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Chapter x. Fauna.

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1. Introduction

This chapter provides conservation guidelines and recommendations for the long term protection of the animals found the Wombat State Forest. The guiding aim is to provide recommendations and guidelines which, if carried out, will ensure the long-term conservation of all native animals within the Wombat State Forest.

In collecting information we have concentrated on collecting information and making recommendations for rare and threatened species. These are the species most at risk in becoming locally extinct within the Wombat Forest. New information will continue to become available on the distribution and the status of plants and animals in the Wombat Forest. As new biological information becomes known it will need to be incorporated into this plan. We have deliberately catered for this by setting out clear descriptions of the requirements for species already known to occur in the forest. As new sites for these species are discovered the management requirements set out here can be applied.

A major problem in attempting this work is the lack of any prior systematic flora and fauna survey for the Wombat Forest. The recommendations made in this section is based on the existing information on wildlife. It was outside the scope of this project to conduct any general field surveys. As noted in the general recommendations an urgent priority is for a comprehensive flora and fauna survey to be carried out in the area. The results from such a survey could then be incorporated into an improved management plan.

The recommendations given here concentrate on the providing adequate protection for native animals from the effects of continuing logging and woodchipping operations. Such operations are the major threat to native animals in the Wombat State Forest. This chapter does not attempt to deal with other more minor known or potential threats such as feral animals, weeds and changes in fire management. These are significant conservation issues but none of them pose immediate threats on the scale of logging and woodchipping operations. Ideally, appropriate management for these issues should be determined in the near future.

2. Effects of logging and woodchipping operations

Woodchipping and logging operations are the current principal threat to plants and animals in the Wombat Forest. A number of studies have clearly demonstrated that logging operations such as those that occur in the Wombat Forest cause major changes in the abundance of plants and animals. As a background to the recommendations for specific species the general effects of clearfelling on plants and animals are described here.

Intensive logging causes two sets of major changes to forest. Firstly if radically changes the 'structure' of the forest- the number of large, mature* trees with hollows, the number of fallen logs, the density of the understory and the cover of the tree canopy. (Mature here refers to ecologically mature trees. It does not refer to trees which are simply large enough to be logged. Ecologically mature trees have ceased net growth and are likely to have important ecoogical features such hollows and dead branches). It also alters the 'floristics'- the number of plant species and their density in the forest. A range of plants and animals species cannot adapt to these changes and are consequently rare or absent from forests that have been intensively logged.

One of the key changes in the structure of the Wombat Forest that has occurred is the loss of older trees with hollows. Trees with hollows are now very scarce in the Wombat Forest due to past and current logging practices. Sixty-two birds mammals and reptlies known to occur in the Wombat Forest need tree hollows to shelter and breed in. This includes nearly all the possums, all gliders, all owls, all bats known from the forest and all parrots.

Hollows suitable for animals usually only form in eucalypts greater than 120 to 200 years of age (Ambrose 1982; Mackowski 1984; Lindenmayer 1992; Nelson and Morris 1994). Past selective logging in the forest tended to be less destructive. Current 'clearfelling' or 'shelterwood' techniques remove virtually all the older trees. Leaving scattered 'habitat' trees in logged areas will not solve the problem as these are especially prone to collapse within a few years after logging. This is due to damage done to their bases during the intense regeneration fires and because of exposure to high winds when the surrounding trees are remove (Lindenmeyer 1992). The cutting of dead standing trees for firewood adds to the problem as dead trees readily form hollows.

In addition to the loss of tree hollows the loss of large mature trees in the Wombat Forest is likely to have had other more subtle effects (eg Scotts 1991). Dead wood provides a food source for a range of fungi and insect and in turn birds, reptiles and mammals which feed on them. Forests with large trees produce more nectar than forests with younger trees. Nectar is a major food source in most eucalypt forests.

Many plants fail to regenerate, or regenerate poorly following intensive logging operations. During the logging operations falling trees, bulldozing and dragged trees churn the soil and flatten the understorey vegetation. Plants vary in their response to these unnatural disturbances. Some species which come back quickly from seed may become more common in the logged areas. Other species, particularly which are adapted to resprouting after disturbances appear to be particularly disadvataged. After natural disturbances such as wildfire these plants such as tree-ferns readily resprout. However in intensive logging operations such as occurs in the Wombat Forest they are mostly uprooted and crushed largely preventing their resprouting as would occur after a fire (Ough and Ross 1992).

It should be emphasised that the unnatural changes caused by intensive logging operations are in no way related to the changes in vegetation caused by fire (Gill 1975; Lindenmayer et al. 1990). Fire is a natural disturbance to which all animals and plants in Australian

eucalypt forests are adapted.

3. Fauna- Overview and Recommendations

3.1 Methods

Studies on the vertebrate fauna (reptiles, frogs, mammals, birds and fish) of the Wombat Forest have been restricted to studies of the use of hollows and nest-boxes by birds and mammals (Golding 1979; Calder et al. 1979) and the study of the effects of fire (Tolhurst et al. 1992).

No authorative complete list is available of vertebrate animals in the forest. Two lists that are available are given in Appendix 1. They probably list the great majority of species found in the Wombat Forest. The first list, from the Atlas of Victorian Wildlife provides a reliable source of records. However, the data is collected from latitudinal and longitudinal blocks of country. It therefore would include some records from areas adjacent but not in the Wombat Forest. The second list, an undated list prepared by the then Department of Conservation , Forests and Lands lists some species which are very unlikely to occur in the forest. This list cannot be regarded as being completely reliable.

To determine the location and abundance of animals within the Wombat Forest extensive discussions were held with a number of experienced local naturalists. In addition the location of some species was determined from records of the Victorian Wildlife Atlas. Management recommendations where possible were derived from existing DCNR recommendations from other regions (eg DCNR 1995b) and from the current scientific literature. Published information is not available on the habitat requirements of some species. In these instances professional opinions were obtained from recognised experts on the species in question.

Note that this report covers only vertebrate animals. Too little is known about any of the invertebrate animals (eg insects, spiders, crayfish) in the Wombat Forest to make any useful management recommendations.

3.2 Overview

Approximately 200 species of vertebrates (mammals, birds, reptiles, fish and amphibians) are known from the Wombat Forest (Victorian Wildlife Atlas). The forest is of biogeographic interest as it lies on both the north-south and east-west divides between the drier forests and grasslands of western and northern Victoria and the wetter types of forest typical of southern and eastern Victoria. 'Wet Forest' species at the western edge of their range include the Mountain Brushtail Possum, Greater Glider, Olive Whistler, Red-browed Treecreeper and possibly Leadbeater's Possum. The drier northern part of the forest includes areas of Box Forest which has some species not found in the Messmate-Candlebark-Peppermint forests that make up most of the Wombat Forest.

The Wombat Forest is habitat for a number of species which are threatened throughout Victoria (DCNR 1995a). It also has a number of species likely to be of local and regional significance.

3.3 Conservation recommendations for specific species

The following species were listed as target species because they are threatened nationally or in Victoria or are particularly sensitive to woodchipping and logging operations because of their habitat requirements.

Wedge-tailed Eagle
Square-tailed Kite
Masked Owl
Barking Owl
Powerful Owl
Swift Parrot
Tiger Quoll
Tuan (Brush-tailed Phascogale)
Leadbeater's Possum

Specific conservation guidelines for these species are given below. Included are relevant details on the ecology of the species and how they may be effected by woodchipping and logging operations. For lesser known species a brief description of the animal is also included. In some cases there is a need for the exclusion of woodchipping and logging from specific areas. In other cases specific management practices need to be applied throughout the forest.

There are three lists of threatened species which are relevant to to this study.

* The Commonwealth's Endangered Species Act lists species as 'Endangered' or 'Vulnerable' at a National level (ESP Act 1992).

* The Victorian Flora and Fauna Guarantee Act lists threatened species (FFG Act 1988). This may provide legislative protection for listed species.

* The Department of Conservation and Natural Resources list of threatened species lists species in the different threat categories of Endangered, Vulnerable, Rare and Insufficiently Known (DCNR 1995a). Details of each threat category are given in Appendix 2. This is the official list of rare and threatened animal species in Victoria produced by the Department of Conservation & Natural Resorces. However the list does not provide legislative protection from any threatening activities.

Birds

Wedge-tailed Eagle

The Wedge-tailed Eagle is not listed as threatened in Victoria. However, it exists in low densities and is particularly susceptible to disturbance while nesting or preparing to nest (N. Mooney, Tasmanian Wildlife Department, personal communication). Nests of the species need to be protected. Even apparently slight disturbance such as people walking near the nest may prevent the birds from successfully nesting. The management practices indicated here are those developed from the very detailed studies done in Tasmania to protect Wedge-tailed Eagles from logging operations.

During this study three nest-sites have been mapped in the Wombat Forest.

Management required: A permanent buffer of 10 hectares around known nests. The 10 hectares should include all areas (if any) that are uphill from the nest. In addition no works should be conducted within 250m of the nest site during the breeding season July-December. To discourage disturbance, nest sites should not be publicised. These prescriptions are based on those successfully applied in Tasmania where management for this species is most advanced (N. Mooney, Tasmanian Wildlife Department, personal communication).

The location of these sites will be shown to the appropriate land managers but they will not appear on the maps attached to this report.

Square-tailed Kite

The Square-tailed Kite is listed as Vulnerable (DCNR 1995a). It is a medium-sized long-winged hawk. It typically is seen gliding just above the canopy in forest and woodland. They snatch most of their prey from the branches and foliage of trees. They mostly take small birds (particularly nestlings) and insects. In Victoria they are a summer migrant arriving in the spring and leaving in autumn. They tend to be faithful to particular areas returning to them each year (Hollands 1984). The size of a territory required for a pair of breeding birds is unknown. Debus and Silviera (1989) calculated that pairs are typically 35-40 km apart suggesting the species exists at the very low density of one pair per 1200 square km. It's highly threatened status means that a strong precationary approach is required. The species bird has been regularly recorded near Blackwood in recent years and is known to breed there. It has been occasionally recorded elsewhere in the forest.

Management required: 500 ha of 'non-treated' forest for each known breeding pair or area where birds are regularly reported. Non-treated forest is forest that has not been subject to 'shelterwood 1' or 'shelterwood 2' logging operations. Shelterwood operations are clearfell operations that occur over two stages. 'Non-treated' forest is used instead of 'mature' forest as the great majority of the Wombat Forest has few or no mature trees due to past selective logging operations that occurred prior to the introduction of shelterwood practices.

Swift Parrot

The Swift Parrot is listed as nationally vulnerable under the Federal Endangered Species Act (ESP Act 1992). It is listed as Vulnerable in Victoria (DCNR 1995a) and is listed under the Flora and Fauna Guarantee. Swift Parrots breed in Tasmania in the summer and migrate to mainland Australia in autumn and winter. While on the mainland they are nomadic, moving around to find the richest sources of eucalypt nectar and lerps (the sugar secretion of some insects). Their principal habitat on the mainland is Box-Ironbark forests (Emison et al. 1984).

There are several records of Swift Parrots from in an near the Wombat Forest especially the northern drier Box Forests. The bulk of the Wombat Forest is likely to be marginal habitat which is only occasionally used by the species.

Management required: Continuation of policy of no shelterwood treatment of Box type forests in the northern part of the Wombat forest.

Powerful Owl

The Powerful Owl is listed as Rare in Victoria (DCNR 1995a). It is listed under the Flora and Fauna Guarantee. This owl is similar but much larger than the closely related Barking and Boobook Owls. It preys mostly on possums and gliders, particularly Common Ring-tailed Possums, Greater Gliders and Sugar Gliders. Like the other owls listed below breeding pairs of Powerful Owls have permanent or semi-permanent territories which they defend from other owls of the same species. Because a successful breeding pair requires large numbers of possums and gliders each year each breeding pair requires very large territories (refer to references in Appendix 3).

There has been considerable debate over the status and requirements of this species in the Wombat forest. Some land managers in DCNR have argued that only 400 ha of forest is required for pairs of Powerful Owl in the Wombat Forest. To assess the density of possums and therefore better judge the requirements for the Powerful Owl we assessed the density of possums by spotlighting throughout the Wombat Forest. The results and conclusions of this are given in Appendix 3. The management recommendations presented here are based on this spotlighting results and the recommendations made previously by experts on the species.

Powerful Owls are regularly recorded at five sites in the Wombat Forest.

Management required: 800 ha of non-treated forest for each breeding pair or area where the species is regularly recorded. If part of the available area *has* to be areas that have had previous shelterwood treatment then twice the area of such treated forest should be reserved. See Appendix 3 for further details.

Masked Owl

The Masked Owl is listed as Rare in Victoria (DCNR 1995a). It is listed under the Flora and Fauna Guarantee. It is a large owl which closely resembles the smaller and more common Barn Owl. It is usually found in open forest and in adjacent heathland and on the edges of paddocks. It feeds mostly on ground-living and arboreal (tree-living) mammals such as rats, rabbits, bandicoots and small possums and gliders (Hollands 1984).

There are no recent confirmed reports of the Masked Owl from the Wombat Forest. However, it is possible that the species may be a resident, or become resident in the forest as the forest is rehabilitated.

Management required: 500 ha of non-treated forest for each known breeding pair or area where birds are regularly reported (DCNR 1995b).

Barking Owl

The Barking Owl is listed as Rare in Victoria (DCNR 1995a). It has been recommended for listing in the Flora and Fauna Guarantee. This medium-sized owl is similar to the smaller and more familiar Boobook Owl. The Barking Owl is usually found in drier forests and forest edges such as in the 'Box' type eucalypt country. It feeds on a range of small mammals and birds (P. Peake, zoologist with Ecology Australia Pty. Ltd., personal communication. Mr. Peake is a recognised expert on the species in Victoria).

The only reliable record in the Wombat Forest is from the dry Box forest in the north-west

of the forest. Here a bird or birds has been regularly reported.

Management required: 200 ha of non-treated forest for each known breeding pair or area where birds are regularly reported (P. Peake, personal communication)..

Tiger Quoll

The Tiger Quoll (Spot-tailed Quoll) is listed as vulnerable (DCNR 1995a). It is listed as threatened under the Flora and Fauna Guarantee. The Tiger Quoll is a powerful marsupial predator the size of a large cat. It is the largest marsupial carnivore on the Australian mainland. The species has declined considerably and is now absent from much of its former range. Tiger Quoll's feed on small mammals, birds and insects. They are found in many different forest types (Belcher 1995; Menkhorst 1995).

The single record of the Tiger Quoll is from the eastern part of the forest. xx two records in 1992. Further work would be needed to determine if they are resident in this area or elsewhere in the forest.

Management required: 500 ha of non-treated forest at each site where they have been recorded (DCNR 1995b).

Tuan (Brush-tailed Phascogale)

The Tuan is listed as Rare (DCNR 1995a). It is listed under the FFG. The Tuan is a small grey marsupial the size of a small kitten. It forages mostly mostly on insects caught on the bark of trees. It also occasionally feeds on nectar and small birds and mammals. It nests in tree hollows during the day. Tuan's have large home ranges relative to their size. In Victoria females have home ranges of around 40 hectares, while males have home ranges greater than 100 ha. Research in Box-Ironbark forests in Victoria has shown that they prefer foraging in larger trees and on dead wood- either dead branches or standing dead trees (Traill and Coates 1993). A crucial resource in the Wombat Forest is likely to be hollows suitable for breeding. Breeding females prefer hollows with large chambers and narrow entrances (Soderquist 1993). Tuan are particularly susceptible to local extinction due to their naturally low densities and because all males die at the end of their first year. If an isolated population is to persist, some juvenile males must be successfuly raised in every year to serve as sires.

Tuans have been recorded from a number of sites in the Wombat Forest. The Wildlife Atlas records show that there have been few reported records of Tuans in the last few years. This may indicate a worrying trend of a reduction of the species numbers in the Wombat Forest.

Management required: Protection of five blocks of non-treated forest of at least 600 ha in size. Each of these could support between 5 and 10 breeding females. These areas can be part of areas excluded for other species. In addition, a strictly enforced rule of no cutting of any standing dead tree or any tree with an existing hollow.

Leadbeater's Possum

Leadbeater's Possum is listed as threatened nationally under the Federal endangered species act (ESP Act 1992). Also listed as Endangered in Victoria (DCNR 1995a) and listed under

the Flora and Fauna Guarantee. Leadbeater's Possum is a small agile possum with particular habitat requirements. Leadbeater's Possum was recorded in late 1994 from Slatey Creek near the Calder Highway, aproximately two kilometres east of the Wombat Forest.

During fauna surveys on a proposed freeway route a tuft of hair was found. This has been confirmed by DNA analysis as definitely being a Leadbeater's Possum (Larwill et al. 1995). The find is a major range extension for the species. Since its rediscovery in the 1960's Leadbeater's Possum had previously only been recorded from Mountain Ash forests of the Victorian Central Highlands, in Snow Gum vegetation at Lake Mountain in the Central Highlands and in Mountain Swamp Gum Forest in Yellingbo State Nature Reserve near Woori Yallock in the foothills of the Central Highlands (Lindenmayer and Possingham 1994).

While surveying the Wombat Forest it became apparent that there are extensive areas of Swamp Gum (*Eucalyptus ovata*) habitat in the central and western parts of the forest. Many of these areas of Swamp Gum are similar to the Slatey Creek site where the Leadbeater's Possum hair was found. The habitat is potentially suitable for Leadbeater's Possum. The details of these sites and the likelihood of their supporting Leadbeater's Possum are discussed in detail in Appendix 4.

Management required: There is an urgent need to properly survey for Leadbeater's Possum in the apparently suitable Swamp Gum habitat in the western and central parts of the Wombat Forest.

Until the presence of Leadbeater's Possum can be confirmed, or it's absence reasonably inferred, there should be no woodchipping or logging operations within a 30m buffer of likely habitat in Swamp Gum and any dense gully vegetation which has a similar structure.

3.4 General Recommendations

Fauna Survey

Current knowledge of the fauna of the Wombat Forest lies largely with the observations of local field naturalists. In many cases the naturalists consulted for this report have detailed knowledge of the distributions and the habitat requirements of particular species. However, the distribution and the requirements of many species remain poorly known. The recent finding of Leadbeater's Possum just outside the Wombat Forest indicates that even vertebrate species may remain unknown in the forest.

A comprehensive flora and fauna survey is needed to address these gaps in knowledge and to ensure that current logging and woodchipping operations are not unwittingly destroying areas with rare species or with other high conservation values.

Management required: A comprehensive flora and fauna survey of the Wombat Forest. The 'pre-logging' surveys formerly conducted by the Department of Conservation & Natural Resources provide an useful model on how such a survey could be conducted.

Hollow dependant species.

Due to past forestry practices tree hollows are now rare in the Wombat Forest. As discussed earlier in this chapter hollows are a key resource for hollow-dependant animals.

The lack of hollows in the Wombat Forest is likely to severely effect not only some threatened species such as those listed above but also many other species which require the hollows for roosting or nesting. For example Greater Gliders and the Mountain Brushtail Possum (note this is a different species to the Common Brushtail Possum familiar to most people) now appear to be rare and localised in the Wombat Forest. They appear to be concentrated in areas which retain some mature trees. These species are not threatened in Victoria but the regionally significant populations in the Wombat Forest may be at risk from extinction if current intensive logging continues to damage and fragment their preferred habitat of mature forest.

Most hollows occur in mature trees and in dead trees. Mature trees begin to from hollows as the tree crowns mature and branches break off. Fungi and termites enter the tree, destroying the heartwood and causing hollows to form. Different species of trees vary in their propensity to form hollows. Some species will tend to form hollows at a younger age (and consequently smaller size) than other species. The same processes occur rapidly in dead trees of all sizes as dead wood is less resistant to rot. With both mature live trees and dead trees, bigger trees are more likely to form hollows suitable for animals, particularly the larger animals such as owls and large possums and gliders.

Management required:

(i) retention of *all* standing dead trees, with rigorous enforcement to prevent illegal removal by firewood cutters

(ii) retention of *all* trees with a visible hollow, this to be assessed by forest officers trained to identify hollows

(iii) retention of *all* trees greater than 150 cm diameter at breast height

Streams and streamside vegetation

The riparian vegetation (streamside and gully vegetation) within the Wombat Forest is crucial as habitat for many animal species.

The quality of the riparian vegetation effects the quality of the water in streams and therefore the habitat of aquatic animals. A range of studies have demonstrated that water quality is directly effected by logging operations, particularly clearfelling operations where bare earth is exposed (eg. Davies & Nelson 1994). Water running off the bare earth causes silt to be dumped into the streams. This muddies the water and deposits silt on the floor of streams. A number of fish and aquatic invertebrates are effected by this. The silt on the bed of the stream smothers fish eggs and insects (Davies & Nelson 1994; Grouwns & Davis 1994).

The most recent research shows that a unlogged buffer strip along streams of at least 30m is needed to trap silt running off logging coupes and therefore preventing it entering streams (Davies & Nelson 1994).

The riparian vegetation is also important for some terrestrial animals. The riparian vegetation is typically the richest part of the forest for birds and mammals. Riparian vegetation is lusher as it receives more water and typically has richer alluvial soils than the adjacent ridges. Some animal species are likely to be found only or mostly in riparian vegetation (eg Bush Rat, Swainson's Antechinus). Others are found in the highest densities in riparian vegetation (eg Common Ringtail Possum, Red-browed Treecreeper)

(Tolhurst et al. 1992; B. Traill personal observations)

Management required:

(i) 30m buffer from the edge of all alluvial flats. Note that this is measured from the boundary of the flat not from the edge of the stream itself. For example the Werribee River at Carroll's Crossing has formed an alluvial flat approximately 30m wide. The stream itself takes up only about 5m of this. The area protected would be 30m from where the hill slope meets the alluvial flat on each side of the stream. In total a 90m strip would be formed.

(ii) 30m buffer from the side of all gullies where there is distinct riparian vegetation. This would include all intermittent streams.

Table 1. Spotlighting results

a. Non-treated forest

Time spent spotlighting:	7 hours and 42 minutes
Number of arboreal mammals recorded (No. per hour of spotlighting)	
Common Ringtail Possum:	27 (3.64 per hour of spotlighting)
Common Brushtail Possum:	1 (0.13 per hour of spotlighting)
Greater Glider:	7 (0.94 per hour of spotlighting)
Koala:	1 (0.13 per hour of spotlighting)
Unidentified large possum:	1 (0.13 per hour of spotlighting)
Total:	37 (4.98 per hour of spotlighting)

b. Shelterwood 1

Time spent spotlighting:	1 hour and 57 minutes
Number of arboreal mammals recorded (No. per hour of spotlighting)	
Common Ringtail Possum:	1 (0.63 per hour of spotlighting)
Unidentified large possum:	1 (0.63 per hour of spotlighting)
Total:	2 (1.26 per hour of spotlighting)

c. Shelterwood 2

Time spent spotlighting:	1 hour and 14 minutes
Number of arboreal mammals recorded (No. per hour of spotlighting)	
Sugar Glider	1 (0.87 per hour of spotlighting)
Total:	1 (0.87 per hour of spotlighting)

Common Ringtail Possums were the most common mammal spotlighted. They were noticeably concentrated in gullies, with only 4 of the Common Ringtail Possums being observed more than 30m from distinct gullies or valleys. Six of the seven Greater Gilders observed were seen in a block of forest with many mature trees near Carroll's Crossing. The seventh was observed near a gully line in the Bullarto block. The single Common Brushtail Possum and the single Koala that were observed were also in gully vegetation. The single Sugar Glider was observed on the edge of Shelterwood 2 vegetation adjacent to non-clearfelled forest.

The results indicate that arboreal mammals are concentrated in forest which had not been subject to shelterwood treatment. Within such forest possums were concentrated in gully vegetation and in the few areas which have substantial numbers of mature trees remaining. This is not surprising. Most of the arboreal mammals found in the forest require tree hollows for shelter. The exceptions are the Common Ringtail Possum and Koala. Koalas are too large to be taken by Powerful Owl except for the possibility of rare captures of juvenile animals.

The Common Ringtail Possum is likely to be the major prey item for Powerful Owls in the Wombat Forest (from analysis of pellets from the Powerful Owl pair in the Bullarto Block). It could be argued that as clearfelled areas regrow they could form suitable habitat for high densities of Common Ringtail Possums. This possum is common in some dense habitats in other regions such as in tea-tree thickets (Pahl 1984). However, the spotlighting in this study found no Common Ringtail Possums in dense logging regrowth of up to 10 years of age. The single Common Ringtail Possum observed in a sheterwood treated area was in a 'shelterwood 1' area and was in one of the remaining uncut older trees. The available evidence indicates that areas that have been logged intensively in shelterwood treatment will provide negigible numbers of prey for Powerful Owls. Unless more detailed research shows otherwise management prescriptions should be based on the assumption that areas that have been felled for shelterwood provide provide only very poor quality habitat for Powerful Owls, until the structure of the forest begins to mature. This would take at least several decades.

The most work on densities of arboreal mammals in similar forest types has been done in East Gippsland (Ecological survey reports for East Gippsland completed by Department of Conservation & Environment). Overall densities of favoured Powerful Owl prey are towards the lower end of the range of densities of arboreal mammals found in these surveys. As noted above the current prescriptions for Powerful Owls are for 800 ha of mature forest in East Gippsland. The great majority of the Wombat Forest is likely to have lower densities of arboreal mammals than in most of the East Gippsland forests. This is almost certainly due to past logging practices which have removed most mature trees.

The low number of prey means that an area of 800 ha that has not been subject to shelterwood treatment is an absolute minimum for providing areas adequate for breeding Powerful Owls. This should comprise as much as possible areas of streamside and gully vegetation and areas which retain some mature trees. Where a distinct block of forest that has not had shelterwood treatment is not available then the available forest should be utilised with the addition of twice as much area of shelterwood treatment to make up the balance. For example if only 500 ha of non-treated forest is available at an owl site this should be reserved, with the addition of 600 ha of shelterwood treated area to make up the balance (300 ha x 2).

As the areas of protected forest mature over a period of several decades the densities of arboreal mammals will increase to their former natural densities. It may then be possible to to reduce the size of the areas reserved for Powerful Owls.

Appendix 1. Lists of animal species from the Wombat Forest.

(Note the comments made in the text on the accuracies of these lists)

Appendix 2. List of Threatened species categories (DCNR 1995a).

The categories and definitions used to describe the threatened status of fauna included on the list are largely based on those developed by the World conservation Union and are defined as follows:

Threatened: a collective term used to denote taxa that are **Extinct, Endangered, Vulnerable, Rare** or **Insufficiently Known**, or have **Restricted Colonial Breeding or Roosting Sites.**

Extinct: taxa that are considered to have occurred in Victoria since European settlement but that have not definitely been recorded in the wild in Victoria in recent decades, and almost certainly no longer occur there (note that 'taxa are species, sub-species or other distinctive and defined groups of animals).

Endangered: taxa in danger of extinction in Victoria and whose survival is unlikely if the factors causing their decline continue operating. Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Vulnerable: taxa believed likely to move into the Endangered category in the near future if the factors causing their decline continue operating. Included are taxa of which most or all of the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured; and taxa with populations that are still common but are under threat from severe adverse factors throughout their range.

Rare: taxa with small Victorian populations that are not at present Endangered or Vulnerable but are at risk. These taxa are usually localised within restricted geographical areas or habitats or are thinly distributed over a more extensive range.

Insufficiently Known: taxa in Victoria that are suspected but not definitely known to belong to any of the above categories because of lack of information.

Restricted Colonial Breeding or Roosting: taxa that may be common but have only a few colonial breeding or roosting sites in Victoria and consequently may be at risk when many individuals gathered together, through loss of a significant part of the adult population or the young of the year.

In practice, Endangered and Vulnerable categories may include species whose populations are beginning to recover as a result of remedial action, but whose recovery is insufficient to justify their transfer to another category.

Appendix 3. Requirements for Powerful Owl in the Wombat Forest.

The Powerful Owl population in Victoria is estimated to comprise fewer than 1000 pairs of birds (C.Silveira quoted in Lobert et al. 1991). The major prey item of Powerful Owls are arboreal mammals particularly Common Ringtail Possums and Greater Gliders (Fleay 1968; Seebeck 1976; Van Dyck and Gibbons 1980; James 1980; Schodde and Mason 1980; Tilley 1982; Kavanagh 1988; Pavey 1993; Traill 1993; Lavazanian et al. 1994). Fruit-bats may form a major prey item when they are present in large colonies such as around Brisbane and in the Melbourne Botanic Gardens (P. Peake, zoologist, Ecology Australia Pty. Ltd., personal communication). Other mammals regularly eaten include Sugar Gliders, Common Brushtail Possums, Brush-tailed Phascogales and Antechinus spp. Large birds are also taken, particularly Magpies, Currawongs, Ravens, Kookaburras and large parrots. The owls need very large and deep tree hollows to nest in (Schodde and Mason 1980).

Approximately 800 to 1000 ha of mature forest is estimated to be the typical area required by a breeding Powerful Owls (Seebeck 1976; Schodde and Mason 1980; DCNR 1995b). A breeding pair of Powerful Owls will take between 200 and 300 prey per year (Schodde & Mason 1980). For the owls not to wipe out their prey entirely from an area a large block of forest is required.

The Department of Conservation & Natural Resources has proposed that 400 ha of forest be retained for each Powerful Owl territory in the Wombat Forest (R. Humphries, DCNR Flora & Fauna planner, personal communication). This area is significantly smaller than that required in East Gippsland where 800 ha of mature forest is the standard prescription which has been set by the Dept. Conservation & Natural Resources.

After public criticism of the this figure some officers in the Department of Conservation & Natural Resources justified the figure on the basis that:

1. A pair of Powerful Owls was present in Mt. Bolton, a small remnant of bush to the west of the Wombat Forest and that;

2. Powerful Owls have been present at times in the Melbourne Botanic Gardens.

These arguments do not provide any adequate justification for the use of a 400 ha figure for the species in the Wombat Forest. The author examined the site at Mt. Bolton. It is different to any habitat found in the Wombat Forest. The forest at Mt. Bolton is mostly mature Manna Gum forest. It has granitic soils likely to be more fertile than the mostly infertile sedimentary soils in the Wombat Forest. Manna Gum forests are noted for usually high densities of possums and gliders and the area has high densities of mature trees with tree-hollows. The area is likely support high populations of arboreal mammals. Furthermore, there appears to have been no confirmed successful breeding of the birds at Mt. Bolton by local naturalists who monitored the birds in the area (G. Cheers, Maryborough Field Naturalist, personal communication).

The observations of Powerful Owl in the Melbourne Botanic Gardens was of a lone bird which stayed for about 18 months (P. Peake, zoologist, Ecology Australia Pty. Ltd., personal communication). The bird did not maintain a long-term territory in the area, did not attract a mate and did not breed. One of its principal prey items was Grey-headed Flying-foxes taken from the large colony in the Gardens. Such a concentrated supply of prey is not available in the Wombat Forest. The short-term presence of the owl at this site

provides no basis for determining management prescriptions for Powerful Owls in the Wombat Forest.

It needs to be emphasised that the simple presence of Powerful Owls (or of many other animal species) in the Wombat Forest or in other areas cannot be taken to imply that the habitat is suitable for breeding territories. Some areas of apparently suitable habitat for a species may in fact be 'sinks' to which dispersing juveniles settle but do not breed. Such habitats can maintain individuals but they are too poor to support successful breeding. The populations in the sinks are maintained by continued migration of juvenile animals from breeding habitats. The sink in fact plays no part in maintaining the future viability of the species. The mere presence of individual animals can provide the illusion that an area is suitable habitat for the species. This may be the case for some or all of the Powerful Owls currently present in the Wombat Forest.

The estimate of Powerful Owl home ranges of 800-1000 ha is based on the assumption of relatively high densities of arboreal mammals (3.2 per ha, Seebeck 1976). The area required for a breeding pair will vary from site to site depending on the density of prey in a particular area and the reproductive rates of those prey.

In places near Melbourne such as at One-Tree Hill near Warrendyte there are pairs of Powerful Owls successfully breeding in blocks of bush that are only several hundred hectares in size. However, it is not known whether the owls move into adjacent blocks of forest to forage. Also, these forest types are noted for their very high densities of Common Ringtail Possum, a favoured prey item (Traill personal observation). The fact that Powerful Owls live and breed in blocks of bush such One-Tree Hill cannot be automatically taken to imply that areas of the same size in the Wombat Forest will supply adequate prey.

Spotlighting results.

To obtain some estimate of the density of Powerful Owl prey in the Wombat Forest I carried out spotlighting for arboreal mammals within the forest. Spotlighting was carried out on foot along minor forest roads using 30 watt spotlights. The amount of time spent spotlighting in different habitats was recorded and the habitat in which arboreal animals were observed was recorded. This was classed initially as either 'non-treated'- areas that had not been subject to shelterwood practices, 'shelterwood 1'- areas that had the first cut of the clearfelling operation and 'shelterwood 2'- areas that that the second cut of the clearfelling operation. Note that virtually all areas of non-treated forest have been subject to selective logging operations since European settlement. In most cases these areas have few or no mature trees with hollows. Areas were selected haphazardly to include a range of different areas of Messmate-Candlebark-Peppermint forest. The only area specifically selected was the area at Carroll's Crossing which was known to be the area with the largest remaining number of mature trees. No areas where chosen in the western parts of the forest that had been burnt in the 1983 fires. Spotlighting was carried out by the author and by members of the Monash University Biological Society. The results are shown in Table 1.

Appendix 4. Information on Leadbeater's Possum in the Wombat Forest area.

After the finding of the Leadbeter's Possum hair Larwill et al. (1995) conducted an intensive survey for Leadbeater's Possum in the Slatey Creek area. However, they found no more evidence of the species. From the information available to them they concluded the Slatey Creek catchment was likely to support a resident population of Leadbeater's Possum but that the species was likely to be extremely rare in the area. They did suggest that an alternative source of the hair was that it come from a population near to Slatey Creek. In this instance, the hair could have been either transported by a predator or come from a vagrant Leadbeater's Possum which had moved into the Slatey Creek area.

Larwill et al. suggested that suitable habitat was present in the high mountain forests on Mount Macedon to the east of Slatey Creek. However, they were apparently unaware of the similar habitat to that in Slatey Creek which occurs to the west in the Wombat Forest.

Slatey Creek had two communities which Larwill et al. (1995) suggested were suitable habitat for Leadbeater's Possum: Swamp Gum Riparian Woodland and Manna Gum Riparian Forest.

To determine if potentially suitable habitat was present in the Wombat Forest the author visited a number of creeks in the eastern part of the Wombat Forest. The vegetation of these creeks was compared with that found at Slatey Creek.

Several creeks in the upper Campaspe River and the northern part of Saltwater Creek were visited. Swamp Gum Riparian Woodland was found that was similar to that found at Slatey Creek These sites are listed below (Table 1). All the sites visited had hollow-bearing trees. In all cases the sites visited had been burnt in the 1983 fire. The regrowth eucalypts formed a dense well-connected canopy. The presence of hollow-bearing trees and a dense canopy appear to be the key features of Leadbeater's Possum habitat in the population which has been studied in the Swamp Forest at Yellingbo in the Central Highlands (D. Harley, zoologist, Monash University, personal communication).

Table 1. Areas examined that had potential Leadbeater's Possum habitat

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1. Upper reaches Campaspe River- areas where Campaspe River tributaries cross Campaspe Rd.

2. Firth Park on Firth Rd.

3. Northern reaches of Saltwater Creek on Fingerpost Rd.

In addition to these sites an extensive area with unburnt Swamp Gum was observed on the upper reaches of Coliban River. The canopy was well connected and it is possible that this may also be suitable Leadbeater's Possum habitat.

The sites listed in Table 1. lay in areas of flat or gently undulating topography. The gullies were mostly shallow and broad and often had ill-defined stream beds. In some cases the Swamp Gum Riparian Woodland formed sections 30-40m across the water courses. Areas

with similar topography, soils and aspect occur in other stream systems throughout the eastern part of the Wombat Forest that were not visited during this study. It is likely that the riparian vegetation in these areas is similar to that observed at the sites that were visited.

The network of streams in the eastern part of the Wombat forest form large areas of Swamp Gum Woodland which are potential Leadbeater's Possum habitat. It was beyond the scope of this study to measure the amount of the habitat but it appears from the inspections made that hundreds of hectares of potentially suitable habitat may exist. This could form a area of habitat potentially capable of supporting a population of Leadbeater's Possum for some time as has occurred in the Mountain Swamp Gum Forest at Yellingbo in the Central Highlands.

Whether Leadbeater's Possum does occur in the area requires detailed survey work carried out or co-ordinated by an experienced naturalist or professional biologist.

References

Belcher, C. 1995. Diet of the Tiger Quoll *Dasyurus maculatus* in East Gippsland, Victoria. *Wildlife Research*, **22**, 341-358.

Calder, T. Golding, B. and Anderson, A. 1979. *Management for arboreal species in the Wombat State Forest*. Environmental Report Number 16. Graduate Schoool of Environmental Science, Monash University.

DCNR, 1995a. *Threatened fauna in Victoria - 1995*. Department of Conservation and Natural Resources, Victoria.

DCNR, 1995b. *East Gippsland Forest Management Area, Proposed Management Plan*. Department of Conservation and Natural Resources, Melbourne.

Debus, S. and Silveira, C. 1989. The Square-tailed Kite *Lophoictinia isura* in Victoria. *Australian Birdwatcher*, **13**, 118-123.

Davies, P. and Nelson, M. 1994. Relationships between riparian buffer widths and the effects of logging on stream habitat, invertebrate community composition and fish abundance. *Australian Journal of Marine and Freshwater Research* **45**: 1289-305.

Emison, W.B., Bearsell, C.M., Norman, F.I., Loyn, R.H. and Bennett, S.C. 1987. *Atlas of Victorian Birds*. Dept. Conservation, Forests & Lands and R.A.O.U., Melbourne.

ESP Act, 1992. The Commonwealth Endangered Species Act, Commonwealth Government, Canberra.

FFG Act, 1988. *The Flora and Fauna Guarantee Act*, Victorian Government, Melbourne.

Fleay, D.H. 1968. *Nightwatchmen of Bush and Plain. Australian owls and owl-like birds*. Jacaranda Press, Brisbane.

Gill, A.M. 1975. Fire and the Australian biota: a review. *Australian Forestry* **38**: 4-25.

Golding, B. 1979. *Use of artificial hollows by mammals and birds in the Wombat Forest, Daylesford, Victoria*. M.Env.Sc. thesis (unpublished), Environmental Science, Monash University.

Grouwns, I. and Davis J. Effects of forestry activities (clearfelling) on stream macorinvertebrate fauna, south-western Australia *Australia Journal of Marine and Freswater Research*, **45**: 963-975.

Hollands, D. 1984. Eagles, Hawks and Falcons of Australia. Nelson, Melbourne.

James, J.W. 1980. Food of the Powerful Owl *Ninox strenua* in south-eastern Queensland. *Emu* **80**: 34-35.

Kavanagh, R.P. 1988. The impact of predation by the Powerful Owl *Ninox strenua* on a population of he Greater Glider *Petauroides volans*. *Australian Journal of Ecology* **13**, 445-450.

Larwill, S., Brown, D. and Williams, L. 1995. *Flora and Fauna Assessment of the Calder Highway- Black Forest Section, Victoria*. Stage 3. Supplement No. 3, Survey for Leadbeater's Possum. Report prepared by Biosis Pty. Ltd for Vicroads.

Lavazanian, E., Wallis, R. and Webster, A. 1994. Diet of Powerful Owls *Ninox strenua*, living near Melbourne, Victoria. *Wildlife Research* **21**, 643-646.

Lindenmayer, D.G. 1992. The ecology and habitat requirements of arboreal marsupials in the montane ash forests of the Central Highlands of Victoria: a summary of studies. *VSP internal report No 6*. Dept. Conservation and Environment, Victoria.

Lindenmayer, D.B. and Possingham, H. 1994. *The risk of extinction: Ranking management options for Leadbeater's Possum using Population Viability Analysis*. Centre for Resource and Environmental Studies, Australian National University, Canberra.

Lindenamyer, D.B., Norton, T.W. and Tanton, M.T. 1990. Differences between wildfire and clearfelling on the structure of montane ash forests of Victoria and their implications for fauna dependent on tree hollows. Australian ForesMackowski, C. 1984. The ontogeny of hollows in Blackbutt (Eucalyptus pilularis and its relevance to the management of forests for possum, gliders and timber. Pp. 553-67 in *Possums and Gliders* ed. by A.P. Smith and I.D. Hume. Surrey Beatty and Sons: Sydney.

Lobert, B.O., Gillespie, G.R., Lunt, I.D., Peacock, R.J. and Robinson, D. 1991. Flora and fauna of the Goolengook Forest Block East Gippsland, Victoria. *Ecological Survey Report No. 35*. Dept. Conservation & Environment, Victoria.

Menkhorst, P. 1995. *Mammals of Victoria, Distribution, ecology and conservation.* Oxford University Press, Melbourne.

Nelson, J. and Morris, B. 1994. Nesting requirements of the Yellow-tailed Black-Cockatoo, *Calyptorhynchus funereus*, in *Eucalyptus regans* Forest, and implications for forest management. *Australian Wildlife Research* **21**, 267-278.

Ough, K. and Ross, J. 1992. Floristics, fire and clearfelling in Wet Forests of the Central Highlands, Victoria. *VSP internal report No. 11*. Department of Conservation & Environment, Victoria.

Pahl, L. 1984. Diet preference, diet composition and population density of the Ringtail Possum *Pseudocheirus peregrinus cooki*) in several plant communities in southern Victoria. Pp. 261-268. In *Possums and Gliders*, ed. A. Smith and I. Hume. Surrey Beatty & Sons Pty Ltd, Sydney.

Pavey, C. 1992. Impact of powerful owl predation on a population of the greater glider: a response to Kavanagh (1988). *Australian Journal of Ecology* **17**, 463-467.

Schodde, R. and Mason, I.J. 1980. *Nocturnal Birds of Australia*. Landsdowne Press, Melbourne.

Scotts, D. Old-growth forests: their ecological characteristics and value to forest-dependent vertebrate fauna of south-east Australia. In *Conservation of Australia's*

Forest Fauna, ed. D. Lunney, Pp. 147-160.

Seebeck, J. 1976. The diet of the Powerful Owl *Ninox strenua* in western Victoria. *Emu* **76**, 167-170.

Soderquist, T. 1993. Maternal strategies of *Phascogale tapoatafa* (Marsupialia: Dasyuridae) I and II. *Australian Journal of Zoology* **41**: 549-576.

Tilley, S. 1982. The diet of the Powerful Owl, *Ninox strenua*, in Victoria. *Australian Wildlife Research* **9**, 157-175.

Tolhurst, K., Flinn, D., Loyn, R., Wilson, A. and Foletta, I. 1992. *Ecological Effects of fuel reduction burning in a dry sclerophyll forest- A summary of principal research findings and their management implications*. Forest Research Centre, Dept. Conservation and Environment.

Traill, B.J. 1993. The diet and movements of a pair of Powerful Owls *Ninox strenua* in dry forest. In *Australian Raptor Studies*. ed. P. Olsen, Pp. 155-169. Australasian Raptor Association, Royal Australasian Orithologists Union, Melbourne.

Traill, B.J. and Coates, T. 1993. Field observations of the Brush-tailed Phascogale, *Phascogale tapoatafa* (Marsupialia: Dasyuridae). *Australian Mammalogy* **16**: 61-65.

Van Dyck S and Gibbons, D. 1980. Tuan predation by powerful owl. *Victorian Naturalist* **97**, 58-63.