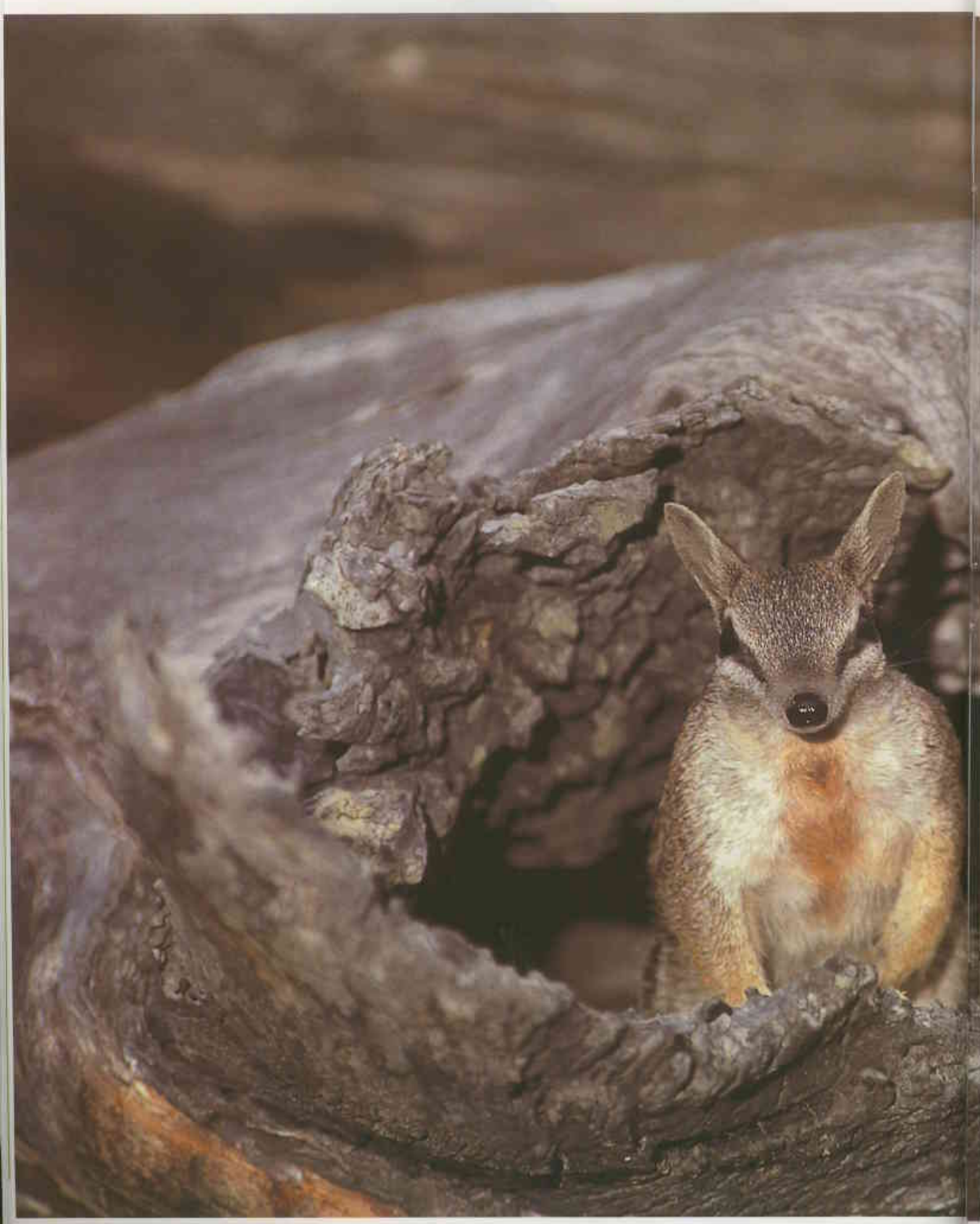
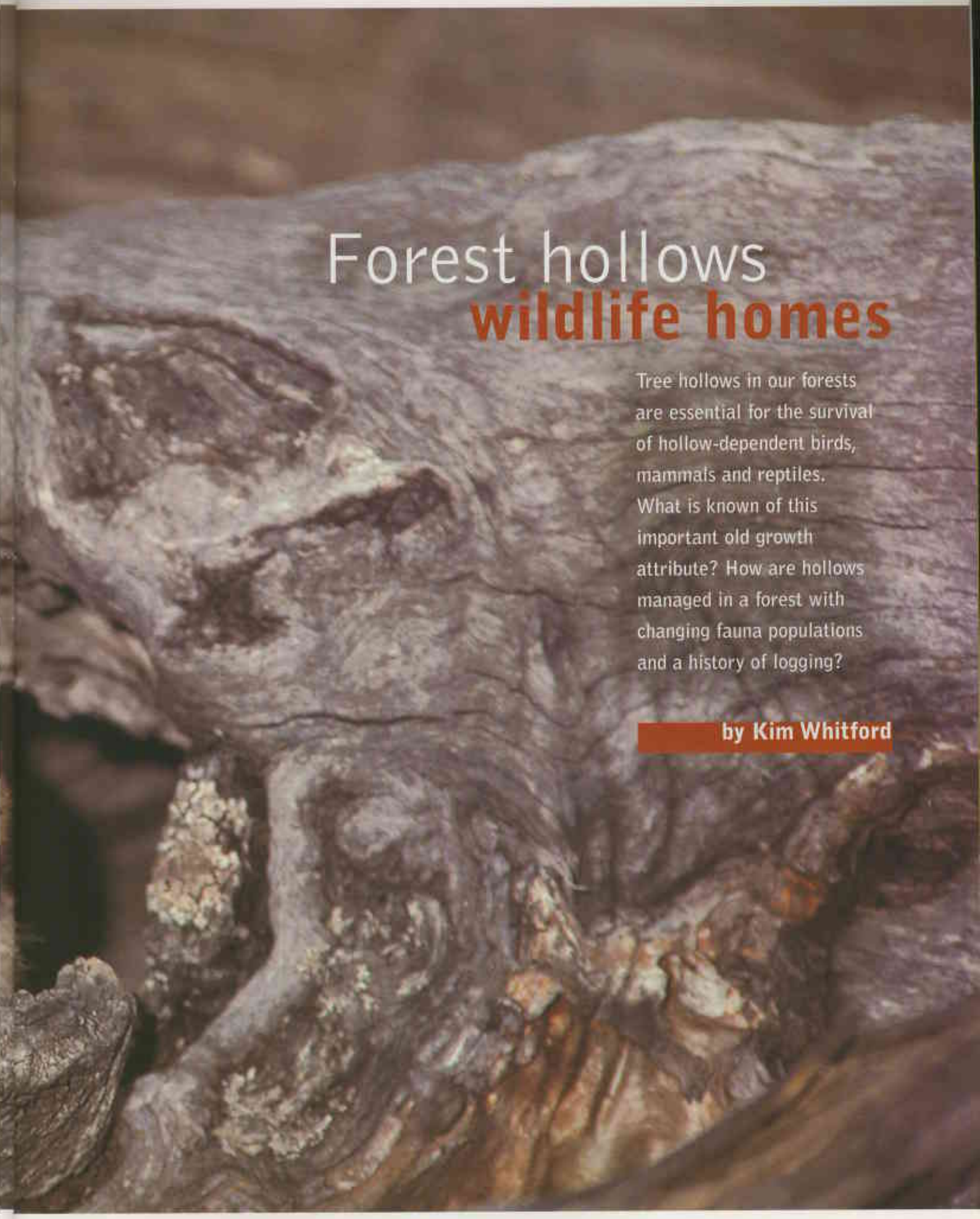




Forest hollows **wildlife homes**

Tree hollows in our forests are essential for the survival of hollow-dependent birds, mammals and reptiles. What is known of this important old growth attribute? How are hollows managed in a forest with changing fauna populations and a history of logging?

by Kim Whitford

In Western Australia, fox baiting and the reintroduction of threatened mammals, together with recent increases in forest reservation, have greatly improved the outlook for forest wildlife. As fox baiting restores native species to large areas of our forests (see 'Western Shield', *LANDSCOPE*, Winter 1996 and 'The Return of the Woylie' *LANDSCOPE*, Autumn 1996), greater demand is placed on the tree hollows in which animals breed.

As trees grow and decay, hollows form. The heartwood used to build houses, floors and furniture is dead tissue, and a tree can lose a large proportion of its internal heartwood and develop extensive hollowing, yet still maintain most of its structural strength. A 130-year-old tree has experienced storms, fires and persistent weathering that damage and tear off branches, exposing the heartwood to rain and sun. These cumulative events cause crowns to decline as trees get older. Wounds develop when branches are burnt or torn from the tree. Fungi, termites and other organisms attack, enlarge and extend these wounds, eating away the non-living heartwood. Eventually, hollows develop. Where these are open to the outside world, they are found and used by birds, reptiles and mammals.

Above: Termites, along with fire, fungi and micro-organisms, contribute to hollow formation and development.
Photo – Jiri Lochman

HOLLOW USERS

In Western Australian forests, 42 species of birds, mammals and reptiles use hollows in standing trees. Seven of these mostly use hollow logs on the ground. Since European settlement, logging has deposited innumerable tree limbs and log ends on the ground. Combined with natural tree fall, these provide abundant hollow logs for

Previous page
Numbats, like chuditch and mardo, make use of the abundant supply of hollow logs on the forest floor.
Photo – Jiri Lochman

Below: A boobook owl (*Ninox novaeseelandiae*) returning to its hollow in a broken limb.
Photo – Hans and Judy Beste/Lochman Transparencies

ground-dwelling species such as the numbat (*Myrmecobius fasciatus*), chuditch (*Dasyurus geoffroii*) and mardo (*Antechinus favipes*). This aspect of logging has probably benefited ground-dwelling forest animals by increasing the number of hollows on the ground. At the same time, logging has reduced the number of hollows available in large, standing trees. Consequently, species that use the hollows in standing trees are those most likely to be impacted by historic and recent logging.

Hollows provide animals with a secure and comfortable place to nest and rear their young. Small entrances provide protection from larger predators. Hollows reduce air movement and exposure, protect animals from rain, provide shade and insulation from summer heat, and limit the loss of heat in winter. These functions reduce extremes of temperature variation inside the hollow. And this helps animals maintain their body temperature and reduces their energy needs, leaving them with more energy to hunt or gather food, and to reproduce. For birds, hollows assist incubation by limiting the movement of eggs. All of these factors contribute to greater breeding success.

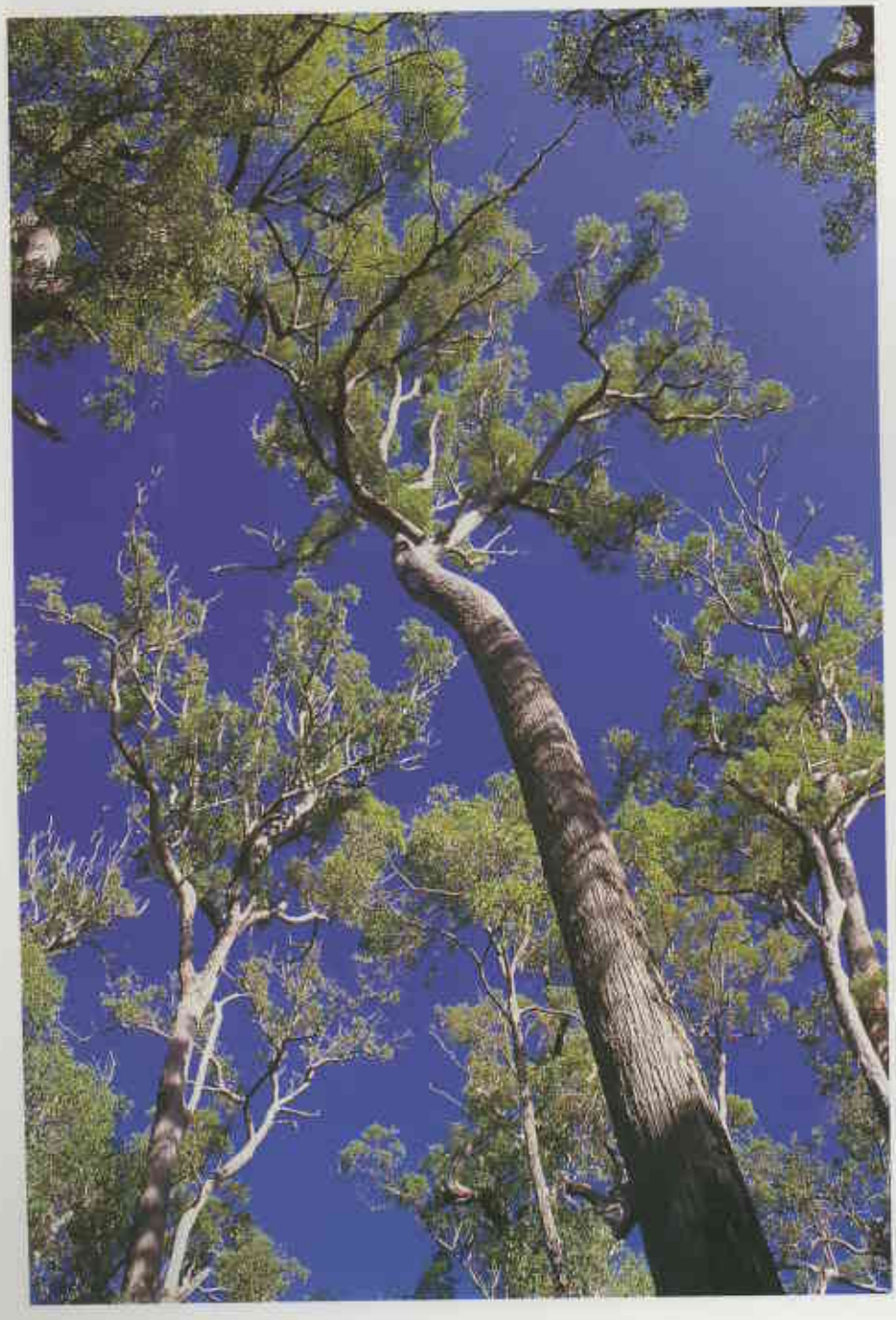
HOLLOW SIZE AND BODY SIZE

Researchers from CSIRO, the Agricultural Protection Board, the WA Museum, the Department of Conservation and Land Management, and Murdoch University have collected information on the size of hollows used by native animals. Hollows were found by radio tracking animals and by searching standing or fallen trees, and the dimensions of these hollows were measured. The size of hollows used by a species is related to its body size, with the largest species requiring the largest hollows, and conversely the smallest species using the smallest hollows. By studying the distribution of hollow sizes in the forest, and relating this to the sizes of hollows used by native species, general conclusions can be reached about how many hollows there are in the forest, and the availability of hollows potentially suited to these species.

A brushtail possum emerging from a well-worn hollow entrance. Photo – Wade Hughes/Lochman Transparencies

Forest animals use all types of cavities in trees, but each species selects hollows from only a particular size range. Bats and lizards use small cracks and places where bark has lifted. Tree martins (*Cecropis nigricans*) and striated pardalotes (*Pardalotus striatus*) use small hollows about the size of a 600-millilitre water bottle. Phascogales (*Phascogale* spp.) and parrots nest in slightly larger hollows, whereas owls and cockatoos breed in the large hollows that form in the main branches and trunks of trees. Red-tailed black-cockatoo (*Calyptorhynchus banksii*) hollows can extend deep into the trunks of marri trees and be seven metres deep and half-a-metre wide. Entries to hollows are often surprisingly small, as most hollow-using animals will enter an opening that is big enough through which to squeeze their head. A brushtail possum (*Trichosurus vulpecula*), for example, is about the size of a large domestic cat, yet it can enter a hollow through an opening only six centimetres in diameter.

These studies show that only a small proportion of all hollows found in the forest are large enough to be used by tree-dwelling creatures. There are many more small hollows than large ones. No usable hollows occur in branches smaller than about 10 centimetres in diameter, and hollows found in branches close to this size are suited only to relatively small species,



such as striated pardalotes, rufous treecreepers (*Climacteris rufa*) and mardos. Larger mammals and birds need larger branches to carry hollows. Most hollows occur in the tree's crown, rather than in the trunk. Sixty-five per cent of all usable hollows in jarrah and marri are found in the dead wood, with 35 per cent in live wood.

WHERE ARE HOLLOWS?

Hollows are difficult, even impossible, to see from the ground. The entrances are often very small and hidden behind clumps of leaves. They are dark and hard to see in shaded parts of the tree crown. Even when they are visible from the ground, it is almost impossible to distinguish an entry into a hollow from the burnt-out stump of a limb that has been blackened by fire and goes nowhere. Because hollows are hard to see, the size of the tree and the condition of the crown help tree markers select trees to keep for wildlife in logged areas. These 'habitat trees' are selected because they are large and have specific types of crown damage associated with hollow development.

Hollows are most common in the largest and oldest trees. These typically have large crowns with many branches, much decay and more places for hollows to form. Although decay creates hollows, as it progresses it causes trees to lose limbs, leaving very senescent trees (those that are old and in decline) with only a few large limbs and reducing the number of hollows. Consequently, both highly senescent trees and those with little or no crown decline tend to have few hollows. The decline of the crown also changes the size of hollows found in the tree. Tree crowns that are largely intact have few or no hollows. Some decay leads to the formation of small hollows, and further decay leads to the formation of larger hollows. The largest hollows usually form in the trunk or in primary branches in the crown that have been

Above left: The hollows that form in these karri crowns provide nesting and roosting sites for a variety of native birds.
Photo – Len Stewart/Lochman Transparencies

Left: Although less majestic than karri, the jarrah forest is home to a greater number of tree-dwelling mammals.
Photo – Rob Olver

Right: An Australian owlet-nightjar (*Aegotheles cristatus*) peers from the entrance to a hollow.

Below: A phascogale and its young shelter in a nest of leaves, sticks and grass at the base of a hollow.
Photos – Jiri Lochman

broken off. So the size of the tree, the form of the tree crown and the type of crown decay all indicate what types of hollows may occur in that tree.

Although the largest trees have the most hollows, trees greater than a metre in diameter (measured 1.3 metres above the ground) make up less than two per cent of trees in the forest, while trees with diameters greater than 50 centimetres make up approximately 20 per cent of all trees. Even though smaller trees individually bear relatively low numbers of hollows, collectively they provide many of the hollows in the forest. This is typical in both regrowth and old growth forests, and conforms with population distributions in nature, as the number of small trees competing to become veterans of the forests is many times larger than the number of trees that actually become veterans.

PROTECTING HABITAT

The primary strategy to protect hollow-dependent wildlife is reservation, and this is applied at a range of scales. It includes the formal reservation of extensive tracts of land in national parks and nature reserves, through to smaller-scale informal reservation of areas alongside roads, streams and other uncut forest areas, down to the retention of groups of individual trees within logged areas. Trees are left across jarrah logging coupes—typically about 40 per cent of a jarrah coupe consists of uncut areas of various types. A very much larger proportion of the karri forest is in reserves of some type. To provide diverse and ongoing habitat, these various reserves, retained trees and stands of trees are spread across the landscape

Left: Geckos and skinks, like this Napoleon's skink (*Egernia napoleonis*), shelter in fissures in dead wood and under lifted bark.
Photo – Jiri Lochman

HOLLOW USERS IN WESTERN AUSTRALIAN FORESTS

Of the 42 forest-dwelling species that use hollows in logs and standing trees, 29—such as the red-capped parrot and phascogale—are highly dependent on hollows for breeding, whereas others—like the carpet python and pygmy possum—make only occasional use of hollows.

There are 12 large hollow-using birds: four owls (boobook, barking, masked and barn owls), four cockatoos (the red-tailed, Baudin's and Carnaby's black-cockatoos, and the long-billed corella), the peregrine falcon, and three large waterbirds (the mountain duck, black duck and grey teal). Medium-sized birds include the red-capped and ringneck parrots, western rosella and purple-crowned lorikeet. A mixed group of medium to small birds (the sacred kingfisher, owlet night-jar, rufous treecreeper, tree martin and striated pardalote) also use hollows.

Bats, such as this Gould's wattled bat (*Chalinolobus gouldii*), shelter under lifted bark, fissures in tree trunks, and open cavities often unsuited to other hollow users.
Photo – Jiri Lochman

There are three large mammals (chuditch, common brushtail possum and western ringtail possum), two medium-sized mammals (the numbat and phascogale), nine small bat species, and the small mardo and western pygmy possum. Surprisingly, five reptiles use hollows (carpet python, Stimson's python, marbled gecko, reticulated velvet gecko and Napoleon's skink).

Many hollow-using birds are well known. The black-cockatoos, parrots and corellas are brightly coloured and have distinctive calls. Most of the mammals are more cryptic. They spend the daylight hours secreted inside tree hollows, where they are sheltered from the elements and protected from predators. The brushtail possum is probably the best known. It uses large hollows, and its den trees can often be readily distinguished by the obvious parallel tracks worn into the bark on the uppermost side of the tree. The timid western ringtail possum has a restricted distribution and is most common in the peppermint forests of the coastal plain. Here, it uses hollows in tuart trees, but also builds platforms of branches and leaves (called dreys) in peppermint trees. In the jarrah forest, ringtail possums nest in the skirts of grasstrees, as well as using hollows.

and logging disturbance is dispersed across the forest and through the years.

A variety of restrictions are placed on jarrah and karri logging activities that reduce the impact of logging by preserving habitat trees for animals to use. As already mentioned, some large trees are retained to provide habitat for hollow-dependent wildlife. These retained trees (called 'habitat' and 'potential habitat' trees and marked with a large white 'H') are the most visible hollow-conservation strategy in the harvested forest. However, the dispersion of logging over time and across the landscape, as well as the creation of reserves, are the most important and effective means of conserving habitat.

ASSESSING RISK

So how well protected are hollow-using species in our forests? The reserve network is extensive and substantial, and provides a secure foundation for conservation. However, the only way to fully answer this question is to monitor forest wildlife or to target research at those species most at risk.

The impact of disturbance and the capacity to adjust to it varies with each species. Some species are hardly affected by the loss of hollows. Other species do not have the flexibility in their behaviour or requirements to cope with this change. For example, species that are totally dependent on hollows for breeding are affected more than species that breed in both hollows and other types of shelter. Similarly, hollow-using species with small home ranges have fewer trees available in which to locate a hollow than species with large home ranges. In addition, large animals need large hollows (which are relatively rare when compared with the number of small hollows) and so they are more likely to be impacted upon than species that use small hollows. Combining and ranking these attributes helps to identify the species most at risk. Those species that are large, are totally dependent on hollows for breeding and have relatively small home ranges will be more affected by the loss of hollow-

Above: This large jarrah tree shows the ravages of age. Wind damage and fire scars allow water, fungi and micro-organisms to enter the tree, advancing the decay process.
Photo – Neville Passmore

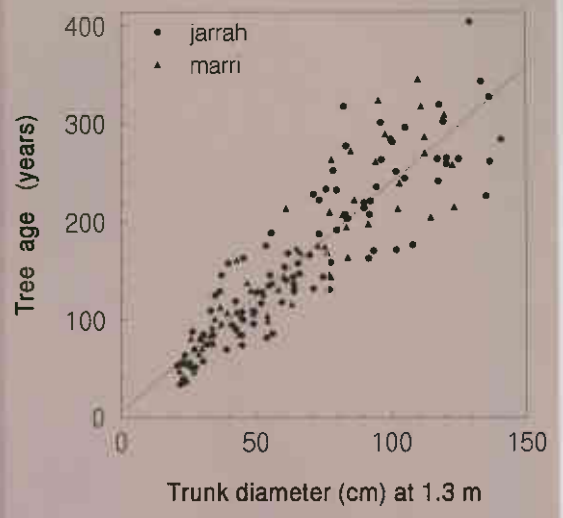
bearing trees than small species that nest in a variety of situations and have large home ranges.

To identify the species likely to suffer the greatest impact from the removal of hollow-bearing trees, Department of Conservation and Land Management scientist Ian Abbott and I assembled information from publications and sought expert advice from wildlife scientists. Of the 42 hollow-using species found in jarrah and karri forests, 29 are highly reliant on hollows in standing trees. Seventeen of these species are totally dependent on hollows for breeding and use relatively uncommon hollows. Of these seventeen, a group of eight species have small or medium-sized home ranges. These species—the rufous treecreeper, brushtail possum, sacred kingfisher (*Halcyon sancta*), phascogale, western rosella (*Platycercus icterotis*), red-capped parrot (*Purpureicephalus spurius*), Baudin's black-cockatoo (*Calyptorhynchus baudinii*) and red-tailed black-cockatoo—are most likely to be impacted by any shortage of hollows. Consequently, these species provide a focus for identifying the impacts of disturbance and determining the success of management practices.

AGE OF TREES WITH HOLLOWS

As trees grow, seasonal variations in wood growth create annual growth rings that can be counted to determine the tree's age (see 'The Age of Jarrah', *LANDSCOPE*, Autumn 1995). Growth rings on 162 jarrah and marri trees that had been felled for saw logs were counted. These trees were between 35 and 405 years old. The relationship between tree diameter and tree age can be used to estimate the age of trees with hollows. The smallest tree found with a usable hollow was 45 centimetres in diameter, and its growth rings showed that it was 163 years old. This tree had a single hollow big enough to be used by a striated pardalote. The youngest tree with a usable hollow was 48 centimetres in diameter, and its growth rings indicated it was 130 years old. This tree contained one hollow big enough for a phascogale or a red-capped parrot. A 405-year-old jarrah tree with a diameter of 129 centimetres had five hollows big enough to be used by the common brushtail possum, western ringtail possum, phascogale, Australian ringneck, western rosella, red-capped parrot and striated pardalote. In contrast, a similar-sized jarrah (135 centimetres in diameter) had a growth ring count of 227 years, but no hollows big enough to be used.

For all but the largest hollow users (red-tailed black-cockatoos and female brushtail possums), usable hollows are typically found in trees larger than about 45 to 50 centimetres in diameter, although phascogales and possums have been found using trees 40 centimetres in diameter. It's not unusual to find usable hollows in trees of this diameter range, which corresponds to ages of 112 to 124 years. Hollows in younger trees are generally suited to smaller species such as mardos, pygmy possums and striated pardalotes. The youngest tree observed with a hollow suited to red-tailed black-cockatoos was 130 years old.



THE FUTURE

There are sound reasons to be optimistic about the future for hollow-using species in the south-west forests. The forests available for timber production, together with forest reserves and national parks, form a large, continuous and extensive forest mosaic through which species can disperse. The 1.9 million hectares of forests grow on relatively flat terrain, with few major rivers or other barriers to limit movement of ground-based species. Most hollow-using species are birds and bats, which can fly freely through the forest over relatively large distances and readily access hollows in the canopy. There are only three large, hollow-dependent, tree-dwelling mammals (compared with nine species in the forests of south-eastern Australia) and only three major types of tall forest. All of these factors simplify the task of managing the forests for hollow-dependent species in WA.

Forest management strategies are developed from an established and expanding basis of scientific knowledge of wildlife habitat requirements. Research—such as examining specific stand attributes that are related to the use of hollows by wildlife—is ongoing, and management practices are regularly adapted in the light of changing circumstances and improved knowledge. Fox baiting, recent increases in reservation and an ongoing commitment to adaptive management provide a promising outlook for hollow-dependent species in Western Australian forests.

Kim Whitford, from the department's Science Division in Dwellingup, researches the impacts of logging in the south-west forests. He can be contacted on (08) 9538 0021 or by email (kimwh@calm.wa.gov.au).

This article is based on studies described in scientific papers by Kim Whitford, Matthew Williams and Ian Abbott.

Winner of the Alex Harris Medal for excellence in science and environment reporting

LANDSCOPE

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An exciting range of recreational opportunities are being offered in some national parks, creating employment for locals. See page 28.

Native animals need tree hollows and people need wood. How are these conflicting uses managed? See page 20.

The search to find out the cause of a new tree killer known as Mundulla Yellows. See page 41.

Declining water levels threaten a remarkable community of cave-dwellers in Yanchep National Park. Turn to page 34.

Re-discovering the long-forgotten memoirs of a Kimberely pioneer. See page 48.

COVER

Leafy seadragons are occasionally seen in the seagrass around the Busselton Jetty (see page 10). They are in the same family as seahorses but, unlike seahorses, they have leafy appendages that make them almost invisible in their surroundings. The male carries the eggs in the skin beneath his tail. After hatching, the young swim off to fend for themselves.

Cover illustration by Philippa Nikulinksy

FEATURES

REGULARS

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