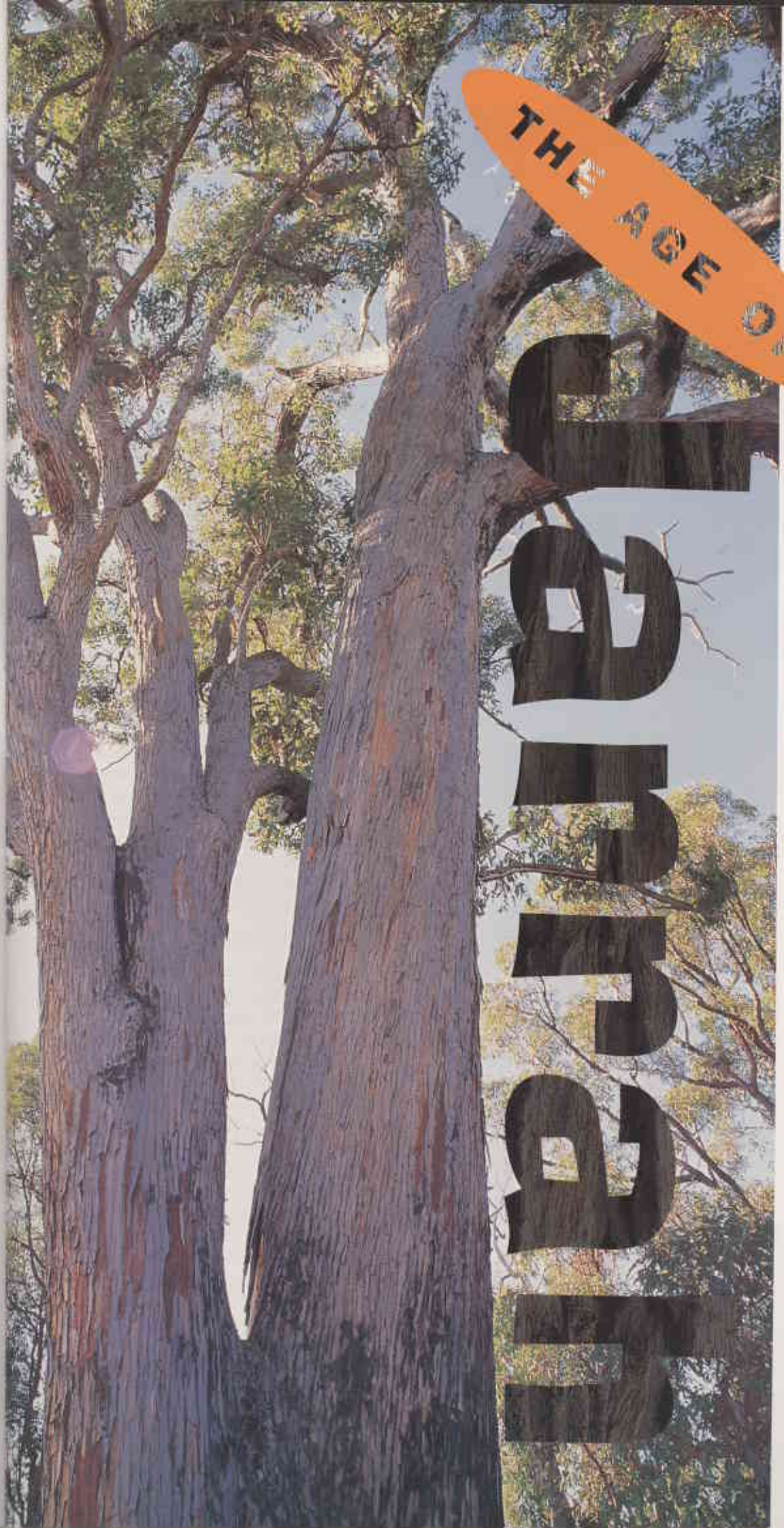


THE AGE OF TREES

Australia is a land of breathtaking landscapes, its beauty enhanced by a rich sense of age. Forests are no exception, growing from ancient times on primaeval soils. Yet research is showing that the trees themselves, the dominant eucalypts, are relatively short-lived—rarely more than 400 years old. In Western Australia, the jarrah has an even briefer lifespan.

BY MANDY GLEWS AND TAMMIE REID

Australia's unique environment can lay claim to many fascinating superlatives. This ancient continent hosts ecosystems which have evolved in isolation from the rest of the world since the great continent of Gondwana broke up and began to drift apart 55 million years ago. More than 90 per cent of Australia's species occur nowhere else. In the south-west of Western Australia, buffered by the Nullarbor Plain and spared from the last Ice Age, 70 per cent of plants are endemic to the area. Among these, the jarrah tree (*Eucalyptus marginata*) stands out as one of the most enduring and remarkably adapted of the local organisms.

Yet this tree is actually quite short-lived. Recent research shows that, contrary to popular belief, which credits jarrah with a span exceeding 1 000 years, mature jarrah trees range in age from only 100–380 years. Compared with a sequoia in California, which might have begun life at the time of Christ, the jarrah is almost youthful. Nestled in an inhospitable habitat, defiant of nutrient-poor soils, almost invincible to fire and producing some of the most highly-prized timber in the world, the jarrah survives and thrives by fairly frequent self-renewal. The forest is old; the trees are comparatively young.

But even the jarrah's short lifespan is a feat of survival. In the harsh Mediterranean environment of the South West, it is miraculous that hardwood forests exist at all. The region is hot, dry and fire-prone, with frequent lightning strikes from summer thunderstorms. In other areas of the world with similar soils and climates—South Africa's Cape, southern California, and central Chile are some examples—forests are unheard of. The vegetation instead consists of low-growing shrubs with tough, water-retaining leaves, and little else. And yet in Western Australia this hostile area nurtures tall stands of eucalypts. The jarrah tree has evolved an array of ingenious mechanisms that allow it to thrive on this barren ground.

A REMARKABLE SURVIVOR

The jarrah forest survives on ancient soil—among the oldest and most nutrient-impoverished in the world—that yields its nutrients grudgingly. For millions of years it has been drenched, desiccated, and leached, blown and washed away. The trees acquire their nutrients from this reluctant source with extensive root systems plunging to depths of up to forty metres.

Previous page The jarrah tree and close-up of its bark.
Photos – Marie Lochman and Dennis Sarson/Lochman Transparencies

Right: Kim Whitford examining and counting jarrah growth rings.
Photo – Barb Giles

The roots grow in two layers, the first stretching out to four-and-a-half times the area of the tree canopy. The second layer reaches down to the water table, far beneath the mantle of stony soil that characterises the landscape. The two layers of roots are linked by sinkers which have felt their way down through fissures in the hard cap-rock and underlying dense clay sub-soils. This dual system evolved to ensure the adequate intake of nutrients and water from an otherwise starved and parched environment.

Once the nutrients have been extracted, the jarrah makes the best possible use of them. Nutrients are recycled within the tree in a process which helps minimise the need for fresh nourishment: like a deciduous tree, the jarrah withdraws nutrients from its leaves before shedding them completely, frequently injecting the recycled nourishment into a new cloak of green. Feeding itself in this way, the jarrah tree replaces its leaves every 12–36 months.

Another tool in the jarrah's handy survival kit is the lignotuber, a growth mechanism that enables the infant tree to bide its time, waiting for the best growing conditions. The lignotuber is a woody underground mass of tissue which forms while roots are being set down. As the dual root system establishes itself, the lignotuber waits—for as long as 20 years—until a gap opens in the canopy, then sends off a vigorous shoot that will become a strong young tree. The lignotuber also allows the jarrah tree to recycle itself: even if a leafy shoot is burnt to the ground in a fire, the lignotuber is still able to send up a new shoot, so that the tree rises like a phoenix from its ashes.

TIME IN A TREE TRUNK

Most trees have a natural built-in history recorder. They grow in seasonal bursts. At the onset of the growth flush, the type of wood produced is called 'earlywood', and is larger and usually more porous than the dense 'latewood', which is laid down as growth slows. In the freezing winters of parts of the northern hemisphere, tree growth ceases until the spring; in Australia, it is the summer drought rather than the freezing winter that slows tree growth.

The practice of dendrochronology, or examining tree growth rings, is ancient. First practised by 15th century artist, inventor and great thinker Leonardo da Vinci, it has become an increasingly useful modern science to extract or confirm information about the age of stands of trees, as well as their climatic history.

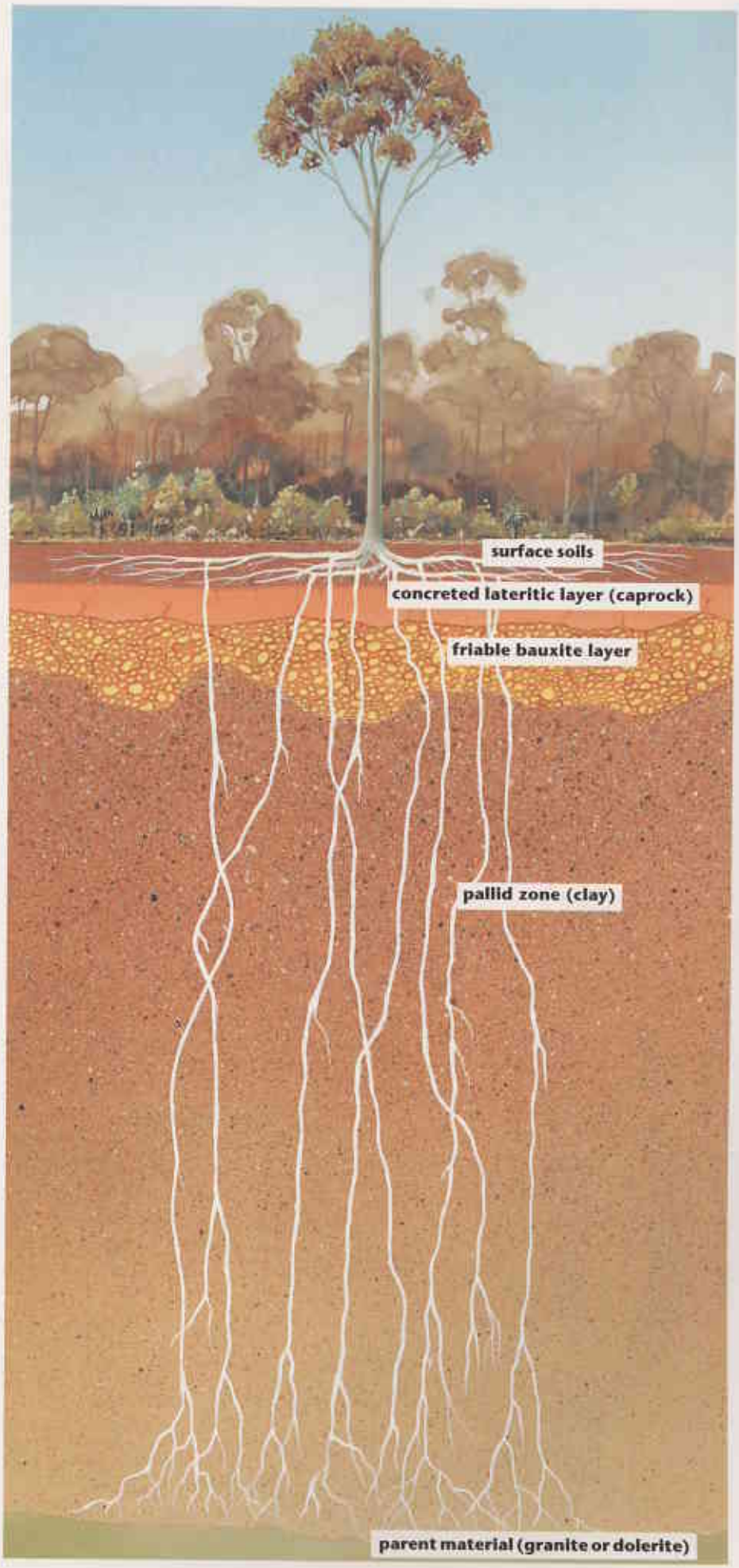
With living tissues regenerating at short intervals, a tree is an ideal form of life to attain great age. Yews, junipers, and

redwoods living 2 000 years and longer have shown durability of wood to be the main factor in achieving their impressive lifespans. It was therefore a surprise to forest scientists to discover that while jarrah's wood is also very durable, the individual tree is short-lived. This is true for many eucalypts. Dendrochronological techniques used in unlogged forests of karri (*E. diversicolor*) have shown that the largest karri—which rivals the sequoia as one of the tallest trees in the world—is less than 350 years old, with many mature forest stands no older than 250 years. Studies of woodland trees have found a wandoo (*E. wandoo*) aged 420 years and a salmon gum (*E. salmonophloia*) aged 460 years.

The information to be gleaned from a set of growth rings stretches far beyond the mere age of the tree. A cross-section of a tree-trunk is like an encyclopaedia of climatic events and disturbances. Fire, frost, insect plagues, and forest dynamics can all be interpreted from dendrochronological evidence. The technique can also be applied in human culture, through the archaeological dating of prehistoric settlements and timber used in old buildings. It has even been used in the exposure of fraud, enabling an expert to date the timber of a violin, allegedly made by the 17th century master craftsman Stradivarius, as having been harvested no earlier than 1910.

Jarrah's survival in the face of colonial settlement and more than a hundred years of development is testament to its long-evolved preference for inhospitable habitats. The rocky lateritic soils where it grows best were the least arable and hence the least attractive to farmers, who were also put off by the lack of permanent water, the coinciding presence of poison shrubs, and the sheer difficulties of clearing the big trees. Clearing for farming and settlement in the South West since the late 19th century led to a progressive shrinking of forest areas towards the prime jarrah belt, a swathe 30–50 kilometres wide running from Perth to Albany, which has stayed largely intact, and which represents more than 50 per cent of the original jarrah forests.

The surprising statistics on the age of jarrah trees were revealed when forest



Right: Diagrammatic representation of a jarrah root system.

scientists from the Department of Conservation and Land Management (CALM) began using dendrochronology for other purposes in the jarrah forest: to determine the age at which the trees develop hollows, and to piece together the fire history of the forest before and after colonial settlement.

LOOKING INTO HOLLOWS

Tree hollows are essential for the breeding and survival of some forest animals. Other animals in the forest also use hollows, but do not depend on them. For example, the brush-tailed phascogale and the red-capped parrot rely totally on hollows, while the ringtail possum and the pygmy possum are known to use them, but can also use other habitats for shelter and breeding. It is believed that 30 of the 250 species of birds and other vertebrate animals in the jarrah forest make some use of ground or tree hollows.

CALM scientist Kim Whitford is carrying out dendrochronology-based research to understand hollow formation in jarrah trees. Kim is measuring and describing the hollows and counting the growth rings of trees to get an idea of the age at which hollows form and what factors affect their size and abundance. His work has so far taken him to two sites near Dwellingup: Holyoake block, a lush and fertile valley bottom close to a creek; and the drier, less scenic O'Neill block. Further studies will be carried out at various sites around Collie and Manjimup, covering high- and low-rainfall areas.

Results to date indicate that hollows large enough to be used by birds and other animals occur in trees of 110 years and older. It has also been observed that tree hollows increase with tree size and age, and that ground hollows increase with the amount and size of old logging debris. Examination of more than 100 trees has revealed that few of the available hollows are used at any one time, suggesting that the number of hollows available exceeds the demand by birds and other animals.

CALM is conscious of the habitat value of these trees in its timber-harvesting operations. Thirty-three per cent of publicly owned jarrah forest is set aside in conservation reserves and cannot be logged. In timber-harvesting areas there are additional nature conservation strategies. Uncut strips of forest are retained between logging areas, and there are strict guidelines requiring the retention of at least three 'habitat trees' per hectare. In practice, more than three

Bark, phloem and cambium
Bark protects the live cells beneath it from fire and other damaging agents. Phloem is the nutrient carrying tissue that lies between the dead bark on the outside and cambium on the inside. The cambium is a single layer of cells that are responsible for radial growth of the tree bole.

Sapwood
Transports water from the roots to the leaves. Generally paler in colour, although the functional sapwood includes some of the darker coloured wood.

Fire damage
Intense wildfire has damaged this section of the trunk. The fire scar was eventually covered in sound wood, by the continual growth of the remaining cambium at the time.

Heartwood
Sapwood becomes dysfunctional over time and turns into heartwood. Heartwood is a darker colour because of deposits of tannins, gums and resins.

Pith
The central cylinder of cells, chiefly parenchymatous, surrounded by vascular tissue.

Kino (or gum) vein
This was probably caused by an insect borer.

Drought
Below average rainfall for several successive years results in limited growth and narrower growth rings.

Normal growth
During years of average rainfall, growth rings are more even and of moderate width.

Disease
Fungi probably killed this area, but continued growth of the remaining live cambium at the time resulted in it being covered in sound wood.

large trees are usually kept, along with many more small and medium-sized trees. The goal of this research into tree hollows is to refine and improve CALM's management of animal habitats, in conjunction with logging.

DIVINING FIRE HISTORY

Although jarrah with its thick, fibrous bark has a strong natural resistance to fire, an intense blaze leaves evidence of stem injury which is easily read by dendrochronologists. Invisible on the outside, 'fire scars' show up in sections of large, established trees, where strips of trunk matter have been killed in a moderate or high-intensity fire and then encased in new wood. Dendrochronology is helping CALM determine the intensity and frequency of fire in the forest before and after colonial settlement.

A recent CALM research project examined sections from 107 of the biggest trees at 14 sites around the State forest, to assess the patterns of fire. The full climatic range of the main jarrah belt was represented. The evidence showed the incidence of fire to be much more frequent and less intense before the colonial period. This is thought to be because of the displacement of Aborigines, who carried out regimes of frequent low-intensity burning in the forest. Without the traditional Aboriginal burning practices, there was a greater build-up of fuel (forest growth) between wildfires, which were consequently more intense. A return to prescribed burning in the 1960s, although controversial, again reduced the intensity of wildfires, and may have brought the forest closer to its ecology under the regime practised by Aboriginal people for many thousands of years.

TIME IN PERSPECTIVE

Just why eucalypts should be such short-lived trees is still a matter of conjecture. But whatever their age, they are still trees, and for that fact still command a sense of wonder. A jarrah that is more than 200 years old may not be considered old when compared with its ancient counterparts on other continents, but it still set down its roots before European colonists arrived in WA.

Tremendous change has confronted the jarrah since that time. Tough enough to weather the ravages of its natural environment, the best of the jarrah forest has also withstood the pressure of almost all the early efforts at conquest and exploitation. However, in 150 years of settlement—about half the lifespan of a single tree—it is the introduction of weeds and disease pathogens such as *Phytophthora cinnamomi* (the organism which causes dieback) that has added the most challenging layers of complexity to jarrah's survival story. Ongoing research will enable CALM to minimise the impact of logging on the forest system, as well as prevent the spread of disease. With responsible management, the jarrah will continue to survive and thrive long after this generation's scientific questions are answered.

Top: Tree hollows are important habitats for animals such as the ringtail possum.
Photo – Geoff Taylor/Lochman Transparencies

Above: Dendrochronological evidence has shown that the incidence of fire in jarrah forest was much more frequent, but less intense, before the colonial period.
Photo – Dennis Sarson/Lochman Transparencies

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LANDSCOPE

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Flower arrangements featuring eucalyptus foliage are becoming popular with florists. Find out why on page 35.

Unseen for more than 100 years and believed to have been extinct, Gilbert's potoroo turned up quite unexpectedly. See page 28.

Salinity is a problem in the State's south-west, but farmers, communities and government agencies are working to find solutions. See page 39.

A giant dragonfly lives in the south-west of Western Australia. You can find out more about this ancient relict of the jarrah forest in 'Western Petalura' on page 52.

The thick-billed grasswren is one of several animals that may be reintroduced to Shark Bay as part of an ambitious project. See 'Return to Eden' on page 22.

FEATURES

REGULARS

COVER

The stunning royal robe (Scaevola striata*) is one of a host of fabulous fanflowers found in Western Australia. Suzanne Curry discusses this and other species in the family Goodeniaceae on page 10.*

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