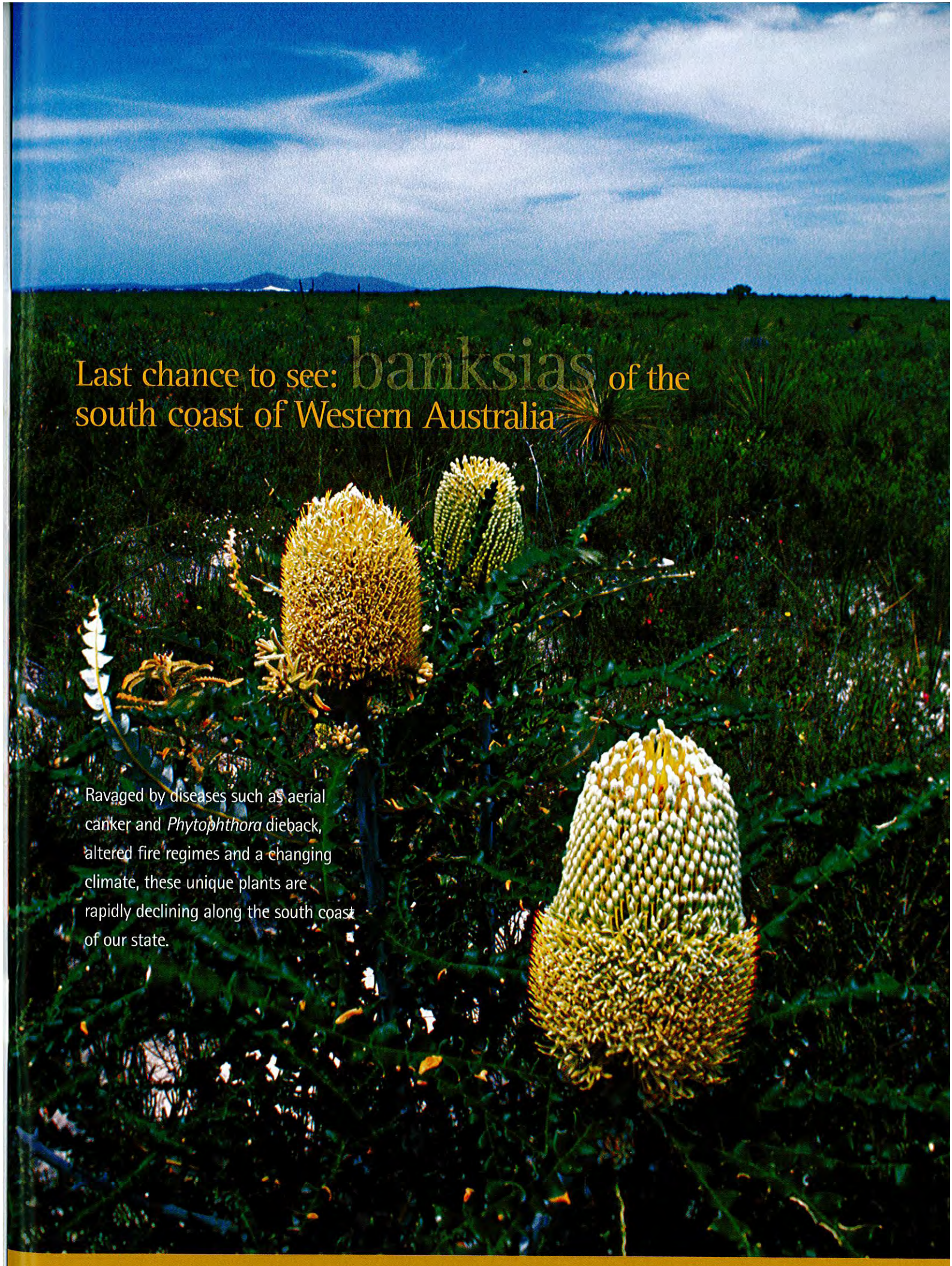
Last chance to see: banksias of the south coast of Western Australia



Ravaged by diseases such as aerial canker and *Phytophthora* dieback, altered fire regimes and a changing climate, these unique plants are rapidly declining along the south coast of our state.

by Anne Cochrane, Sarah Barrett, Colin Crane, Chris Dunne, Renée Hartley and Greg Freebury

Members of the genus *Banksia* are some of Western Australia's most distinctive plant species, perhaps because they are also some of our most readily identifiable native flora. The flowers and leaves have been used extensively in flower arrangements and specimens are planted in many home gardens for their floral display and their attraction to native birds. With recent taxonomic changes, there are now more than 170 species in the genus, which includes the previously recognised genus *Dryandra*.

Banksias are typically 'keystone species'—that is, they are functionally important components of native plant communities in the south-west, including heathlands, shrublands and forests, and they play a major role in supporting native fauna. In the wild, they are pollinated by birds—honeyeaters such as the New Holland honeyeater (*Phylidonyris novaehollandiae*) and red wattle bird (*Anthochaera carunculata*)—and mammals, such as the honey possum (*Tarsipes rostratus*), bush rat (*Rattus fuscipes*) and dibbler (*Parantechinus apicalis*). In addition, they provide food in the form of nectar and seed, as well as habitat for a large range of species.

Adult plants store their seeds in the leafy canopy, generally releasing these seeds from woody fruiting cones after fire. This canopy storage or 'serotiny' maximises the number of seeds available for post-fire regeneration. This plant strategy is considered to be favoured in fire-prone regions such as the south-west of WA that have reliable seasonal rainfall. Some species may live for up to 100 years, sometimes taking 10 to 15 years to flower and fruit sufficiently for population persistence in the face of further fires. The wind-dispersed seeds may travel up to 40 metres from parent plants after fire, with long-distance dispersal events of several kilometres occurring rarely. In the south-west, more than 60 per cent of banksia species are known as obligate seeders. These seeders are killed by fire and reproduce only from seed. The remaining species are able to resprout from rootstock after fire or have fire-tolerant trunks.

A warming, drying climate

In WA, most banksias are confined to the south-western corner, being naturally restricted to areas with greater than 250 millimetres of rainfall. Unfortunately, as the climate changes, so too will the reliability of rainfall. Total annual precipitation has declined in the south-west over the past 50 years, with the most significant decreases seen in the Augusta to Albany region and along parts of the south coast. In addition, temperatures across WA have increased by approximately 0.8 degrees Celsius since 1910, with most of the increase occurring since 1950.

Under future predicted climate scenarios, the south-west is projected to become even warmer and drier and this will affect the frequency of fires and droughts. This means that although the fossil records tell us that the 'original' banksias have been around for the past 40 to 50 million years virtually unchanged in appearance, having managed to survive past climate shifts, their future survival may be compromised. Climate modellers have already predicted dire consequences for the fate of WA banksias, with many species expected to decline dramatically or become extinct by 2080, due mainly to changing climate.

For much of the south-west flora, germination of seeds is cued

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Main Showy banksia (*Banksia speciosa*) with Cape Arid in the background.
Photo – Jiri Lochman

Left Candle banksia (*Banksia attenuata*) at Stirling Range.
Photo – Marie Lochman

Above Downloading temperature and humidity data at an aerial canker monitoring transect.
Photo - Anne Cochrane/DEC

to the cooler wetter months around winter. If temperatures rise and rainfall decreases, regeneration of these species after disturbance could be threatened. Currently, the Department of Environment and Conservation is supporting a project assessing how well banksia species will adapt to reduced moisture and increased temperatures during germination and early seedling growth. The potential for adaptive responses is being assessed for a number of significant banksia species with distributions along the south coast of WA. From previous seed germination research, it is already known that some banksias have quite restricted temperatures for germination; it remains to be seen whether they will cope with the new warmer and drier climates forecast for the future and avoid widespread germination failure as the climate changes.

Going, going, gone ...

In addition to the potential impact of a changing climate, over the past few decades banksias have been exploited for the local and overseas cut flower industry. Fortunately, the pressure of wildflower picking has eased in recent years with more stringent regulations and wildflower plantings. Not so the pressure of disease. These beautiful plants are highly susceptible to aerial cankers and introduced *Phytophthora* dieback (*Phytophthora cinnamomi*), with the incidence of these pathogens increasing steadily. From year to year, the evidence of decline and death is highly apparent in the landscape.

Most of the aerial cankers are caused by fungi and are recognisable on plants as the death of twigs and branches, browning unhealthy leaves and limbs with discolouration just beneath the bark. In banksias, cankers may only kill one branch on a host plant, but in some cases they can cause almost complete crown death of the infected plant or the collapse of the entire community. Worldwide, the incidence of canker diseases caused or associated with fungi has been steadily increasing and climate change is seen as the driving force behind these once-minor diseases. The contribution of canker-causing fungi to stem and branch death in southern WA is not yet well documented or understood. Currently, two declared rare flora—the granite banksia (*Banksia verticillata*) and the round leaved honeysuckle (*Lambertia orbifolia* subsp. *orbifolia*)—are being severely impacted by canker disease and concerns have been raised that this may be caused by emerging pathogens in a changing climate.

Studies of banksia decline have now identified a number of associated fungal species, including *Neofusicoccum, Cryptodiaporthe* and *Microthia*. Monitoring of transects established in 2010 to track the health and survival of three keystone banksia species of the south coast—Baxter's and scarlet banksia (*Banksia baxteri* and *B. coccinea)* and granite banksia—has identified an increase in canker incidence and a further increase is forecast due to the future climate change scenarios projected for the region. Increasing canker impact on Baxter's banksia has been closely linked to increases in maximum and average temperatures and daily humidity. For scarlet banksia the influence of minimum temperatures and evaporation is apparent.

This research will determine the range of fungal pathogens affecting each species and clarify the relative impact of each. Data loggers located at

these sites will provide further clues as to environmental triggers that initiate major canker epidemics, such as the one near Cheyne Beach east of Albany in 1989 when large numbers of scarlet banksias were dying downward from their apex-forming branches, with rapid complete death typical for many diseased stands. A number of transects established in this project revisited sites from the 1990s and, in at least two sites, scarlet banksia populations were no longer present. The rare granite banksia has also undergone population extinctions due to aerial canker, in addition to death from *Phytophthora* dieback. Fortunately, several fungicides have shown some ability to reduce canker lesion development and will be useful for treatment of high-value wild or translocated populations of declared rare flora.

In addition to canker studies, the past few decades have seen a number of research projects investigating the impact, biology and spread of *Phytophthora cinnamomi* in native plant communities across our state's south-west. The *Phytophthora* pathogen is a 'water mould' that favours warm, moist conditions, yet can survive dry periods within the plant tissue. Attracted to plant roots, *Phytophthora* is carried through soil water and attaches to the plant, eventually stopping the plant's uptake of water and nutrients, causing death. More than 40 per cent of native flora species are susceptible to the disease, including more than 50 per cent of our declared rare flora. Activities such as bushwalking, four-

Top left Soil fumigation at a *Phytophthora cinnamomi* site.
Photo – Colin Crane/DEC

Centre left Crown death due to aerial canker on the rare granite banksia at Woolbales, near Walpole.
Photo – Anne Cochrane/DEC

Left Installing electric fencing in Fitzgerald River National Park to deter fauna movement across a dieback site. Fauna are considered to be a significant agent of spread for *Phytophthora cinnamomi.*
Photo – Renée Hartley/DEC

Right Newly developing *Microthia* canker in Baxter's banksia in Fitzgerald River National Park.
Photo – Colin Crane/DEC

Below right Sampling aerial canker fungi causing decline and death of scarlet banksia in Gull Rock National Park.
Photo – Sarah Barrett/DEC

wheel driving, timber harvesting and track or road establishment pose a high risk of spreading the disease. This risk can be significantly reduced, however, with appropriate planning, using only clean machinery and equipment, and restrictions associated with soil and weather conditions.

Recent studies have demonstrated the loss of ecosystem services that occurs after healthy native vegetation is invaded by this destructive plant pathogen. In particular, the loss of keystone species such as banksias often leads to a significant change in vegetation structure and, as a consequence, the ecosystem functions less well. For example, all banksia species in Stirling Range National Park were found to be susceptible, with infestation destroying all but seven per cent of canopy cover. As banksias are integral elements of many native plant communities, their death has flow-on effects to other flora, dependent fauna and ecosystem processes. The impact of *Phytophthora* dieback is often compounded by too-frequent fires and other plant diseases such as aerial canker. Climate projections for the south-west include an increase in the likelihood of extreme summer rain events which are expected to worsen the impacts of *Phytophthora* dieback and aerial canker on banksia species.

The use of the chemical phosphite in areas of high conservation value is enabling banksia and other communities to survive for longer when threatened by disease. An innovative project is currently improving our ability to contain or eradicate *Phytophthora* dieback infestations in natural ecosystems and, incredibly, the past 12 months has seen the first eradication of a *Phytophthora cinnamomi* infestation in Cape Arid National Park on the south coast, east of Esperance. The technique involves a combination of controls that combat the pathogen's key strategies for spread and survival, such as managing water movement, treating vegetation with herbicide to remove hosts and fumigation of the soil. However, eradication is a last resort for management, and prevention of introduction and spread is essential to the health of our native communities.

Lastly, ongoing sampling of declining banksia species in coastal areas has confirmed the influence of armillaria root rot, caused by the basidiomycete fungus *Armillaria luteobubalina*, in plant death and population demise. Although an indigenous mushroom-producing plant pathogen, this fungus is believed to have caused significant deaths of banksias including oak-leaved, holly-leaved, slender and swamp banksia (*Banksia quercifolia, B. ilicifolia, B. attenuata* and *B. littoralis*). This adds to the already significant disease impact of *Phytophthora* species and aerial canker-causing fungi on the genus in the south coast.

Banksias and fires

Many features of the biology of banksias—for instance their long juvenile period—also make them particularly susceptible to frequent fire. Under future warmer drier climates, fire regimes are likely to change, resulting in an increase in fire danger. Fire management plans now seek to incorporate ecological guidelines for keystone banksia species

Top right Oak-leaved banksia.
Photo – Andrew Davoll/Lochman Transparencies

Top Aerial canker has caused severe decline and death of the threatened granite banksia in Torndirrup National Park.
Photo – Sarah Barrett/DEC

Above Scarlet banksia.
Photo – Jiri Lochman

based on known fire responses and time to first flowering and fruiting. This aims to ensure that there is sufficient time for canopy seed banks to re-establish between fires. At the other end of the spectrum, banksias in fragmented remnants that are long unburnt (more than 50 years) may also decline if they are unable to regenerate in the absence of fire. Careful fire management is needed where diseases such as *Phytophthora* dieback and aerial cankers are present because in these stressed environments regeneration can be poor or the impact of dieback can be accelerated. Grazing by native or introduced herbivores can further reduce survival of new seedlings.

A future for our banksias

Almost 100 banksia species are considered to be threatened in the wild and have a listed threatened status of some kind. Loss of habitat through land clearing has had the greatest impact on their conservation status over the past 50 years. Roughly a quarter of these species are found on the south coast of WA, where diseases and a changing climate are taking their toll, and these threats may pose the greatest impact on their future survival.

Some of our most well-known and highly visited recreational areas, such as Stirling Range National Park and Cape Le Grand National Park, have a high incidence of disease. When visitors move from these areas to enjoy the surrounding landscapes such as Fitzgerald River National Park—which currently has very little disease—there is a real chance they could be taking the pathogen with them.

People can help protect banksias and their dependent species by ensuring that all vehicles and footwear are clean from soil and plant materials when passing through bushland. Beyond the potential introduction and spread of disease, recreational impacts—such as soil compaction and trampling—exert multiple stresses on vegetation communities. Other impacts of recreational pressure include nutrient enrichment, increased fire risk, erosion and the introduction of weeds. Without systematic monitoring of their presence and health, some banksias may disappear before our eyes without our even being aware, until it is too late. We can each play a part in ensuring the survival of banksias for future generations; our bushland will be poorer for their absence.

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