen will also affect the numbers of vertebrate pollinators in these plant communities through loss of food sources and habitat. Other impacts may include changes in invertebrate fauna, loss of wildlife habitat in the form of thick vegetation cover and increased predation risk. Julie Whelan, a PhD student at Murdoch University, conducted a study in coastal heath near Albany and found significantly higher bush rat abundance in healthy sites

Above The passage of fire triggers seed release from the woody fruits of feather-leaved banksia.
Photo – Ellen Hickman

Above left Swamp banksia is a close relative of the feather-leaved banksia, but has smaller deep red flowers.
Photo – Marie Lochman

compared with infested sites. Bush rats are known pollinators of feather-leaved banksia, so an indirect impact of the disease on the plant species through loss of pollinators is highly likely.

On the brink

There are currently 17 known populations of feather-leaved banksia, comprising about 12,000 mature plants. This may seem like a large number of plants, but another 10 populations have been proclaimed locally extinct in recent times because of dieback. Within the Stirling Range National Park, eight of 13 populations were burnt in hot fires in both 1991 and in 2000, an interval of only nine years. Of these, five are considered to be either extinct or close to extinction. Of the remaining coastal populations, three are close to extinction, with less than 15 mature plants per population. Only five of the 17 current living populations contain more than 200 plants. The viability of very small fragmented populations is unclear, as the genetic diversity in the gene pool declines, while inbreeding may potentially reduce plant reproduction. All surviving populations are threatened by dieback.

Feather-leaved banksia is just one of many species perched on the brink of extinction due to threatening processes. The continued loss of local populations—and the potential loss of the entire species—is not only a tragedy in itself but may have unforeseen, and potentially disastrous, consequences for the functioning of the vegetation communities of which feather-leaved banksia is an integral part. Several south coast flora species that are declining due to frequent fire and dieback are food sources for mammals, birds and insects. As these plants form a vital part of the structural habitat, their loss from an ecosystem may have profound effects on countless numbers of other animals and plants within that community.

Strategy for survival

Tackling a killer disease and the vagaries of wildfire are two major hurdles to overcome in conserving feather-leaved banksia for future generations. To ensure the species survives in the wild we must continue to spray plants with phosphite, while monitoring the disease's rate of spread and the subsequent survival of the plants. Practising good hygiene is essential to reduce the spread of the pathogen, and visitors should always be mindful of the irreparable damage they can do when moving soil around on muddy boots or vehicles in wet conditions. Implementing an appropriate fire management plan is vital to protect areas from too-frequent fires and to ensure that seedlings can develop to maturity and produce adequate seed for regeneration. Seed collection and conservation is a vital link in this integrated conservation strategy. Stored seed is the genetic resource of the species, and can be used to recreate and augment wild populations. If we continue to do these tasks well, then there is hope for the survival of the species.

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Volume 20 Number 3 AUTUMN 2005

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Regulars

Publishing credits
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Prepress Colourbox Digital.
Printing Lamb Print, Western Australia.

© ISSN 0815-4465

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Published by the Department of Conservation and Land Management, 17 Dick Perry Avenue, Kensington, Western Australia.