

**Threatened hollow-dependent fauna
in Box-Ironbark forests of Victoria
Bendigo Forest Management Area**

prepared by
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for the

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1 BACKGROUND AND PROJECT BRIEF

The loss of hollow-bearing trees from native hardwood forests in Victoria has been listed recently as a potentially threatening process under the *Flora and Fauna Guarantee Act* (1988). An Action Statement is currently being drafted which describes the appropriate management strategies needed to mitigate the loss of hollow-bearing trees from the landscape (Garnett and Loyn, in prep.).

Natural tree hollows are a vital habitat component for many species of wildlife that inhabit Box-ironbark forests (Soderquist *et al.* 1994). Today, only 25% of the original Box-ironbark forest-cover remains in Victoria (Duncan, in prep.). Because of past land-use practices, no extensive areas of mature Box-ironbark now exist in Victoria (Traill 1991).

Past clearing practices, the resultant loss of topsoil, change to nutrient levels, alteration of hydrological regimes and fragmentation of habitats, further alienates wildlife populations leaving them highly susceptible to local extinction. The habitat value of the Box-Ironbark forests is under further threat as a result of the gradual decline of existing trees on agricultural properties and from factors such as increasing soil salinity.

The Bendigo Forest Management Area (FMA) encompasses a large proportion of the Box-Ironbark Ecosystem, and extends from Murchison in the east to Donald in the west; it covers approximately 1 901 460 hectares. Roughly 15 % of this is public land, managed primarily by the Department of Natural Resources and Environment (NRE). A further 2% is managed by the Commonwealth or the Victorian Plantations Corporation. (Helen Vaughan, NRE, pers. comm.) Legislated conservation reserves comprise 3.5% of the area of the FMA.

The study area supports a diverse range of native, terrestrial vertebrate species: 277 bird species, 34 mammal species, 42 reptile species and 16 amphibian species have been recorded (Atlas of Victorian Wildlife). Seventeen percent of these species are considered to be threatened in Victoria (CNR 1995). The following threatened species depend on tree hollows for their survival and are the major emphasis of this report. Although not listed as threatened in Victoria, the Tree Goanna was also included in the project brief because of its perceived vulnerability within the study area.

1. Powerful Owl (*Ninox strenua*)
2. Barking Owl (*Ninox connivens*)
3. Brush-tailed Phascogale (*Phascogale tapoatafa*)
4. Squirrel Glider (*Petaurus norfolcensis*)
5. Tree Goanna (*Varanus varius*)

The major objectives of the study were to report on the distribution and occurrence of these threatened hollow-dependent fauna within the Box-Ironbark Ecosystem, and provide faunal input into the Bendigo Forest Management Area Plan.

2 METHODS AND REPORT OUTLINE

A variety of techniques were employed to collect and collate the fauna information for the Bendigo FMA. The key methods used are outlined below.

- *Interrogation of the Atlas of Victorian Wildlife*
A complete list of faunal species for the Bendigo FMA was constructed after searching all records held within the Atlas of Victorian Wildlife database. Specific information was extracted with respect to the five threatened species.
- *Spotlight surveys*
In conjunction with other fauna research in the Box-Ironbark Ecosystem, spotlight surveys were carried out targeting the selected threatened species. Eighty sites (1 ha plot) were chosen to represent the range of ecological vegetation classes (EVC's) within the Box-Ironbark Ecosystem. A sub-set of these, (63 sites) were within the Bendigo FMA. All sites were spotlit on three occasions, twice in spring (October - November 1995) and once in autumn (May 1996). A total of 118.6 spotlight hours were expended to search all these sites systematically (Av. = 0.6 spotlight hours/census).
- *Owl surveys*
Pre-recorded tapes of five owl species (Powerful Owl, Barking Owl, Masked Owl, Southern Boobook, Tawny Frogmouth) were played immediately following the autumn spotlight census to elicit a response from local birds.
- *Interviews with NRE staff, naturalists and local community groups*
Personal interviews conducted with NRE staff, naturalists and local community groups were a useful technique for supplementing the records currently held on the Atlas of Victorian Wildlife database. Representatives from the Castlemaine, Bendigo, Maryborough and Victorian Field Naturalist Clubs were asked a series of questions in order to gain a better understanding of the conservation status and distribution of the local threatened fauna. Forest Officers, FFF Planners and Rangers from Bendigo, Inglewood, St. Arnaud and Maryborough were also consulted.
- *Advertisements*
Articles written for local newspapers, 'Out of the Box' and the Wildlife Shelter Bulletin newsletter explained the background of the study and requested information concerning the selected species. Articles were placed in local newspapers (North Central News, The McIvor Times and The Maryborough District Advertiser), hoping to identify new locality records for the Tree Goanna and the Brush-tailed Phascogale.
- *Hair-tube surveys*
Using double-sided tape within PVC tubes (hair-tubes) is an unobtrusive survey technique for determining the presence of mammalian species within an area. Ten small hair-tubes and three Faunatech Universal Hair Funnel Traps (Ross Meggs, Faunatech Wildlife Technical Consultants, pers. comm.) were placed at each of the EVC sites. The Hair Funnel incorporates a removable styrene card covered with pressure sensitive glue (Faunagoo). The small tubes were fixed to trees at intervals of 25 m and baited alternately with standard or meat mixture baits (Bob Anderson, Kinhill Consultants, pers. comm.). The Hair Funnels were pegged to the ground and baited with the meat mixture only. Both tube and funnels were left in position for approximately two weeks until retrieved, and the fur samples identified by Barbara Triggs.
- *Community spotlight weekend*
A spotlight weekend was organised at Teddington Reservoir involving 24 participants. High-quality roadside reserves, specifically selected as potential habitat for the Squirrel Glider and Brush-tailed Phascogale, were searched.

This report provides an account for each species to include:

- i. A general species overview.
- ii. Distribution and historical context.
- iii. Habitat requirements (including the importance of tree hollows for the species survival).
- iv. Records from previous studies and from current surveys.
- v. Potential threatening processes and factors affecting population viability.
- vi. Representation within conservation reserves in the Bendigo FMA. Site locality records for each species, extracted from the Atlas of Victorian Wildlife, were assigned to three broad land tenure categories (Conservation Reserve, State Forest & Freehold). Previous Land Conservation Council categories, such as Nature Conservation Reserve, State Park, Regional Park, Natural Features Reserve, Water Production, and Historical & Cultural Features Reserve were pooled into the one category, Conservation Reserve.

A synopsis for all species included in this report may be found in the Appendix.

3 SURVEY RESULTS

3.1 Spotlighting

A complete list of faunal species recorded from the Bendigo FMA during 118.6 hours of spotlighting at the 63 EVC sites is given in Table 1.

Table 1. The number of individuals recorded by the Box-Ironbark Fauna Studies Group (BIFSG) during spotlighting of the EVC sites in the Bendigo FMA. Offsite records indicate species detected outside the one ha plot, but during the spotlight census.

SPECIES		NUMBER OF OBSERVATIONS [ON-SITE]	NUMBER OF OBSERVATIONS [ON + OFF-SITE]
Common name	Scientific name		
Southern Boobook	<i>Ninox novaeseelandiae</i>	3	43
*Barking Owl	<i>Ninox connivens</i>	0	2
*Powerful Owl	<i>Ninox strenua</i>	0	1
Barn Owl	<i>Tyto alba</i>	1	1
Tawny Frogmouth	<i>Podargus strigoides</i>	5	8
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	15	59
White-throated Nightjar	<i>Eurostopodus mystacalis</i>	0	2
Short-beaked Echidna	<i>Tachyglossus aculeatus</i>	1	1
Yellow-footed Antechinus	<i>Antechinus flavipes</i>	1	1
Common Dunnart	<i>Sminthopsis murina</i>	1	1
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	59	106
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	70	100
Sugar Glider	<i>Petaurus breviceps</i>	20	27
Feathertail Glider	<i>Acrobates pygmaeus</i>	2	2
Koala	<i>Phascolarctos cinereus</i>	0	2
Black Wallaby	<i>Wallabia bicolor</i>	25	29
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	14	26
White-striped Freetail Bat	<i>Tadarida australis</i>	38	39
European Rabbit	<i>Oryctolagus cuniculus</i>	9	10
Feral Dog	<i>Canis familiaris</i>	1	1
Southern Bullfrog	<i>Limnodynastes dumerilii</i>	2	17
Striped Marsh Frog	<i>Limnodynastes peronii</i>	0	1
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	1	14
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	0	1
Plains Froglet	<i>Crinia parinsignifera</i>	5	25
Common Froglet	<i>Crinia signifera</i>	7	43
Peron's Tree Frog	<i>Litoria peronii</i>	0	7
<i>Number of individuals</i>		280	569
<i>Individuals / spotlight hour</i>		2.4	4.8
<i>Number of species</i>		20	27
<i>Arboreals / spotlight hour</i>		1.3	2.0
<i>Nocturnal birds / spotlight hour</i>		0.2	1.0

* Indicates threatened hollow-dependent species

A total of 27 species were detected during 118.6 hours of spotlighting (including offsite records). Fifty percent more individuals were recorded from outside the standard one ha plot. Two threatened species (Barking Owl and Powerful Owl) were encountered during the spotlight searches.

3.2 Owl survey

The number of each species recorded during the owl census is given in Table 2.

Table 2. The number of responses recorded by the Box-Ironbark Fauna Studies Group during the owl census of EVC sites in the Bendigo FMA. Offsite records indicate species detected outside the one ha plot, but during the owl census.

SPECIES		NUMBER OF OBSERVATIONS [ON-SITE]	NUMBER OF OBSERVATIONS [ON + OFF-SITE]
Common name	Scientific name		
Southern Boobook	<i>Ninox novaeseelandiae</i>	4	6
*Barking Owl	<i>Ninox connivens</i>	2	2
*Powerful Owl	<i>Ninox strenua</i>	0	5
Barn Owl	<i>Tyto alba</i>	1	1
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	1	1
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	1	1
Feral Dog	<i>Canis familiaris</i>	1	1
<i>Number of individuals</i>		10	17
<i>Individuals / 10 Surveys</i>		1.6	2.7
<i>Surveys</i>		63	63
<i>Total species</i>		6	7

* Indicates threatened hollow-dependent species

A breeding pair of Barking Owls was observed in the Kamarooka State Park. The Powerful Owl was recorded from Smiths Reef State Forest, Kooyoora State Park, Mt Bolangum Flora and Fauna Reserve and St Arnaud State Forest.

3.3 Hair-tube survey

The results of the hair-tube survey are presented in Table 3. Overall, there were nine taxa detected using small hair-tubes and hair funnel traps. The Sugar Glider and Squirrel Glider cannot be differentiated using hair samples, and *Sminthopsis* sp. indicates either the Common Dunnart or the Fat-tailed Dunnart. Given the habitat type where the *Sminthopsis* fur was recorded (Box-Ironbark Forest), it is more likely to be the Common Dunnart. Hair-tubes placed in trees proved to be an effective technique for detecting the presence of the Brush-tailed Phascogale.

Table 3. The total number of hair tubes from which each species was recorded by the Box-Ironbark Fauna Studies Group at the EVC sites in the Bendigo FMA. Small hair-tubes were installed on trees while hair funnel traps were located on the ground.

SPECIES		SMALL HAIR-TUBES [Trees]	HAIR FUNNEL TRAPS [Ground]
Common name	Scientific name		
*Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	20	2
Yellow-footed Antechinus	<i>Antechinus flavipes</i>	37	8
Feathertail Glider	<i>Acrobates pygmaeus</i>	2	0
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	1	4
Eastern Pygmy-possum	<i>Cercartetus nanus</i>	1	0
Sugar/Squirrel Glider	<i>Petaurus</i> sp.	5	0
Black Wallaby	<i>Wallabia bicolor</i>	0	18
unidentified Sminthopsis	<i>Sminthopsis</i> sp.	0	1
House Mouse	<i>Mus musculus</i>	3	2
<i>No. of detections</i>		78	35
<i>No. of Tubes</i>		630	189
<i>Detections / 100 Tubes</i>		12.4	18.5
<i>Survey sites</i>		63	63
<i>Total species</i>		10	6

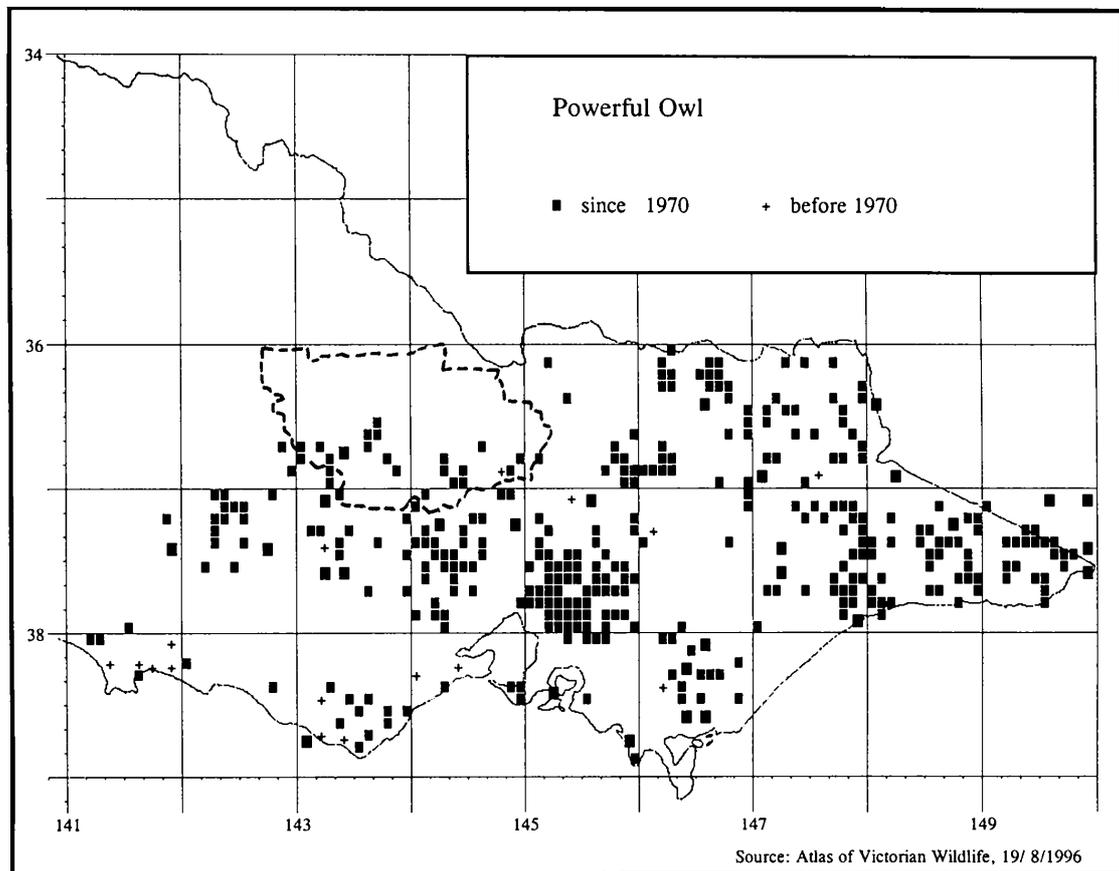
* *Indicates threatened hollow-dependent species*

4 SPECIES ACCOUNTS

4.1 Powerful Owl (*Ninox strenua*)

The Powerful Owl is the largest Hawk-Owl in Australia with a wing span in excess of one metre. It is readily distinguished by its large yellow eyes, distinctive chest barrings (or chevrons) and powerfully-built talons (Slater *et al.* 1989). The Powerful Owl has been listed as rare in Victoria under the *Flora and Fauna Guarantee Act* (1988) (see CNR 1995). It is estimated that there are fewer than 500 pairs in the Victorian population (Humphries and Webster 1996). Breeding pairs are known to have high site fidelity where a number of permanent roost and nest trees are used from one year to the next. A more detailed description of the birds' ecology is given in Schodde and Mason (1980) and Hollands (1991).

Figure 1. The distribution of the Powerful Owl in Victoria, as indicated by records of its occurrence within each 5' latitude/longitude cell. The Bendigo FMA is approximately delineated by the dashed line.



4.1.1 Distribution and historical context

The Powerful Owl has been recorded over much of Victoria, excluding the more arid parts of the north-west (Emison *et al.* 1987). Over 1000 records exist for the State, emanating from the coastal forests, forests of the ranges and from the drier forests inland of the Great Dividing Range (Atlas of Victorian Wildlife). A concentration of records exists north-east of Melbourne and in the forests of East Gippsland (Figure 1). This density of records may not be representative of natural 'hot-spots', but probably reflects the relative effort on surveys near Melbourne and in East Gippsland.

The southern portion of the Bendigo FMA roughly coincides with the north-western limit of this species' distribution. The first confirmed record within the study area was from the Heathcote area, attributed to J. de Ranen and dating back to 1934 (Royal Australasian Ornithologists Union (RAOU) Historical Record). It was not until 1970, that renewed interest in the conservation status of threatened wildlife and the development of more systematic surveys for owls (e.g. Debus 1995) resulted in an influx of locality records for this species. Consequently, most of the database records (96 %) were collected after 1970. This is unlikely to indicate an increase in abundance during those years, as it coincides with an increase in biological survey effort and the use of more sophisticated searching techniques. The Powerful Owl has been recorded from around Bendigo, Stuart Mill, Mt. Moliagul, Dargyle Forest, Mt Alexander and the Loddon River (Atlas of Victorian Wildlife; Dale Gibbons pers. comm.). The Bendigo FMA currently accounts for about 8% of the known distribution of the Powerful Owl in Victoria (based on 29/366 five-minute latitude/longitude cells).

4.1.2 Habitat requirements

In New South Wales, the Powerful Owl has been recorded from tall eucalypt forest greater than 70 years old growing on nutrient-rich soils (Davey 1993). There is some evidence to suggest that the occurrence of the Powerful Owl in these areas may be linked with the distributional patterns of their main prey species (e.g. Greater Glider, Grey-headed Flying-fox). The sclerophyll forests of north-east New South Wales are considered a population stronghold for the Powerful Owl; these forests also support high densities of arboreal marsupials (NSW NPWS 1994). Powerful Owls have been recorded roosting in a variety of tree types in mountain gullies of tall open forest and, inland of the divide, in drier woodland sites (Debus and Chafer 1994). In a major study to determine the distribution and habitat relationships of forest owls in south-eastern New South Wales, Kavanagh and Peake (1993) recorded the Powerful Owl at 9% of sites surveyed (i.e. 22/250 sites). No significant associations were established between this species and landform, topography, aspect of the site, understorey characteristics or tree basal area; low sample sizes, however, may have influenced these results. The majority of records from Queensland come from the south-east of that state (Pavey 1993).

The dedicated input of many local naturalists has added greatly to our knowledge of the distribution of this species in Victoria, although no systematic State-wide survey has yet been attempted. The major emphasis of research on the Powerful Owl in Victoria has been studies of its diet from western Victoria (Seebeck 1976), central Victoria (Tilley 1982), near Melbourne (Lavazanian *et al.* 1994) and in the Box-ironbark forests of the north-east (Traill 1993). The analysis of regurgitated pellets collected from beneath known roost sites is a simple technique for determining previously digested food items (e.g. James 1980). It appears that the Powerful Owl is a specialist predator, feeding primarily on arboreal marsupials with average weights between 200–800g (Traill 1993). Although regional and seasonal variation in prey species was evident during these dietary studies, the major prey item tended to be the most abundant arboreal species present in the area. In Chiltern Regional Park, the Squirrel Glider (*Petaurus norfolcensis*) was the preferred prey species over its smaller and more common close relative, the Sugar Glider (*P. breviceps*). Diurnal birds, such as the Australian Magpie (*Gymnorhina tibicen*), and large invertebrates may also be taken at various times of the year (Tilley 1982). Accurate data on the size of the home range of the Powerful Owl are not available, but the foraging area required for a breeding pair has been estimated as between 800 and 1000 ha, depending on the habitat type, quality and stocking levels of potential prey species from the surrounding forest (Seebeck 1976). A breeding pair of Powerful Owls usually occupies a permanent territory that contains a number of roost and nest sites which may be used consistently from one year to the next.

The nest is usually located in a large deep hollow of a mature or senescing tree (Hollands 1991). Breeding occurs during winter and, while the female is confined to the nest, the male is responsible for capturing and providing food for the nest inhabitants. In marginal habitat, a single tree hollow may be used for nesting in consecutive years. Nesting females are sensitive to disturbance and may vacate the nest if approached too closely (Hollands 1991; Quinn 1993).

Breeding pairs of Powerful Owls are known from the Bendigo FMA, but their breeding success has not been documented. Dispersing immatures require separate territories with suitable prey densities and roost sites to survive. As these owls are considered to be long-lived, their perceived conservation status now may not truly represent the health and viability of the population.

4.1.3 Previous research

Many of the records for this species in the study area result from opportunistic observations made by local field naturalists; some have been visiting known roost and nest sites for many years. In recent times, Dale Gibbons (Field Naturalist, Bendigo) has conducted a more systematic search of the Box-ironbark forests to determine current breeding territories of the Powerful Owl (Gibbons 1995). Gibbons censused 150 potential sites in approximately one month in 1995; Powerful Owls were detected at 13 of these sites. A high concentration of records came from the St. Arnaud State Forest and Kara Kara State Park, but otherwise the owl was considered to be sparsely distributed and rare in the Box-ironbark forests. Three historical sites where the Powerful Owl had been previously recorded, showed no evidence of their presence during that survey. An observation of the Powerful Owl was made in the Rushworth State Forest by the Fauna Survey Group in June 1994 (Felicity Garde, Field Naturalists Club of Victoria (FNCV), pers. comm.).

4.1.4 Current surveys

A Powerful Owl was heard calling in the St Arnaud State Forest by the Box-Ironbark Fauna Studies Group (BIFSG) in just over 118 hours of spotlighting the 63 EVC sites. One individual was heard calling at a site in Kara Kara State Park during the community spotlight weekend (11/2/96). None were recorded at 22 sites searched by spotlighting (although inclement weather conditions prevailed). Two roost sites were confirmed on that weekend: one just north of Stuart Mill (Dale Gibbons, pers. comm.) and the other from within the Lyell State Forest. One individual was seen during bat research studies at Mt. Brenanah (north of Melville Caves) on the 12/2/1996 (Steffan Krasna, NRE, pers. comm.).

4.1.5 Potential threatening processes and factors affecting population viability

- *Removal of large hollow-bearing trees*
Large hollow-bearing trees are an essential component of the Powerful Owl's habitat. Large tree cavities are required as nest sites during the breeding season. Tree hollows (of various sizes) are also used by many of the known prey species in this region (e.g. Common Ringtail Possum, Sugar Glider, Squirrel Glider, Brush-tailed Phascogale). Land-use practices which involve the direct removal of these very old trees, are deleterious to the survival of this species. The protection of large hollow-bearing trees in the vicinity of known roost sites will assist in maintaining the viability of these breeding sites.
- *Reduction in size of foraging area*
The Powerful Owl requires large tracts of forest to supply a sufficient prey base to ensure survival and reproductive success. Fragmentation of the forest could lead to competition for resources by neighbouring birds, a decrease in foraging range and the loss of individuals from the area.
- *Loss of suitable tree cover for roosting*
Many of the known roost sites are within gully vegetation or dense foliage. The protection to the birds during the day offered by this structural feature is likely to be an important habitat component. It is unclear why specific roosts are selected, or the reason why birds return to them year after year. Disturbance to these roost sites may lead to the evacuation of particular trees, and so disturbance in these sites should be avoided.
- *Decrease in prey density and composition*
Arboreal marsupials are the major food item in the diet of the Powerful Owl. Birds and insects appear to be secondary food items, and, by themselves may not be sufficient to support a population of Powerful Owls. Retention of a range of tree hollow sizes would likely support a diverse arboreal marsupial population, underpinning owl populations.
- *Human interference and disturbance to nest site*
The dissemination of locality information of Powerful Owl nest trees to the general public is a sensitive issue that requires careful consideration. Females may desert the nest, following human disturbance. Anecdotal evidence of illegal egg collection has been provided during the survey. Such activity may cause desertion of nest sites with deleterious impacts on breeding success. The degree of publicity that these trees receive is an on-going dilemma for land managers during the planning process, as it is important to protect sites without giving undue publicity to them. The best option is to provide locality information to the relevant land managers, select researchers and field naturalists, and not to the general public. The use of owl play-back tapes to elicit calls from local individuals should be used sparingly during scientific research so as not to interfere with breeding success (see Debus 1995:47).

4.1.6 Action statement

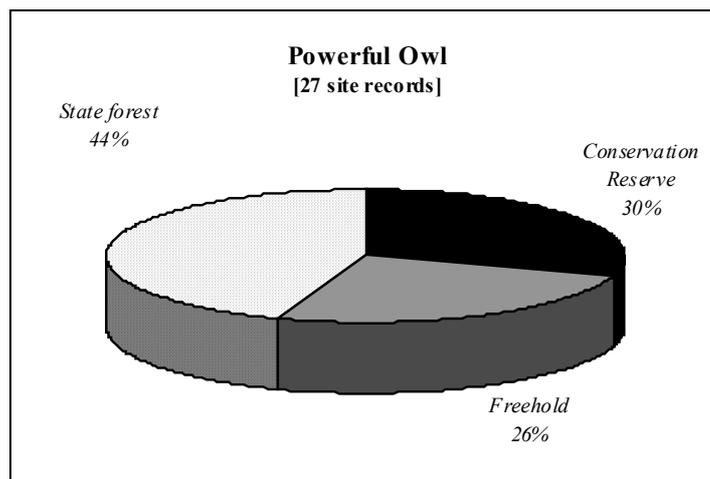
A draft Flora and Fauna Guarantee Action Statement for the Powerful Owl is being prepared by the Department of Natural Resources and Environment (Humphries and Webster in prep.). This document highlights a number of actions essential for the protection of the minimum number of Powerful Owls in Victoria. Briefly, these involve:

- the development of a site register
- the encouragement of the community to report nest and roost sites
- the identification and protection of habitat areas across the State to support 500 pairs of Powerful Owls
- the protection of sensitive areas in State forest, conservation reserves and private land; and
- the development of research projects that would contribute towards future management decisions.

4.1.7 Representation within conservation reserves in the Bendigo FMA

A large proportion of the site locality records for the Powerful Owl (44%) come from State forests (Figure 2 & Map 1). A further 30% are from conservation reserves (e.g. Kooyoora State Park, Kara Kara State Park). Clearly, the management objectives of these forested blocks need to account for the long-term conservation and survival of the Powerful Owl. To fully ascertain the precise distribution of the Powerful Owl in the Bendigo FMA, Gibbons (1995) recommended that a long-term programme needs to be instigated to document all incidental observations of this species.

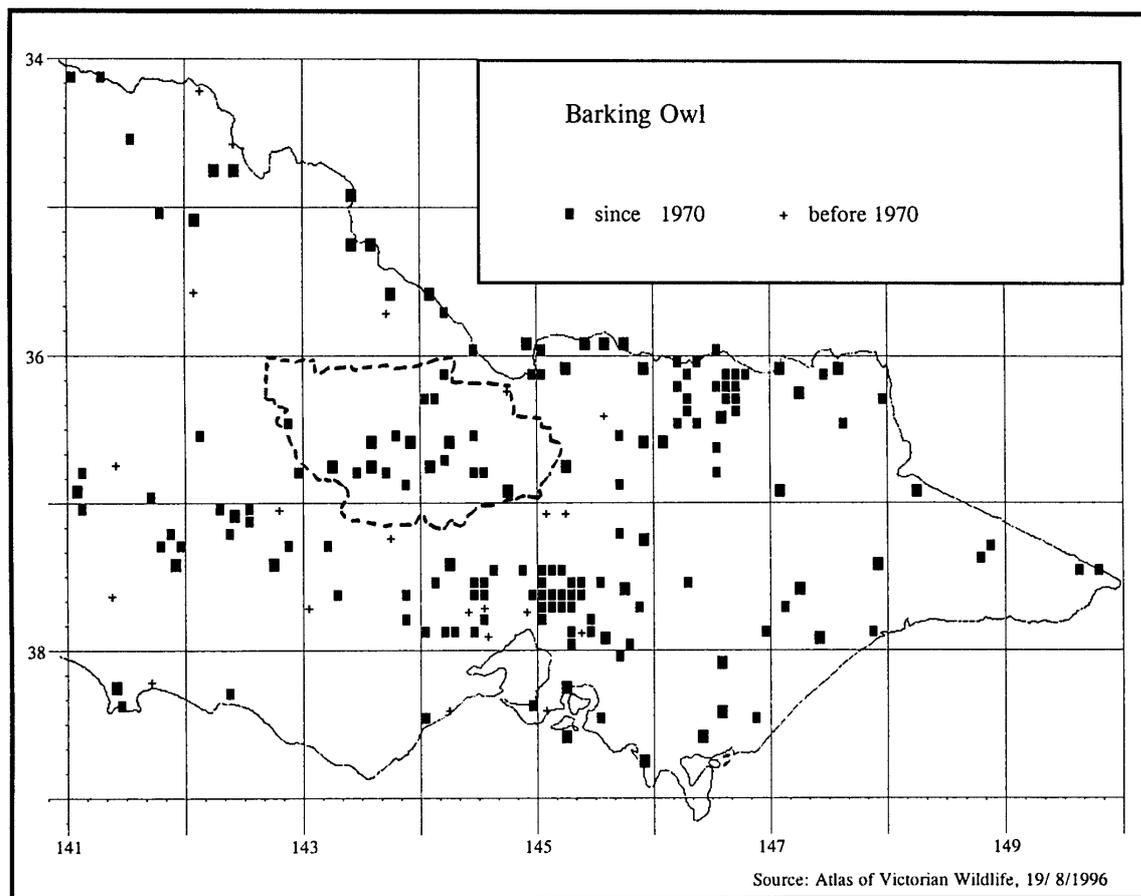
Figure 2. The proportion of site locality records for the Powerful Owl (Atlas of Victorian Wildlife) from the Bendigo FMA relative to three broad land tenure categories. Note that only site locality records able to be attributed to an accurate land tenure were used for this analysis and proportions indicated may represent an artefact of the collection method (e.g. when records emanate from roadkills).



4.2 Barking Owl (*Ninox connivens*)

The Barking Owl is named from its characteristic dog-like call, occasionally heard during the day (Hollands 1991). This medium-sized owl, sometimes confused with the smaller Boobook Owl, can be distinguished by its vivid yellow eyes, strongly streaked breast and more powerfully built talons (Schodde and Mason 1980). It is probably one of the least studied of the large owls, and is classified as rare in Victoria where it has been recommended for listing under the *Flora and Fauna Guarantee Act 1988* (see CNR 1995).

Figure 3. The distribution of the Barking Owl in Victoria, as indicated by records of its occurrence within each 5' latitude/longitude cell. The Bendigo FMA is approximately delineated by the dashed line.



4.2.1 Distribution and historical context

The Barking Owl is widespread throughout Australia, and occurs as two morphologically-distinct subspecies (Blakers *et al.* 1984); Barking Owls in Victoria belong to the *connivens* race. Throughout its range it is more commonly found in parts of northern Australia. Although geographically more widely distributed in Victoria than the Powerful Owl, there are fewer records (413 records) in the Atlas of Victorian Wildlife database, most from inland of the Great Dividing Range. No distinct pattern emerges from its broad distribution across the State, except that there appear to be fewer records from the wetter forests of the ranges and coastal areas of East Gippsland (Figure 3).

The Bendigo FMA is located centrally within the distribution of the Barking Owl in Victoria. This area represents 11% (20/184 five-minute cells) of the known distribution of the Barking Owl in Victoria. The earliest reliable record for the study area is from the Bendigo region in 1951. Over half the records on the database cannot be allocated to a specific locality due to the vague nature of the original description. It was not until the 1980's and 90's that site locality information was more strictly recorded. The Barking Owl has been recorded from areas including Goldsbrough, Laanecoorie Reservoir and Axedale. A record from Mt. Bolangum Flora and Fauna Reserve has yet to be substantiated (Christine Crafter, NRE Ranger, pers. comm.). The status and long-term viability of these populations is unknown.

4.2.2 Habitat requirements

The Barking Owl is a sedentary bird, usually living in pairs in eucalypt woodland and open forest. The species is able to extend inland where it occurs in riparian woodlands along drainage systems, but there are no records from the treeless areas of arid central Australia (Blakers *et al.* 1984). The nominate subspecies (*N. c. connivens*) is primarily found in the dry, low elevation forests south of the 20° latitude; it is infrequently found in more mesic forests of north-east NSW (NSW NPWS 1994). Previous analysis from surveys in NSW (albeit from a small sample size), has revealed that this species is more likely to be found in habitat with a mean annual temperature greater than 18° Celsius (NSW NPWS 1994). Within the open country of Victoria, the Barking Owl is often associated with riverine or swampy areas dominated by large, old River Red Gum (*E. camaldulensis*). There is little botanical data for the records of Barking Owl from the Bendigo FMA and therefore few conclusions can be drawn about habitat preferences.

The precise ecological requirements of this nocturnal bird are poorly documented, but mature hollow-bearing trees are known to be used as nest and roost sites (Kavanagh *et al.* 1995). The nest is usually located within a large hollow in the trunk or in a dead spout (Hollands 1991). Breeding generally occurs from mid-winter to spring (Schodde and Mason 1980). It has been suggested that while the female remains within the confines of the hollow, the male may roost outside in the same large tree (Kavanagh *et al.* 1995). Dietary information has been collated from analysing the contents of pellets collected below these trees. Food preferences may vary depending on the time of year. Vertebrate species such as the introduced European Rabbit (*Oryctolagus cuniculus*) and a range of diurnal birds and gliders are taken during the breeding season, whereas during the non-breeding period there may be a dietary shift towards smaller food items (e.g. insects, mainly beetles and crickets) (Hollands 1991; Kavanagh *et al.* 1995).

4.2.3 Previous research

Before the BIFSG study, there had been no systematic searches for the Barking Owl in the Bendigo FMA. Dale Gibbons played Barking Owl tapes opportunistically during his Powerful Owl survey in 1995, but only at sites that he considered 'suitable'. The single Barking Owl observed during his survey came from State forest near Eddington.

4.2.4 Current surveys

A pair of Barking Owls was observed in Kamarooka State Park during the owl survey work undertaken by the BIFSG (Lindy Lumsden, NRE, pers. comm.). A single bird was heard calling from within the Dalyenong Flora Reserve during the autumn spotlighting session (John Silins, NRE, pers. comm.). Biologists interviewed during the present study believe that specific surveys are urgently required to ascertain the habitat requirements and conservation status of this species (Paul Peake, Ecology Australia, pers. comm.).

The RAOU has recently initiated a study of hollow use by birds on private land in the Box-Ironbark Ecosystem (George Appleby, RAOU, pers. comm.). Private property is an important source of remaining large trees and nest sites for hollow-dependent fauna. Results from the RAOU study should be closely monitored and linked with future management decisions applied to public land.

4.2.5 Potential threatening processes and factors affecting population viability

All potential threats listed for the Powerful Owl are also relevant to this species, i.e.:

- *Removal of large hollow-bearing trees*
- *Reduction in size of foraging area*
- *Loss of suitable tree cover for roosting*
- *Decrease in prey density and composition*
- *Human interference and disturbance to nest site*

Because of the perceived habitat preference of this owl for riverine Red Gum woodland, additional factors may also influence the habitat of Barking Owls.

- *Clearing of native vegetation on agricultural property*
The home range of a Barking Owl may extend over both private and public land. Surveys of State forest indicate that many of these areas are dominated by young, even-aged trees.

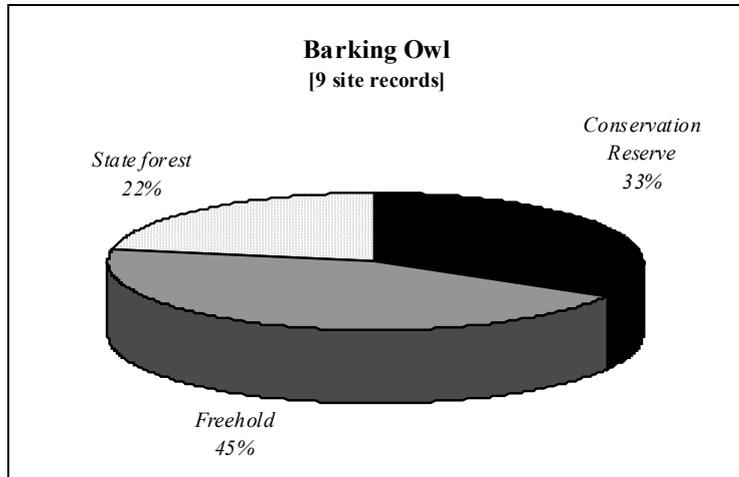
Many of the remaining mature red gum trees are within remnant patches on private land. Any further loss of hollow-bearing trees, or continued loss of forest cover on private land, would reduce nesting sites and foraging areas.

4.2.6 Representation within conservation reserves in the Bendigo FMA

Due to the lack of site locality details of the historical records, many of the database records could not be allocated to a specific land tenure (Figure 4). The recent observations by the BIFSG within Kamarooka State Park and Dalynong Flora Reserve are the only current records confirmed from a conservation reserve (Map 2).

The lack of biological information on the Barking Owl has been highlighted in this report. Surveys and research should be initiated to provide a greater knowledge of the distribution, conservation status and specific habitat requirements for this species. Appropriate management strategies are required for the long-term conservation of the barking owl in the Bendigo FMA.

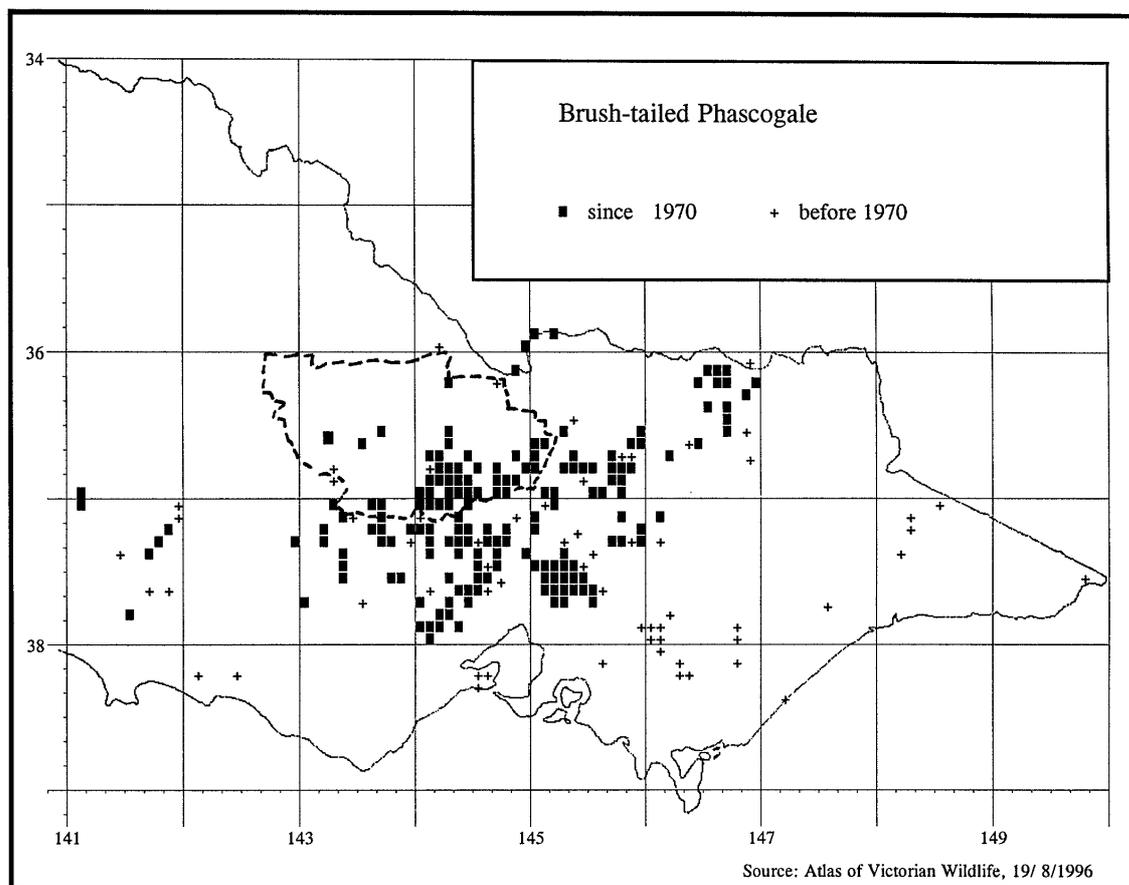
Figure 4. The proportion of site locality records for the Barking Owl (Atlas of Victorian Wildlife) from the Bendigo FMA relative to three broad land tenure categories. Note that only site locality records able to be attributed to an accurate land tenure were used for this analysis and proportions indicated may represent an artefact of the collection method (e.g. when records emanate from roadkills).



4.3 Brush-tailed Phascogale (*Phascogale tapoatafa*)

The Brush-tailed Phascogale (or Tuan) is one of the largest marsupial carnivores (body weight 106-300 grams) within the Bendigo FMA. It is a cryptic species that can be readily distinguished by its dark, bottle-brush tail, the hairs of which become erect when the animal is excited or alert (Soderquist 1995). It is an arboreal insectivore that forages for insects and other invertebrates on the trunks and branches of trees, and may infrequently forage on the forest floor. Traill and Coates (1993) believe its early reputation for killing poultry may be exaggerated. The Brush-tailed Phascogale has been listed under the *Flora and Fauna Guarantee Act 1988* as rare in Victoria (CNR 1995).

Figure 5. The distribution of the Brush-tailed Phascogale in Victoria, as indicated by records of its occurrence within each 5' latitude/longitude cell. The Bendigo FMA is approximately delineated by the dashed line.



4.3.1 Distribution and historical context

The two subspecies of the Brush-tailed Phascogale have a disjunct distribution around the margin of Australia, with the southern nominate race (*P. t. tapoatafa*) occurring in the south-east and parts of the south-west (Soderquist 1995). Its altitudinal range extends from near sea level to 1500m at Barrington Tops in east-central NSW (Dickman and McKechnie 1985). In Victoria, the Brush-tailed Phascogale has not been recorded above 700m and it now appears to be largely restricted to a broad geographic band across central Victoria (Atlas of Victorian Wildlife). There are currently over 500 records on the database for this species (Figure 5) which indicate a marked decline in its range since 1970. Despite many fauna surveys being conducted in the East Gippsland area over the past 25 years, no

individuals have been positively sighted. However, Brush-tailed Phascogale fur has been detected in a number of Spot-tailed Quoll scats collected from the Suggan Buggan Valley in the early 1990's (Chris Belcher, pers. comm.). Ecological studies have been carried out at select sites throughout Victoria (e.g. Cuttle 1982; Traill and Coates 1993; Soderquist and Ealey 1994), but knowledge of the distribution and conservation status of populations elsewhere is poorly known.

The Bendigo FMA encompasses the north-western limit to the Brush-tailed Phascogale's distribution in Victoria; it has not been recorded further inland in more arid parts. The earliest record for the study area on the database is from 1904 from Elphinstone, with several records from Newstead and Heathcote in the 1920's. Many of the early records were the result of cat kills or specimens found dead on the roads. Surveys targeting this species were conducted after the 1970's by the local naturalists of Bendigo in areas close to Bendigo (e.g. Whipstick State Park, Mt Alexander). Other areas where this species has been recorded include Mandurang, Taradale and Yandoit. Primarily, the database indicates that the known records for the Bendigo FMA centre around the Bendigo district. The Bendigo FMA represents 23% (52/227 five-minute cells) of the known distribution of the Brush-tailed Phascogale in Victoria and therefore represents a significant proportion of its range.

4.3.2 Habitat requirements

The Brush-tailed Phascogale inhabits dry open forest and woodland with a sparse understorey and ground cover. In north-east NSW the Brush-tailed Phascogale is occasionally found in high elevation, cool temperate rainforest (Dickman and McKechnie 1985). It is more typically associated with box, ironbark and stringybark species of eucalypts (Menkhorst 1995). Clearing of these vegetation communities for agricultural purposes has severely depleted suitable habitat, and probably resulted in the decline and loss of the species from many areas. Given the large home range of this species (see below), it is not possible for self-sustaining populations to persist in small remnants; hence, large blocks of forest are an essential habitat component.

Tree hollows are used for nesting and daytime refuge (den sites), with a preference for the smallest entrance hole that will allow access by the animal. Competition with other native arboreals occurs in areas with few hollows and may result in the use of less than optimal nest sites, such as stumps or bird nests (Traill and Coates 1993), where these animals are more susceptible to predation. Each individual requires a large number of nest sites within its home range with up to 20 used by a single animal in one year (Rhind 1996). Maternal nests typically occur in the largest available cavities with small openings. The breeding season commences in early winter after which nearly all males in the wild die (aged less than one year) while the female may go on to breed in their second year (Cuttle 1982). Mating usually occurs inside the hollow (Soderquist 1995). Significant mortality may occur to young in the nest and recently weaned individuals.

In areas where natural tree hollows are limited, nest boxes are sometimes used by Brush-tailed Phascogales and have proved to be a useful research tool. In the long-term, however, artificial hollows cannot be considered as a viable replacement for hollow-bearing trees.

The home range estimates for females are approximately 40 ha and more than double this for the males (Traill and Coates 1993). One tagged individual (a male) is known to have travelled 15 km over a six week period (Platt 1993).

Scat and gut analysis have been used to determine the diet of the Brush-tailed Phascogale (Traill and Coates 1993). It mainly feeds on arthropods such as beetles, spiders and ants, which it extracts from the crevices of dead limbs on large trees. Heavily-flowering eucalypts are often visited, possibly to feed on the nectar.

4.3.3 Previous research

The Bendigo Field Naturalists have been very active in their search for the Brush-tailed Phascogale around the Bendigo region. This, in part, explains the concentration of records for that species in the area. The erection of nest boxes has been used extensively to increase shelter and breeding sites in areas where natural hollows may be limited (Rob Price, NRE, pers. comm.).

Several Brush-tailed Phascogales have been trapped in the Rushworth State Forest by the Fauna Survey Group in 1994/95 (Felicity Garde, FNCV, pers. comm.).

4.3.4 Current surveys

No Brush-tailed Phascogales were sighted during the extensive BIFSG spotlight censuses, but this species is difficult to detect by spotlight. Hair tube analysis detected this species at 5 of the 63 EVC sites (Rushworth, Redcastle, Mount Ida, Maldon State Forests and Mt Brenanah). At the Mount Ida site, nearly all tubes contained evidence of Brush-tailed Phascogale fur. Interviews with local naturalists added a further four locality records to the database (Garry Cheers, "Carawah", pers. comm.).

4.3.5 Potential threatening processes and factors affecting population viability

The following threats could impact adversely on the Brush-tailed Phascogale:

- *Removal of large hollow-bearing trees*
- *Reduction in size of foraging area*
- *Permanent clearing of native vegetation*

- *Grazing pressure*
Many areas of public land in streamside reserves and unused roads are currently licensed for grazing by introduced, hard-hoofed stock. The conservation values of these linear reserves are poorly documented. Grazing may reduce regeneration of these areas and consequently monitoring of grazing pressure relative to regeneration success should be implemented at key sites.
- *Feral carnivores*
In sub-optimal habitat, where natural tree hollows are limited the Brush-tailed Phascogale may use less protected nest sites where they are more vulnerable to introduced predators such as the fox or cat.
- *Feral bees*
Feral bees are known to invade tree hollows making them unsuitable for native species, such as the Brush-tailed Phascogale. Resources are required to investigate the effects of this competition on the native hollow-dependent fauna.
- *Destruction of standing dead timber*
Standing dead trees are a valuable foraging substrate for the Brush-tailed Phascogale. Removal of these trees for firewood or other uses will reduce available foraging sites and possible nest/shelter sites for the Brush-tailed Phascogale.

4.3.6 Action statement

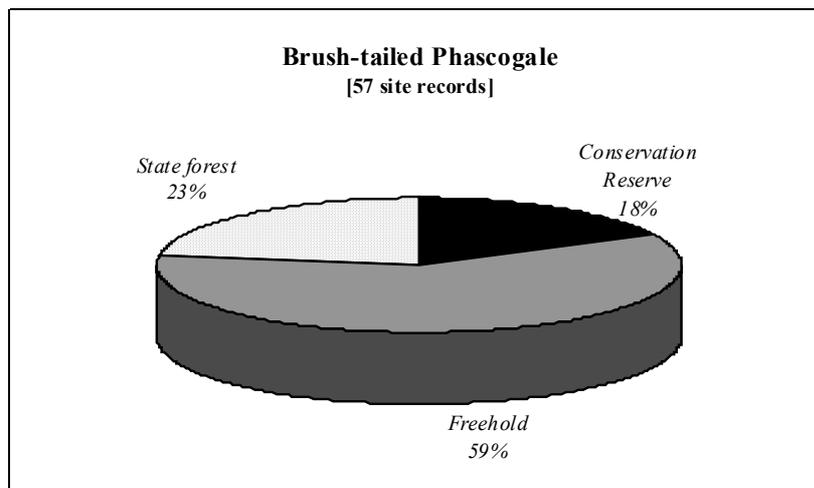
A draft Flora and Fauna Guarantee Action Statement for the Brush-tailed Phascogale has been produced by the Department of Natural Resources and Environment (Humphries and Seebeck 1995). This draft document proposes actions needed to ensure the long-term survival of the species.

4.3.7 Representation within conservation reserves in the Bendigo FMA

The Brush-tailed Phascogale has been recorded from a number of conservation reserves including Pilchers Bridge Flora and Fauna Reserve, Whipstick State Park and Mt Black Flora and Fauna Reserve (Map 3). A large proportion of the site locality records (59%) are from freehold land (Figure 6).

The importance of natural tree hollows for the long-term conservation of the Brush-tailed Phascogale is emphasised. A range of cavity sizes and a diversity of hollow-bearing trees are required for successful reproduction, nesting and dispersal. The large home range, low density, short life span and male die-off period make this species particularly vulnerable to stochastic events and local extinctions.

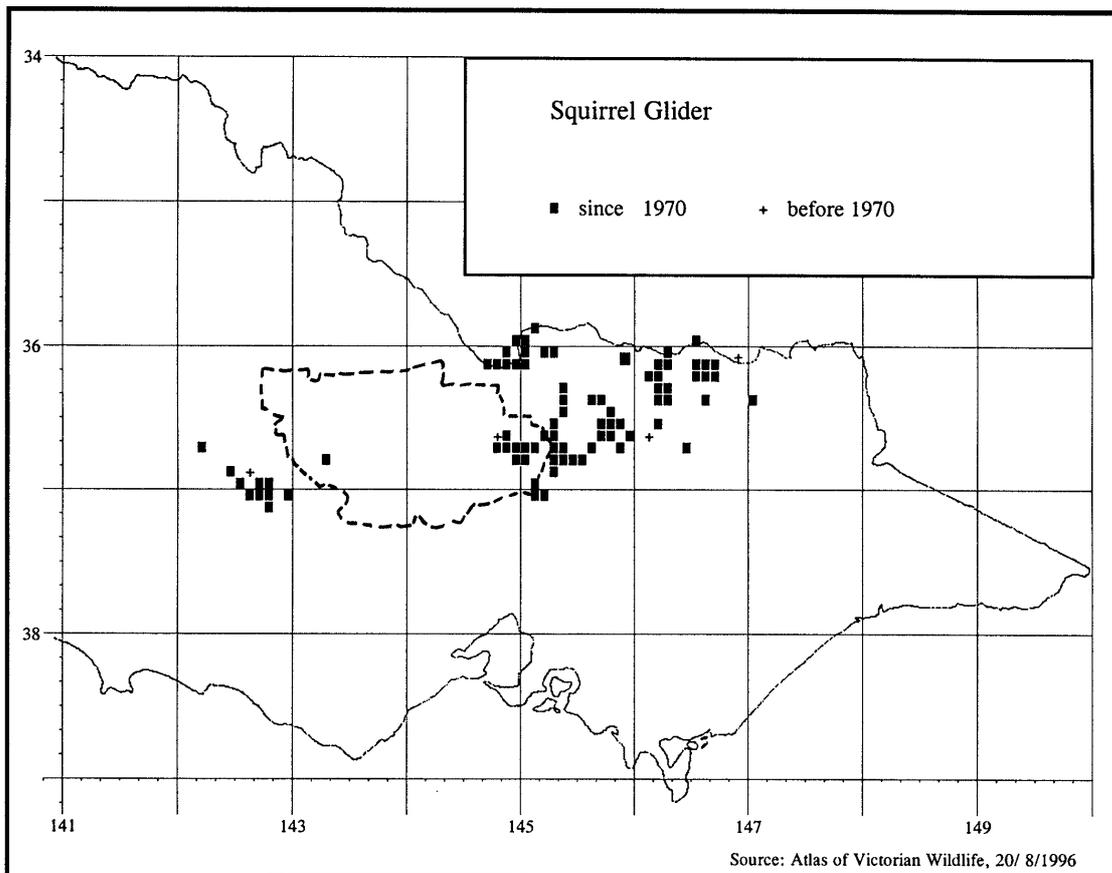
Figure 6. The proportion of site locality records for the Brush-tailed Phascogale (Atlas of Victorian Wildlife) from the Bendigo FMA relative to three broad land tenure categories. Note that only site locality records able to be attributed to an accurate land tenure were used for this analysis and proportions indicated may represent an artefact of the collection method (e.g. when records emanate from roadkills).



4.4 Squirrel Glider (*Petaurus norfolcensis*)

In the wild, the Squirrel Glider is often difficult to tell apart from its more commonly encountered close relative, the Sugar Glider (*P. breviceps*). These species are distinguishable when a number of morphological features are compared- the Squirrel Glider is larger (body weight 190-300g, cf. 95-160g); the belly fur is completely white (cf. a patchy grey fur); and the fur at the base of the tail is relatively longer (Gibbons 1980; Alexander 1981; Turner 1986). The Squirrel Glider is listed as vulnerable in Victoria under the *Flora and Fauna Guarantee Act 1988* (CNR 1995).

Figure 7. The distribution of the Squirrel Glider in Victoria, as indicated by records of its occurrence within each 5' latitude/longitude cell. The Bendigo FMA is approximately delineated by the dashed line.



4.4.1 Distribution and historical context

In Australia, the Squirrel Glider has a patchy distribution extending along the east coast from western Victoria to north Queensland. The south-east of Queensland is one of the few areas where this species is regarded as common. Since European settlement, it is believed that this species has suffered a 10 - 50% geographical reduction in range (NSW NPWS 1994). Density of Squirrel Gliders on the central north coast of NSW is higher ($0.89-1.54 \text{ ha}^{-1}$) than recorded for Box-ironbark in Victoria (0.38 ha^{-1}) (Quin 1995). In Victoria, the Squirrel Glider occurs as isolated populations restricted to the Riverine Plains and northern slopes of the Western Highlands (Menkhorst *et al.* 1988) (Figure 7). Apparent strongholds for this species are along the Goulburn River, north of Murchison; parts of Chiltern Regional Park; the Wanalta Creek - Gobarup Creek catchments and some of the remnants of the northern plains (Bennett in prep.).

The Bendigo FMA represents 14% (12/87 five-minute cells) of the known distribution of the Squirrel Glider in Victoria. Apart from one record in 1983, no Squirrel Gliders have been recorded from the 185 km 'Menkhorst Gap' between the Colbinabbin populations and known populations from Stawell (Menkhorst *et al.* 1988). Only one individual was seen in July 1983 at Wattle Flat, north-west of Stuart Mill. Despite intensive searching since, the species has not been observed again from within this gap. Moreover, no records exist for the Bealiba, Dunnolly and Maryborough districts. The Bendigo FMA incorporates this gap and it is therefore important to determine the conservation status of this species in this area.

4.4.2 Habitat requirements

A large proportion of the Squirrel Glider's preferred habitat has been removed through clearing of private land. The Squirrel Glider has been recorded from mixed species box woodland and open forest dominated by species such as Grey Box (*E. microcarpa*), White box (*E. albens*) and Yellow Box (*E. melliodora*) (Menkhorst *et al.* 1988). Riparian open forest of River Red Gum (*E. camaldulensis*) with an understorey of Silver Wattle (*A. dealbata*) is also a much favoured habitat, provided that large, old trees are available. Squirrel Gliders are often seen in linear reserves of remnant vegetation along roadsides or stream reserves. These remnants are extremely valuable as Squirrel Glider habitat, particularly if large, hollow-bearing trees are present and the reserve is contiguous with a large forest block. The long-term viability of these reserves to function as Squirrel Glider habitat is uncertain. The structural attributes of the Squirrel Glider habitat can be characterised by an overstorey of mixed-aged trees, a sparse understorey often containing *Acacia* sp. (e.g. Silver Wattle) and a ground cover of grasses and herbs.

An important component of the Squirrel Glider habitat at sites where the species has been regularly recorded is the presence of many large, old trees containing suitable hollows for nesting and refuge. Dead trees are also known to be used as den sites (Menkhorst 1995). At Reedy Lake, the average circumference of Red Gums where this species has been detected was 3.17 ± 0.47 m. (Menkhorst *et al.* 1988). Some trees, that measured up to 38 m in height, may be several hundred years old.

Generally, litters of one or two young are born between June and December (Smith 1979), but in NSW births may occur at any time during the year (Quin 1995); therefore there is the potential for females to raise two litters in a year. In Victoria, juveniles leave the pouch between August and December. Breeding success or recruitment may be tied in with heavy periods of eucalypt flowering (Quin 1995).

Based only on a few field studies, Squirrel Gliders are regarded as feeding primarily on insects but also rely on plant exudates (e.g. *Acacia* gum, eucalypt sap, nectar, manna) and honeydew to supply essential carbohydrate requirements; invertebrates (e.g. beetles, moths and weevils) and pollen would provide an important seasonal source of protein (Menkhorst and Collier 1988).

4.4.3 Previous research

Previous surveys of North Central Victoria by the Land Conservation Council in the 1970's reported a specimen of Squirrel Glider from the Rushworth State Forest (Menkhorst and Gilmore 1979). It was later established that this specimen was collected from outside the State Forest, "...some 12 km south-east of Colbinabbin" (Gibbons 1980). At this time, it was recognised that the Gobarup Creek, Wanalta Creek and nearby roadside reserve systems were important Squirrel Glider habitat which needed protection from further land degradation (Menkhorst 1981). Alexander (1981) supported this recommendation when

eight Squirrel Gliders were observed during his study of the area on the 22 January 1981. Despite extensive surveys in the forest, Menkhorst *et al.* (1988) reported that no Squirrel Gliders had been recorded from the Rushworth State Forest. Over a decade passed before Squirrel Gliders were later confirmed from within the interior of the Rushworth State Forest (Lyndall Rowley, pers. comm. and Felicity Garde, FNCV, pers. comm.).

Specific surveys have been undertaken in the Bendigo FMA to elucidate whether the 'Menkhorst Gap' is indeed a natural phenomenon or an artefact due to lack of search effort (Peter Menkhorst, NRE, pers. comm. and John Robinson, Bendigo Field Naturalists Club, pers. comm.). It would appear that, if the Squirrel Glider does still occur in this area, it is in extremely low numbers. The precise reason why no Squirrel Gliders have been seen since 1983 at the Wattle Flat site is unknown.

4.4.4 Current surveys

No Squirrel Gliders were detected during the BIFSG spotlight censuses across the region. Hair samples of this species cannot be differentiated reliably from Sugar Gliders and therefore the hairtube survey did not reveal any new records. The community spotlighting weekend during February 1996 involving 24 participants, failed to locate the Squirrel Glider in the Mt Bolangum-Stuart Mill-Dalyenong area; but inclement weather conditions at the time may have reduced detectability.

4.4.5 Potential threatening processes and factors affecting population viability

The major threat to the survival of the Squirrel Glider in the Bendigo FMA is the loss of hollow-bearing trees from the rural landscape. Fragmentation of already isolated populations will undoubtedly impact on the conservation genetics of the species and may lead to local extinctions. Little is known of the health of the extant populations (e.g. parasite loading, inbreeding effects, disease). Research is urgently required to address these issues. Natural predators (e.g. Powerful Owl and Barking Owl) potentially could reduce the abundance of the Squirrel Glider in a localised area (see Traill 1993).

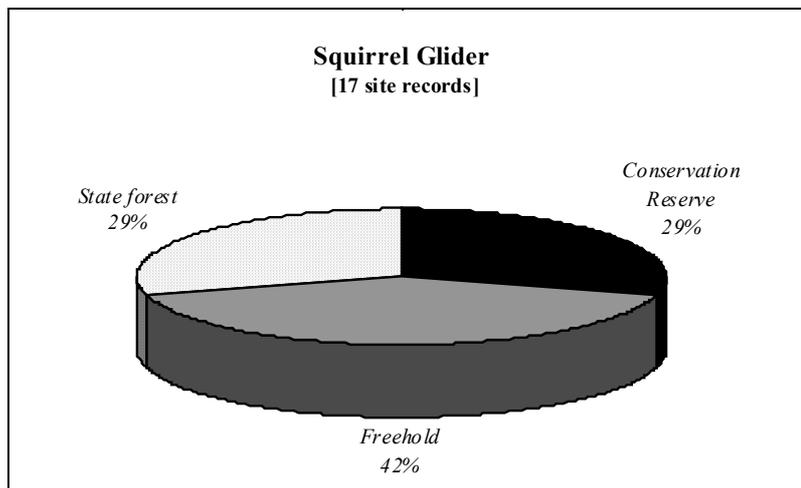
Specific threats to the conservation of the Squirrel Glider are listed below.

- *Destruction of standing dead timber*
- *Removal of large hollow-bearing trees*
- *Reduction in size of foraging area due to clearing of forest areas*
- *Excessive grazing pressures inhibiting natural regeneration*
- *Feral carnivores*
- *Feral bees*
- *Damage to roadside vegetation corridors by maintenance clearing*

4.4.6 Representation within conservation reserves in the Bendigo FMA

The Squirrel Glider has been recorded primarily from Freehold land (Figure 8 & Map 4). Little is known of its true representation within conservation reserves and State forest.

Figure 8. The proportion of site locality records for the Squirrel Glider (Atlas of Victorian Wildlife) from the Bendigo FMA relative to three broad land tenure categories. Note that only site locality records able to be attributed to an accurate land tenure were used for this analysis and proportions indicated may represent an artefact of the collection method (e.g. when records emanate from roadkills).

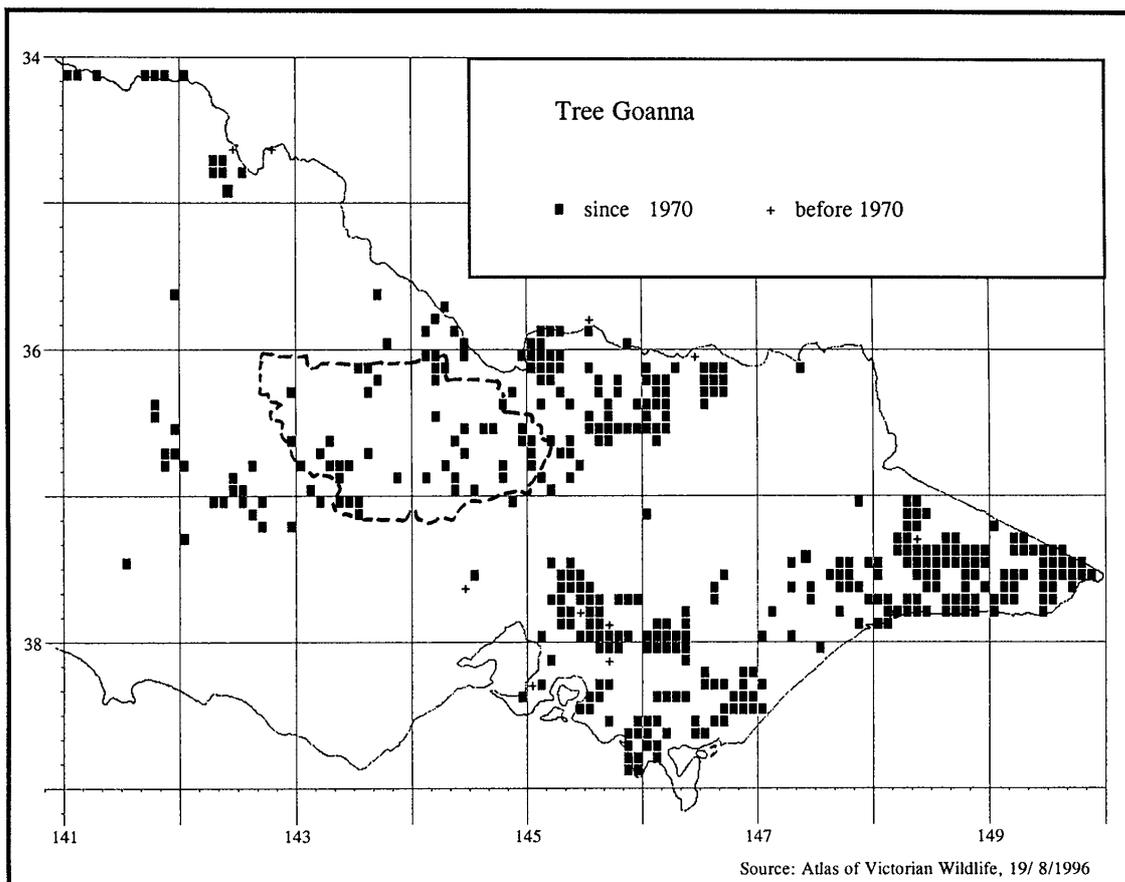


4.5 Tree Goanna (*Varanus varius*)

The Tree Goanna, or Lace Monitor, is the largest reptile to occur in the study area and may grow to more than two metres in total length. It is distinguished from other monitors that may inhabit the area (e.g. Sand Goanna) by usually having black bars across the snout, chin and throat (Cogger 1992); the long, laterally compressed tail is typically marked with irregular yellow bands. This high order predator is one of the few lizards that is largely arboreal.

Until recently, the Tree Goanna was included on the threatened fauna list (CNR 1995). Concerns were expressed, at the time, at the lack of juveniles perceived within the population. As there was no biological information with respect to life expectancy, its vulnerable status seemed warranted. Subsequently, an increase in survey effort has revealed the presence of young individuals (~2 years old) in certain areas and, after some debate, this species was removed from the threatened fauna list. However, it is still considered to be potentially vulnerable in some areas of the state (Peter Robertson, NRE pers. comm.). Two major field investigations have added greatly to our knowledge of this species ecological requirements (Weavers 1983; Carter 1992).

Figure 9. The distribution of the Tree Goanna in Victoria, as indicated by records of its occurrence within each 5' latitude/longitude cell. The Bendigo FMA is approximately delineated by the dashed line.



4.5.1 Distribution and historical context

The Tree Goanna inhabits coastal and more inland areas of eastern Australia. In Victoria, it appears to have two main strongholds: one in the coastal forests and foothills of south-east Victoria and the other inland of the Great Dividing Range around north central Victoria (Figure 9). The Bendigo FMA fits into the latter geographic area and accounts for 10% (40/394 five-minute cells) of the known distribution of the Tree Goanna in Victoria. The first documented evidence of this species from the study area comes from Majors Creek in 1972. Other localities where the Tree Goanna has been recorded include Wellsford State Forest, Lyell State Forest and Rushworth (Atlas of Victorian Wildlife).

4.5.2 Habitat requirements

The Tree Goanna has been recorded from a variety of forest types, for example, the open stringybark forests of the Deua National Park in south eastern NSW (Carter 1992) and coastal eucalypt forest near Mallacoota (Weavers 1993). Tree Goannas are widely scattered throughout the Bendigo FMA, especially in larger remnant vegetation, although linear reserves, such as roadsides, are also utilised (Geoff Brown, NRE, pers. comm.). The long-term viability of these linear reserves for Tree Goannas is uncertain. Based on a recent community 'survey', large numbers of Tree Goannas were reported from the Dalyenong and Rushworth forest blocks. Large hollow-bearing trees are used for shelter at night and during periods of inactivity (Greer 1989). Young individuals also require tree hollows as refuge sites (Peter Robertson, pers. comm.).

Tree Goanna eggs are incubated over winter in active termite mounds and hatched in early spring (King and Green 1993); termite mounds are therefore a vital feature of their habitat and essential for breeding success. There has been some speculation that if termite mounds are scarce, nesting may also occur in tree hollows or logs. A complex ground layer and high density of logs would be beneficial for the survival of dispersing young.

Adult Tree Goannas are opportunistic carnivores that take a range of food items including arthropods, rabbits, birds, other reptiles and reptile eggs (Weavers 1989). A large proportion of their diet is carrion. Juveniles rely on small skinks as a stable part of their diet (Peter Robertson, pers. comm.).

4.5.3 Previous research

No systematic surveys of the study area have been completed for this species. Most of the records of the Tree Goanna originate from incidental sightings.

4.5.4 Current surveys

Observations of this species by the BIFSG were generally infrequent. Media advertisements and community response during this study have proved to be the most productive method for collecting locality records, resulting in 38 records being added to the database.

4.5.5 Potential threatening processes and factors affecting population viability

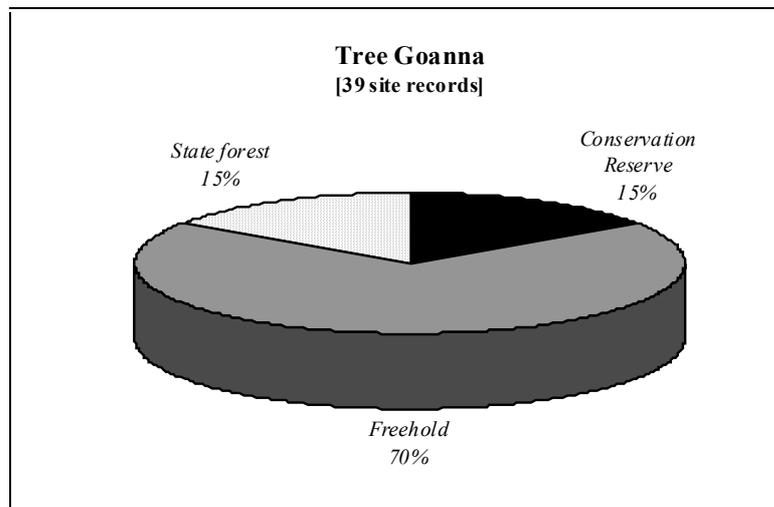
The greatest threat to the survival of the Tree Goanna in the Bendigo FMA is habitat fragmentation and degradation which affects the viability of hollow-bearing trees and ground cover composition. Specific issues which need to be addressed, if the long-term conservation of the Tree Goanna is to be ensured, are listed below.

- *Removal of large hollow-bearing trees*
- *Permanent vegetation clearing*
- *Predation by introduced carnivores*
- *Inappropriate timing of baiting for foxes*
- *Habitat degradation leading to a decrease in small skink abundance*

4.5.6 Representation within conservation reserves in the Bendigo FMA

The Tree Goanna has been recorded from a number of conservation reserves including Pilchers Bridge Fauna Reserve and Kamarooka State Park (Map 5). Its major representation appears to be on Freehold land (Figure 10).

Figure 10. The proportion of site locality records for the Tree Goanna (Atlas of Victorian Wildlife) from the Bendigo FMA relative to three broad land tenure categories. Note that only site locality records able to be attributed to an accurate land tenure were used for this analysis and proportions indicated may represent an artefact of the collection method (e.g. when records emanate from roadkills).



5 CONCLUDING REMARKS

A variety of techniques have been used to collate all existing records of threatened hollow-dependent fauna in the Bendigo FMA. Limited field work has been carried out to supplement this data. Distribution maps for the five nominated species have been constructed, based on this information. Additional maps depicting site locality records, with respect to land tenure, are also included.

The loss of hollow-bearing trees from the rural landscape and incremental fragmentation are processes that have been identified as having deleterious effects on the breeding and foraging success of these species. Relatively large home ranges are essential for the Powerful Owl, Brush-tailed Phascogale and probably the Barking Owl to satisfy their foraging strategies. Research is urgently needed to help gain a better understanding of the current distribution and conservation status of the Barking Owl in the Bendigo FMA.

The Bendigo FMA is considered an important area for the Brush-tailed Phascogale as it constitutes nearly a quarter of its known distribution in Victoria.

General habitat information for these species is now available, but the key environmental attributes that ultimately determine their distribution are still poorly documented. This report highlights the need for protection of large hollow-bearing trees within the Bendigo FMA if hollow-dependent fauna are to survive, however our knowledge of the precise ecological requirements of these species is still limited. Accurate data on the current distribution, conservation status and specific habitat requirements of these species are not available. Resources are required to monitor the effects of environmental change on the populations of these species so that management practices can address threatening processes.

Land use management in the Bendigo FMA area must take into account the habitat requirements of these threatened species to ensure their long term survival.

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APPENDIX

SPECIES SYNOPSIS FOR THE BENDIGO FMA

BIRDS

Powerful Owl *Ninox strenua*

Rare, Flora and Fauna Guarantee Act Listed

- *Distribution*: Recorded in 29 five-minute cells from a Statewide total of 366 cells.
- *Breeding*: Nests in large cavities of old trees within large territories.
- *Habitat requirements*:
 - Key requirements in the Bendigo FMA are poorly known.
 - Large old hollow-bearing trees are essential for breeding success.
 - High densities of arboreal marsupials required in home range.
- *Recent surveys*:
 - Gibbons (1995) recorded Powerful Owls at 13 of the 150 specially selected sites.
 - Box-ironbark spotlight surveys recorded one individual from 63 sites.
 - Box-ironbark owl surveys recently recorded five individuals.
- *Representation within Conservation Reserves*: 30% of site records within reserve.
- *Major threats in the Bendigo FMA*:
 - A paucity of large, old hollow-bearing trees for nest sites.
 - Incremental fragmentation of habitat causing declines in prey population densities below critical foraging levels.

Barking Owl *Ninox connivens*

Rare, Flora and Fauna Guarantee Act Recommended for Listing

- *Distribution*: Recorded in 20 five-minute cells from a Statewide total of 184 cells, accurate data on current distribution are not available.
- *Breeding*: Nests in large cavities of old trees within large territories.
- *Habitat requirements*:
 - Key requirements in the Bendigo FMA are poorly known; often associated with riverine habitats.
 - Large old hollow-bearing trees are essential for breeding success.
- *Recent surveys*:
 - Gibbons (1995) recorded a single Barking Owl from a survey of 150 sites.
 - Box-ironbark spotlight surveys of 63 sites recorded one individual.
 - Box-ironbark owl surveys of 63 sites recorded a pair from one site only.
- *Representation within Conservation Reserves*: 33% of site records within reserve.
- *Major threats in the Bendigo FMA*:
 - A paucity of large old hollow-bearing trees for nest and roost sites.
 - Incremental fragmentation of existing habitat causing declines in prey population densities below critical foraging levels.

Mammals

Brush-tailed Phascogale *Phascogale tapoatafa*

Rare, Flora and Fauna Guarantee Act Listed

- *Distribution:* Recorded in 52 five-minute cells from a Statewide total of 227 cells.
- *Breeding:* Nests in large cavities of old trees within large territories.
- *Habitat requirements:*
 - Hollow-bearing trees are essential for breeding success.
 - Standing dead timber required for foraging.
 - Large home range within extensive patches of forest.
 - Large number of nest sites used by each individual.
- *Recent surveys:*
 - Box-ironbark spotlight surveys recorded no individuals from 63 sites.
 - Box-ironbark hair-tube survey recorded this species at 5 sites.
- *Representation within Conservation Reserves:* 18% of site records within reserve.
- *Major threats in the Bendigo FMA:*
 - The removal of large old hollow-bearing trees used for breeding and refuge.
 - Incremental fragmentation of existing habitat impacting upon large home ranges needed for a viable population.
 - Introduced predators such as the fox or cat.

Squirrel Glider *Petaurus norfolcensis*

Vulnerable, Flora and Fauna Guarantee Act Listed

- *Distribution:* Recorded in 12 five-minute cells from a Statewide total of 87 cells.
- *Breeding:* Nests in hollows of old trees.
- *Habitat requirements:*
 - Key requirements in the Bendigo FMA are poorly known.
 - Hollow-bearing trees are essential for breeding success.
 - Mature overstorey of mixed-species box woodland and open forest.
 - Sparse understorey often containing *Acacia* sp.
- *Recent surveys:*
 - Box-ironbark spotlight surveys recorded Squirrel Gliders at none of the 63 sites.
 - The community spotlighting weekend did not locate this species around St. Arnaud.
- *Representation within Conservation Reserves:* 29% of site records within reserve.
- *Major threats in the Bendigo FMA:*
 - The removal of large old hollow-bearing trees used for breeding and refuge.
 - Incremental fragmentation of existing habitat.
 - Excessive vegetation clearing along linear reserves disrupting continuity of habitat.
 - Introduced predators such as the fox or cat.

Reptiles

Tree Goanna *Varanus varius*

- *Distribution*: Recorded in 40 five-minute cells from a Statewide total of 394 cells.
- *Breeding*: Eggs layed in termite mounds; availability of tree hollows important for recruitment.
- *Habitat requirements*:
 - Large hollow-bearing trees are used for refuge and foraging.
 - Dependent on larger blocks of remnant vegetation.
 - Active termite mounds are essential for breeding success.
 - Complex ground layer and high density of logs needed for the survival of dispersing young.
- *Recent surveys*:
 - Box-ironbark reptile surveys recorded Tree Goanna at three of the 63 sites.
 - Media advertisements and community response produced 38 new records.
- *Representation within Conservation Reserves*: 15% of site records within reserve.
- *Major threats in the Bendigo FMA*:
 - Habitat fragmentation and altered ground cover composition.