WHAT ABOUT THE ANIMALS?

The Kingston Study Delivers

Four years after it began, the ground-breaking Kingston Study is starting to answer important questions about the impact timber harvesting has on Western Australia's native mammal species.

by Brent Johnson & Keith Morris

For many years, in forests around the world, cries of 'what about the animals?' have been heard whenever words like logging, clearfelling and woodchipping have been used. In Australia, timber harvesting in native forests has become one of the most controversial environmental issues. The logging debate raises passions: some argue that timber production can proceed on an ecologically sustainable basis; others suggest that logging destroys the integrity of the forest and threatens species' survival.

Despite a long history of logging, dating back to European settlement, Western Australia's forests remain an important reservoir for native plant and animal species. Very few studies had looked specifically at the impact of timber harvesting on our native fauna until 1994, when a major study into this controversial question was launched in the unique jarrah forest of WA's south-west, near Manjimup. Much of the background to this project, known as the Kingston Study, has been presented in a previous *LANDSCOPE* article (see 'Forest Focus', *LANDSCOPE*, Summer 1994–95). After four years, some interesting results have come to light and the Kingston Study has the opportunity to become one of the best long-term logging impact studies in Australia.

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Main: The jarrah forest at Kingston has sustained a diverse range of fauna and is now providing a unique opportunity to study the impact of timber harvesting on several native animal species.
Photo – Chris Garnett
Insets: (top) Chuditch have been shown to persist in forest areas subjected to timber harvesting.
Photo – Jiri Lochman
(bottom) An area is cleared within the forest to stockpile logs prior to being trucked to sawmills.
Photo – Gordon Friend/CALM

Left: Brushtail possums were common in the study site and were the subject of intensive radio tracking during harvesting.
Photo – Jiri Lochman

The study is being undertaken in the jarrah (*Eucalyptus marginata*) forest, where there is generally a higher diversity of mammals than the adjacent karri forest. Previous fauna surveys of the 20,000-hectare study area had shown that Kingston and adjacent forest blocks were home to several mammal species, some of them threatened. These included the chuditch (*Dasyurus geoffroii*), woylie (*Bettongia penicillata*), quenda (*Isoodon obesulus*), brushtail possum (*Trichosurus vulpecula*) and western ringtail possum (*Pseudocheirus occidentalis*). The forest blocks had been selectively harvested in the 1940s and again in the 1970s, and were representative of forests due for logging. Harvesting within Kingston block was proposed for 1995–96 under the Department of Conservation and Land Management's (CALM) timber harvesting schedule.

Another important reason for the choice of this study area was the fox control program being implemented by CALM. Reduction of fox numbers has been shown to be crucial for the recovery of many species of native mammal in the south-west (see 'Western Shield', *LANDSCOPE*, Winter 1996). It was important to the study that relatively large populations of animals be present before any timber harvesting began, so that any changes afterwards could be detected. Fox control is now undertaken throughout most of the jarrah forest, so the study would be investigating current forest management methods.

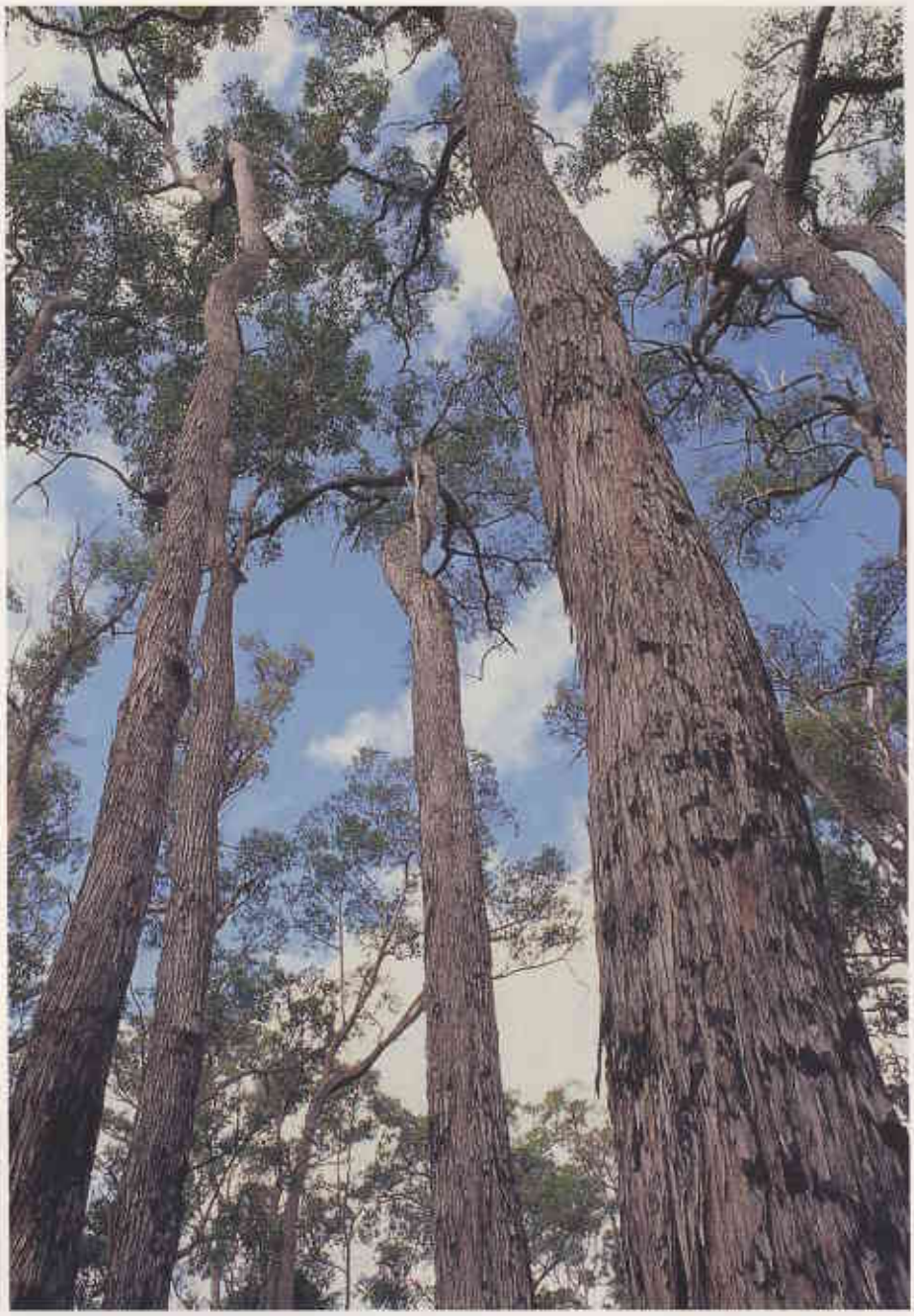
Left: CALM staff have relied on volunteer assistance throughout the project.
Photo – Gordon Friend/CALM

Terrestrial vertebrate fauna are not the only focus of work around Kingston. Postgraduate university students have begun studies into the impacts of logging on birds and invertebrates, while other CALM scientists are investigating changes to vegetation, and the size and abundance of hollows that hollow-dependent species require.

THE STUDY BEGINS

Before harvesting, a detailed survey of the structure of the forest was undertaken. This is part of normal forestry operations to determine which harvesting methods should be applied to various patches of forest, known as coupes. Following the preparation and marking of these coupes, a series of trapping grids and transects were established to sample the different harvesting treatments. The 'gap' treatment is where the forest overstorey is removed to allow existing regeneration (lignotubers, seedlings and saplings) space to grow and mature. The 'shelterwood' and 'thinning' treatments are where selective thinning occurs to allow seed germination in the former, and rapid growth of the remaining trees in the latter. Habitat trees, or those considered likely to be used by mammals, were retained in both gap and shelterwood treatments at a rate of three per hectare.

Wire cage traps were placed at 200-metre intervals to form trapping transects along 38 kilometres of roads through the area. These were intended primarily to capture chuditch (more widely dispersed than other mammals being studied), but were also useful for comparing mammal numbers at a broad scale. In addition, 20 trapping grids (2.6 hectares each) were laid through the impact areas, and a further four placed outside in forest that was to remain free from disturbance. Of the 20 within the impact zone, two were located in unlogged areas (or buffers) surrounding the gaps and shelterwoods, and another two were outside but relatively close to harvesting operations. The buffer grids and those located away from disturbance are used as controls—they allow comparisons to be made between impact and non-impact sites. Controls are absolutely vital to the experiment because other factors, such as variation in climate, can have a significant influence over condition and abundance of animals. All selected sites were considered typical or representative of forest habitat types found within the area.

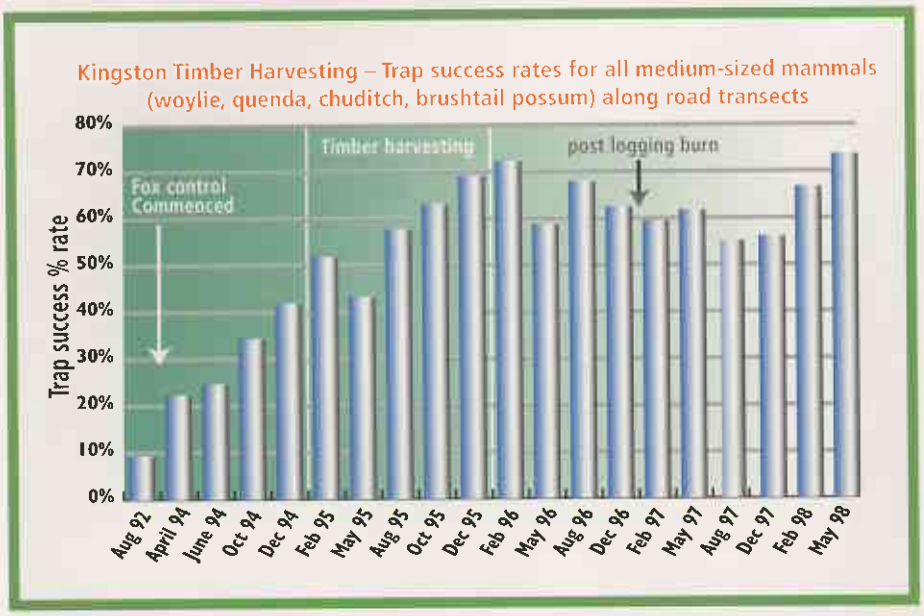


Arboreal mammals, such as possums and phascogales, use hollows in jarrah trees for refuge and as breeding sites.
Photo – Marie Lochman

TRAPPING

The fauna work began with intensive trapping and radio-telemetry to provide as much information as possible before timber harvesting began. Field trips were scheduled for a fortnight every second month. A large taskforce of CALM researchers, CALM district and regional staff and volunteers from all walks of life undertook the very arduous task of setting and checking several hundred traps each day. Once captured, animals were measured, weighed, sexed, tagged and promptly released. Then there would be several hours of radio-tracking and marking of animal refuge trees, before a weary return to Manjimup. Monitoring of all sites has continued since harvesting and will be maintained for the next few years.

The sheer number of species and individual animals captured has surprised and excited all involved in the study. By the end of 1997, there had



been more than 16,000 captures of all species overall, giving scientists the opportunity to provide good statistical evidence on the impacts of timber harvesting and contribute further to the knowledge of local species.

Mammal species captured included the chuditch, woylie, quenda, brushtail possum, brush-tailed phascogale, western ringtail possum, mootit or bush rat (*Rattus fuscipes*) and the little long-tailed dunnart (*Sminthopsis dolichura*). This gave researchers a good representation of animals with different life histories within the study site. The arboreal, or tree-dwelling, possums (folivores) and phascogales (insectivores), considered most likely to suffer from harvesting operations, were well represented. There was also a diverse range of ground-dwellers: the woylie (fungivore), quenda (omnivore) and chuditch (carnivore/insectivore), and a cross-section of reptile and frog species.

A large amount of information on where the mammals spent their daylight hours was gathered by radio-collaring the different species and tracking them to their refuges. One of the early findings was that, before logging occurred, brushtail possums used a wide range of refuge sites, not just tree hollows. One quarter of all refuges used by possums were ground-based in hollow logs or stumps. Chuditch occupied hollow logs and burrows, while woylies and quenda occupied nests under shrubs.

The radio-tracking study also shed light on the number and types of trees best left in logged areas to provide enough hollows for arboreal species. As a result, an increase in retained habitat trees, from three to four trees per hectare, was recommended and incorporated into CALM's harvesting

Top left: Manjimup District Manager Rod Simmonds helps Gordon Friend process the day's captures.
Photo – Brent Johnson/CALM

Top right: A radio-collared ringtail possum is discovered in a tree hollow.
Photo – Gordon Friend/CALM

Left: Radio collars were fitted to several species such as this chuditch to allow researchers to track animals during logging.
Photo – Keith Morris/CALM

Above: Woylie nests were found among logging debris on the impact sites.

Right: Woylies appeared not to be affected by logging and quickly increased on all sites.
Photos – Jiri Lochman

Below: CALM researchers investigate the 'home' of a radio-collared animal.
Photo – CALM

specifications. This recommendation will be reviewed, if required, as more information becomes available.

Timber harvesting began in the summer of 1994–95 and followed the prescriptions laid down under normal CALM guidelines. The harvesting continued until the onset of rain in May 1995. Following a winter recess, all areas to be cut were completed by early 1996. Normal post-harvesting regeneration burns were carried out on all sites during December 1996. Trapping and radio-tracking continued during this period to assess the direct impacts.

WHAT HAPPENED TO THE ANIMALS?

For the first 18 months of the study there was a steady increase in the number of medium-sized mammals captured throughout the study site. Because of fox control, total numbers have increased about six-fold in five years. But, despite fox control measures, there was a slight increase in fox activity during and immediately following harvesting, particularly near the boundary adjacent to farmland. This increase was detected through sightings and the use of prepared sand pads rather than through known predations—none of the radio-collared animals was known to have been taken by a fox.

Two years after logging, and one year after the regenerative burn, woylies showed no detrimental effects. All radio-collared woylies survived the logging process and immediately used logged coupes for feeding and refuge sites. In fact, their numbers increased on all sites, probably due to the ongoing fox-baiting, and easier access to open areas of disturbed soil and underground fungi, their favoured food source. They were also quick to use the logging debris as nest sites.

Because of the difficulties associated with fitting radio-collars to quenda, only a small number were tracked during the logging process. One was killed by a chuditch and another by a feral cat, but none as a direct result of logging. While there was some variation in the abundance of quenda after the logging process, their relatively low numbers at all sites made interpretation difficult. There was a reduction in numbers in unlogged buffers after the regenerative burns, and this may be related to the use of above ground nests by these species. However, woylies, which also use above-ground nests, were not affected.

The logging process did result in the mortality of some radio-collared

brushtail possums, in areas cut to gaps where habitat trees were not retained, and in those areas thinned to shelterwood. Interestingly, there was an increase in abundance at gap sites where habitat trees were retained, suggesting that these trees perform a critical role. Numbers have now returned to former levels, indicating a rapid recolonisation from surrounding buffers and other unlogged areas. Possum numbers on the road transects also appeared to decline after the logging and burning, but are now recovering.

Another arboreal species, the western ringtail possum, was also considered likely to be vulnerable to logging. This species is difficult to trap on the ground, therefore a separate and intensive study began in adjacent forest in 1997 and will be reported on at a later date. Spotlight transects throughout the area indicate that this species is as abundant as the common brushtail possum and is still recorded regularly from logged sites.

Brush-tailed phascogales are a difficult animal to study as all males die following breeding in winter each year. This drastically reduces the population available for capture. The difficulties in capturing these animals and interpreting results were increased when the previously healthy population underwent a rapid decline immediately prior to logging in 1994. This was probably due to a particularly dry year, which resulted in a decrease in the insects and other small animals that phascogales rely on for food. It is not uncommon for other members of the same family (Dasyuridae) to show this boom and bust response to environmental cycles. While phascogales are known to persist in previously logged forest, the full effects of timber harvesting remain unknown at this time. Radio-tracking before the population crash did show, however, that while phascogales forage for food in logged areas during the night, they moved back to the unlogged buffers for refuge during the day.

Chuditch were known to occur throughout the study area and several were radio-tracked before, during and after logging. This far-ranging and mobile animal was considered less likely to suffer from harvesting, as its home range of 1,000 to 1,500 hectares is large in relation to the scale of logging. Logged areas vary between 10 and 100 hectares and only about 30 per cent of the study area was affected by logging. No chuditch were known to be killed as a result of the logging process and some used the piles of debris as refuge sites. One problem that did arise as a result of fox control was that the increasing numbers of other mammals, particularly woylies, meant there were very few open traps available for the less abundant and more sparsely distributed chuditch to enter. Recent experiments with alternative baits and modified traps means that we can now more accurately estimate the numbers of this species. These new techniques show the chuditch to be unaffected by logging at Kingston.

The impact of timber harvesting on smaller animals such as frogs and lizards has yet to be analysed, but it appears that most, if not all, species present before disturbance still exist at Kingston.

The brush-tailed phascogale underwent a natural decline before logging began. Photo – Jiri Lochman

MANAGEMENT IMPLICATIONS

Several important results have come out of the Kingston study, so far, with more expected as work continues. However, two years after logging, it is clear that none of the medium-sized mammals has become locally extinct, and all species have maintained or returned to their former abundances.

Animals that depend on hollows in trees for refuge and breeding sites, like possums, are likely to be the most vulnerable to logging. Of the two possum species present in the Kingston study area, the ringtail is the smallest, least aggressive and presumably most vulnerable. Accordingly, a separate investigation into ringtail possums is under way, but it is too early to comment on this study. The brushtail possum was found to be the most affected of the medium-sized mammals, but has now returned to its former abundance.

The intrusion of an opportunist predator like the fox into disturbed areas is of concern, and it is likely that, following further research, CALM's fox-baiting regime in these forest areas that border farmland will be modified. This issue is the subject of considerable investigation.

The surrounding unlogged buffers have proven themselves critical for the maintenance of diversity and abundance of forest fauna, especially during the early years after logging. It is also important to preserve significant quantities of various-age forest adjacent to harvesting coupes. The frequency and intensity of prescribed burning in buffers are also important issues for study. Ongoing monitoring will provide valuable information on the time it takes for the regenerating forest to offer the range of habitat types required by forest species, with their differing life histories and habitat preferences. The key to successful forest management will be getting this balance right.

In the meantime, the Kingston Study will continue to provide tangible benefits. Our growing knowledge will be translated into workshops for forest managers and revised guidelines for operational staff. This 20,000-hectare patch of forest will become one of the State's most important research sites and continue to deliver answers to the age-old question 'what about the animals?'.

Top: The Kingston area is home to large populations of many mammal species.
Photo – Jay Sarson/Lochman Transparencies

Above: A mootit or bush rat, one of several mammal species captured during the surveys.
Photo – Jiri Lochman

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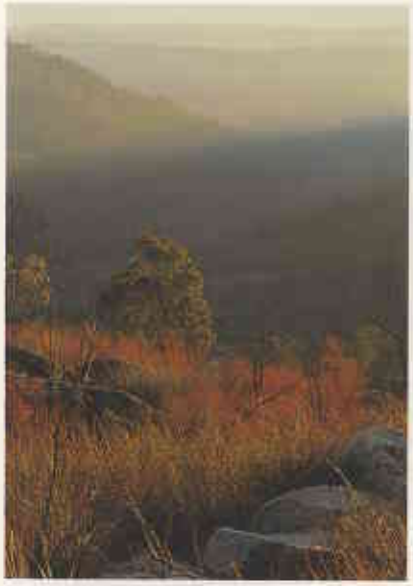

This land, where the Avon River cuts through the Darling Range, was home to WA's most notorious bushranger. His story is on page 10.

'What about the Animals', on page 21, discusses early findings from the Kingston Study.

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Just when everyone thought it was extinct, this small mammal suddenly reappeared. See 'Dibblers' on page 28.

100,000 hectares of bluegums by the year 2000. Was it a realistic target? See 'From Blue sky to Blue Chip' on page 35.

'Karla Wongi: Fire Talk', on page 48, is a Nyungar perspective on the use of fire in the south-west of WA.

FEATURES

REGULARS

COVER

One of Western Australia's best-known woodlands may be under threat now, but research by CALMScience Division staff is playing a key role in safeguarding their future. See 'Small Steps to Save Salmon Gums', on page 17

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