

## Diet and Habitat of the Barking Owl *Ninox connivens* in New South Wales

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### Summary

The diet of the Barking Owl *Ninox connivens* at several locations throughout New South Wales was determined by analysis of the contents of regurgitated pellets and the stomach contents of road-killed birds. These data show that the Barking Owl has wide dietary flexibility which probably varies according to local prey availability. Introduced vertebrates were included as major food items for the owls at some localities. A notable feature of the diet of this species, particularly compared with the diet of other Australian large owls, is the frequency with which diurnal birds and invertebrates are taken.

The habitat of the Barking Owl in New South Wales appears to be primarily open woodland or semi-cleared land near creeks and rivers, particularly with one or more species of red gums *Eucalyptus* spp., that contain a number of large trees for nesting and roosting. In coastal areas, the Barking Owl inhabits similar open country, particularly near riverine or swampy areas. These habitat types are now most likely to be found on private land in fragmented forest-agricultural landscapes and are threatened by continued clearing. The status of the Barking Owl in New South Wales remains poorly known and in need of further investigation.

### Introduction

Study of the the Barking Owl *Ninox connivens* has been neglected, compared with recent advances in knowledge of the status and ecology of other Australian large owls. This species is distributed sparsely throughout the temperate and semi-arid areas of mainland Australia, becoming more abundant in the tropical north (Mees 1964, Schodde & Mason 1980, Blakers et al. 1984, Conole 1985, Hollands 1991). Barking Owls are absent or rare in the tall, wet forests of the coast and mountain ranges in New South Wales and Victoria (Milledge et al. 1991, Kavanagh & Peake 1993, Kavanagh 1995, Kavanagh & Bamkin 1995, Kavanagh et al. 1995, Kavanagh & Stanton 1995, Debus et al. unpubl. data). Instead, they appear to inhabit open savanna and tropical woodlands near denser riparian vegetation and clearings (Fleay 1968, Schodde & Mason 1980, Hollands 1991). In New South Wales, it is not known whether the Barking Owl is more common to the east or west of the Great Dividing Range.

The diet of the Barking Owl is known in general terms (Fleay 1968, Schodde & Mason 1980, Barker & Vestjens 1989, Hollands 1991), but only one study has provided any quantification (Calaby 1951). A wide variety of diurnal birds and nocturnal mammals has been recorded in the diet of this owl, and European Rabbits *Oryctolagus cuniculus* appear to form a major component of the diet in southern Australia. Rabbits were recorded in 93% of regurgitated pellets (n=42) collected by Calaby (1951), together with small numbers of bats, water-beetles and one House Sparrow *Passer domesticus*. The Barking Owl is a late winter/spring breeder in southern Australia, with most clutches laid during the period August to October (Schodde & Mason 1980, Hollands 1991, Olsen & Marples 1993). Clutch size ranges from one to three eggs but one or two appears to be the usual number of young fledged per year (Schodde & Mason 1980, Hollands 1991).

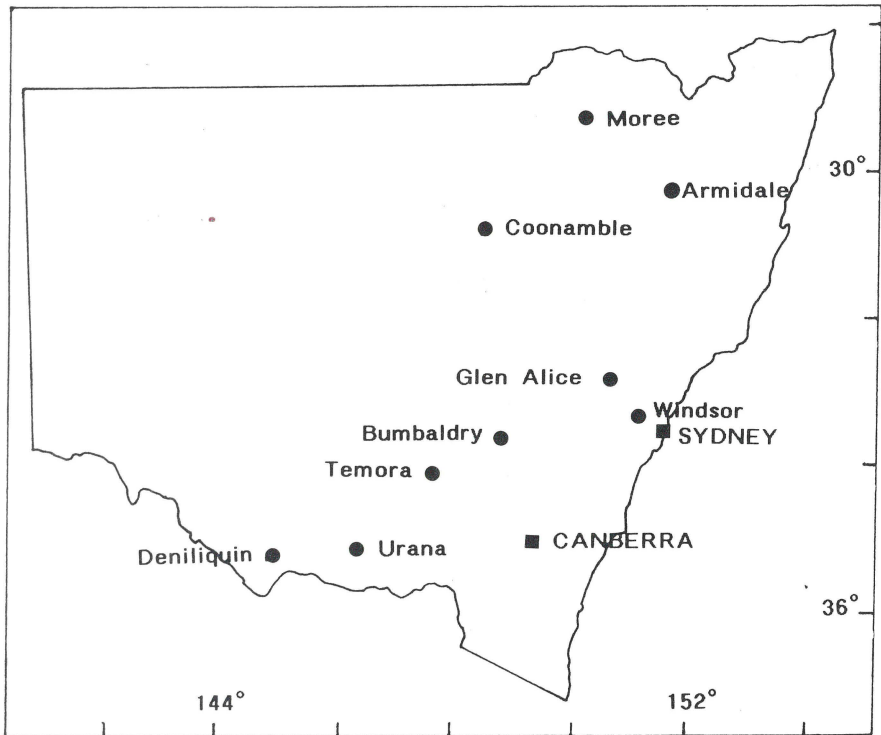


Figure 1. Location of place names mentioned in the text.

This paper reports quantified and incidental dietary data for the Barking Owl from nine locations in New South Wales. The breeding habitat used by five widely separated pairs of owls in New South Wales is described and the breeding success for the owls at three of these locations is reported.

### Study sites and methods

Regurgitated pellets were collected from below the roost or nest trees of four pairs of Barking Owls and below the roost trees used by a young bird at a fifth breeding locality. The locations for these birds (see Figure 1) and the pellet collection dates were: (i) the 'Baram' homestead (29°15'S, 149°15'E), 60 km north-west of Moree in the Moree Watercourse country on 14-16 October 1994; (ii) Glen Alice (33°03'S, 150°12'E), 40 km south-east of Rylestone on 9 October 1994. Additional pellets were collected at Glen Alice on 29 December 1994 and 17 February 1995 from the above location when, each time, only one young bird was observed. The owls were nesting again when the fourth and fifth collections of pellets near the nest tree were made on 13 August and 10 September 1995; (iii) the Edward River (35°32'S, 144°58'E), near Deniliquin in July-August 1991; (iv) Boorolong Creek (29°59'S, 151°26'E), 23 km west of Armidale, on 20 August 1995; and (v) Chain of Ponds Reserve (Stannix Park) (33°31'S, 150°51'E), 15 km north of Windsor, on 4 February 1995 when regurgitated pellets were collected from below several roost sites used by a young Barking Owl (the adults were not located). A pair of Barking Owls was observed (by RJT) at this location on 3 July 1989, and later that breeding season, on 12 January 1990, three birds were observed (by A. and J. Benson; 'Unusual record sheets' appended to the Cumberland Bird Observers Club bimonthly newsletter). This suggests that the owls may breed at this location.

The Moree location can be classified as occurring in the North-west Plains botanical zone (*sensu* McAllan & Bruce 1989), Armidale occurs in the Northern Tablelands zone, and Glen Alice and Deniliquin occur in the Central Tablelands and the South-west Plains, respectively. The location near Windsor, on the eastern side of the Great Dividing Range, can be classified as Central Coast.

The diet of the owls was determined by analysis of the contents of regurgitated pellets. Pellets collected from Deniliquin and from Glen Alice on 9 October 1994 and 10 September 1995 were analysed by Barbara Triggs of Genoa, Victoria. The remaining pellets were analysed by ABR by comparison with reference material in his collection. The contents of each pellet were assumed to be independent of the contents of other pellets in the same sample.

The gut contents of four road-killed Barking Owls were obtained from data sheets held at the Australian Museum: two specimens collected and analysed by ABR (not retained) and two specimens lodged in the Museum. These came from (see Figure 1): (i) and (ii) 5-10 km south of Coonamble (30°58'S, 148°23'E), both on 5 April 1977 and several km apart (North-west Plains); (iii) 40 km west of Temora (34°27'S, 147°37'E) on 13 May 1978 (Central-west Slopes); and (iv) Bumbaldry (33°54'S, 148°27'E), 30 km east of Grenfell on 13 November 1978 (Central-west Slopes). A casual observation of a prey item was obtained by SJSJ at Urana (35°20'S, 146°16'E), date unrecorded, in the late 1960s (South-west Plains).

## Results

### North-west Plains

The pair of Barking Owls at Moree, and their single fledgling, were roosting in Bimble Box *Eucalyptus populnea*-Carbeen *E. tessellaris* semi-arid woodland flanking the Gingham Watercourse which was lined by River Red Gums *E. camaldulensis*. The breeding-season diet of these birds, from a sample of approximately eight partly fragmented pellets (pellets were lumped into one group for analysis), consisted mostly of vertebrates including a native arboreal mammal and three kinds of diurnal birds (Table 1). A small amount of invertebrate material was also included.

The two road-killed owls in autumn at Coonamble, both females, had eaten only insects: (i) 74 scarab beetles (Scarabaeidae), 3+ moths and a mantid; (ii) 83 scarabs, 24 mantids and a grasshopper.

### Northern Tablelands

The pair of Barking Owls near Armidale was detected by vocal responses given by both birds to playback of pre-recorded vocalisations. On the following day (20 August 1995), an adult (presumed male) was observed roosting in the branches of a large creekside Manna Gum *E. viminalis* which was flanked by mostly regrowth woodland of Blakely's Red Gum *E. blakelyi* and Rough-barked Apple *Angophora floribunda*, with River She-oak *Casuarina cunninghamiana* gallery forest on the creek and cleared paddocks nearby. The female was presumed to be nesting inside a large hollow within the Manna Gum. One pellet and fragments of a second pellet were collected from below this tree. The pellet(s) contained the remains of two Eastern Rosellas *Platycercus eximius* and one Black Beetle *Heteronychus arator* (Scarabaeidae).

### Central Tablelands

The pair of Barking Owls at Glen Alice was roosting and nesting in Rough-barked Apple-Blakely's Red Gum woodland, which also included some Yellow Box *E. melliodora* and Narrow-leaved Ironbark *E. crebra*, and an understorey consisting of Fern-leaf Wattle *Acacia filicifolia*, Prickly Tea-tree *Melaleuca styphelioides* and Blakely's Red Gum regrowth. Two adult birds were also recorded at this location on 13 August 1994 by I. Denton ('Unusual record sheets' appended to the Cumberland Bird Observers Club bimonthly newsletter). The nest tree appeared to be a particular Rough-barked Apple containing a very large hollow, although this was not confirmed at night by observations of the birds entering or leaving the hollow. On 9 October 1994, one adult was seen roosting on a branch of this tree; the female was presumed to be inside the hollow. A large sample of pellet fragments (33) was collected from below this tree (pellets were lumped into seven groups for analysis). On 29 December

1994, one juvenile bird was seen roosting approximately 200 m away and a further sample of seven pellet fragments (lumped into two groups for analysis) was collected from below the suspected nest tree. On 17 February 1995, one young bird was seen roosting approximately 500 m away and one pellet was collected. A fourth sample of 16 pellets was collected on 13 August 1995 from below the suspected nest tree where an adult (presumed male) was roosting at the time. Two adults were seen together in the same tree later in the day. Five intact pellets in this sample averaged  $37.3 \times 25.3 \times 14.7$  mm (possibly flattened in transit; range  $31-56.5 \times 23.5-27.5 \times 15-22.5$  mm). A further eight pellets were collected beneath the tree on 10 September 1995.

The breeding-season diet of these birds consisted mostly of vertebrates which were two species of introduced ground mammals and several species of diurnal birds (Table 1). Rabbits, apparently all juveniles, were a major component. Generally, the species of birds could not be determined exactly but the presence of red, black or pink feathers in most pellets, together with the lower mandible of a parrot in one pellet, suggested that rosellas (probably Eastern Rosella) and/or the Galah *Cacatua roseicapilla* were taken by the owls. A small amount of invertebrate material (mainly beetles) was contained in some pellet samples.

#### Central-west Slopes

The stomach of the road-killed owl near Temora in autumn, a male, contained only arthropods: eight moths, a spider, a beetle and a grasshopper. The stomach of the road-killed owl at Bumbaldry in spring, a female, contained the remains of an arboreal mammal: a juvenile Common Brushtail Possum *Trichosurus vulpecula*.

#### South-west Plains

The pair of Barking Owls at Deniliquin was roosting in River Red Gum woodland with patches of Black Box *E. largiflorens* near the Edward River. The birds were also observed occasionally roosting among the foliage of several deciduous trees near the edge of the town of Deniliquin (Rick Webster pers. comm.). A sample of approximately six pellets, which were lumped into one group, was collected from beneath the nest tree (River Red Gum) which has been used in previous years (Webster pers. comm.). At the time of pellet collection (July-August 1991), one bird was roosting in the branches of the nest tree and it was assumed that the female was roosting inside the nest hollow, possibly about to lay eggs. The immediate pre-breeding-season diet of these owls consisted mostly of birds with some invertebrate material (Table 1). Prey remains under the owls' roosts have included Yellow Rosella *Platycercus elegans flaveolus* (Webster pers. comm.).

An owl flushed from its daytime roost low in the foliage of a River Red Gum, on the Urangeline Creek at Urana (season unknown), dropped the rear half of a Magpie-lark *Grallina cyanoleuca*.

#### Central Coast

The young Barking Owl near Windsor (and the adults on previous occasions) was roosting in Cabbage Red Gum *E. amplifolia*-Forest Red Gum *E. tereticornis*-Rough-barked Apple woodland, with some Narrow-leaved Ironbark nearby, and a patchy understorey consisting of Parramatta Wattle *Acacia parramattensis*-Sally Wattle *A. floribunda* and Paperbark *Melaleuca linariifolia*. These birds apparently fledged at least one young in 1989/90 (see above). The nest tree is thought to be one of a number of large Cabbage Red Gums containing large hollows near the observed roosting location. A sample of four pellet fragments collected during the non-breeding

Table 1

Diet of the Barking Owl in New South Wales (see text for details). Data represent minimum numbers of prey per sample.

Species/Food item	Location/Sample													
	Moree	Glen Alice					Deniliquin	Windsor	Coonamble		Temora	Bumbaldry	Urana	Armidale
		1	2	3	4	5			1	2				
Common Brushtail Possum <i>Trichosurus vulpecula</i>											1			
Sugar Glider <i>Petaurus breviceps</i>	1						1							
Lesser Long-eared Bat <i>Nyctophilus geoffroyi</i>							1							
Unidentified bat							1							
European Rabbit <i>Oryctolagus cuniculus</i>		7	3	16	8		2							
Black Rat <i>Rattus rattus</i>		3												
Eastern Rosella <i>Platycercus eximius</i>													2	
Blue Bonnet <i>Northiella haematogaster</i>	3													
Parrot (Psittacidae/Cacatuidae)		1												
Magpie-lark <i>Grallina cyanoleuca</i>												1		
Finch sp. (Passeridae)	1													
Common Starling <i>Sturnus vulgaris</i>	4		1											
Unidentified bird		7			1		1+							
Passerine egg (shell fragments)			1											
Water beetle (Hydrophilidae)	1													
Scarab beetles (Scarabaeidae)							13	74	83				1	
Beetles (Elateridae)							1							
Weevils (Curculionidae)							2							
Unidentified beetles		7	1+	1		1+	3				1			
Moths								3+			8			
Mantids								1	24					
Grasshoppers									1		1			
Spiders											1			

season contained mainly invertebrate material but also the remains of several mammals, including the Lesser Long-eared Bat *Nyctophilus geoffroyi* (Table 1).

## Discussion

The locations of owls considered in this study, together with the results of regional surveys elsewhere, suggest that the Barking Owl is not a true forest bird. Although Calaby (1976) reported the Barking Owl to occur in heavily forested country, in addition to its most common occurrence in savanna woodland (Fleay 1968, Schodde & Mason 1980), our surveys in south-eastern and northern New South Wales indicate that it is very uncommon in forests in New South Wales (Kavanagh & Peake 1993, Kavanagh 1995, Kavanagh & Bamkin 1995, Kavanagh et al. 1995, Kavanagh & Stanton 1995, Debus et al. unpubl. data). Fleay (1968) regarded the Barking Owl to be 'the most vociferous, irrepressible and cheerful of our owls', which suggests that the presence of this species should have been relatively easy to detect during surveys.

The habitat of the Barking Owl in New South Wales appears to be primarily open woodland or semi-cleared land near creeks and rivers, particularly with one or more species of red gums, that contain a number of large trees for nesting and roosting. This assessment agrees closely with that of Hollands (1991). Records of the Barking Owl in coastal areas of New South Wales also suggest (as does Hollands for northern Australia) that this species frequently inhabits similar open country, particularly near Broad-leaved Paperbark (*Melaleuca quinquenervia*) swamps and the ecotone between open forest and cleared agricultural valleys (Kavanagh et al. 1995, John Young pers. comm., Robyn Farrell pers. comm.). These environments, which occur predominantly on privately owned land, can be described as variegated rather than fragmented landscapes (McIntyre & Barrett 1992). Although the Barking Owl may be tolerant of intermediate levels of disturbance, these landscapes are under threat of degradation by continued clearing and require management to maintain local species richness (Barrett et al. 1994). In forests on the south coast of New South Wales, Davey (1993) found that the Barking Owl was similar to the Masked Owl *Tyto novaehollandiae* in its selection of drier and more open forest habitats compared with the Powerful Owl *Ninox strenua* and the Sooty Owl *Tyto tenebricosa*. More surveys are needed in the predominantly privately owned forests and woodlands of New South Wales to determine the status of this species.

Our records of breeding success (four records of at least one fledgling) may be low in comparison with the literature where one to three owlets have been reported (Fleay 1968, Schodde & Mason 1980, Hollands 1991). Relationships between the type of habitat occupied by the owls, prey type and availability, and breeding success for the Barking Owl are unknown.

Our data on owl diets show, in agreement with earlier reports (Calaby 1951, Fleay 1968, Schodde & Mason 1980, Barker & Vestjens 1989, Hollands 1991), that the Barking Owl is an opportunistic predator whose dietary flexibility is probably a response to local prey availability. Introduced vertebrates (i.e. the Rabbit, Black Rat *Rattus rattus* and Common Starling *Sturnus vulgaris*) were major food items at some localities. That the European Rabbit was recorded in the diet at only two localities is of interest compared with the apparently heavy utilisation of this species as prey elsewhere (Calaby 1951, Hollands 1991, Muir & Corke 1993). Calaby reported that Rabbit remains were found in nearly every one of 42 pellets collected during May-July from the roosting area of one pair of Barking Owls in the central Murray Valley, northern Victoria. However, Rabbits are uncommon in the flood-prone riverine forests and woodlands near Deniliquin (Webster pers. comm.). Our data suggest that the

owl is by no means dependent on the Rabbit where other suitably sized birds and mammals are available. The records of the bats and the presence of passerine eggshell fragments (possibly Grey Shrike-thrush *Colluricincla harmonica*?) in the pellets further illustrate the apparent flexibility in foraging behaviour of the Barking Owl.

Fleay (1968) indicated that it was 'a fairly common occurrence' for the Barking Owl to kill and eat a variety of arboreal marsupials such as the Common Ringtail Possum *Pseudocheirus peregrinus*, Sugar Glider *Petaurus breviceps* and Squirrel Glider *P. norfolcensis*. He also reported that one Barking Owl pellet from the Clarence River area near Grafton, N.S.W., contained the remains of two Sugar Gliders, insect remains and also some fish spines, and, in captivity, a Barking Owl killed and ate a Tawny Frogmouth *Podargus strigoides* in a single night.

A notable feature of the diet of this species, particularly compared with the diet of other large owls including the Masked Owl and the Powerful Owl with which it is more likely to be sympatric, is the frequency of diurnal birds and invertebrates taken (Fleay 1968, Schodde & Mason 1980, Hollands 1991, Kavanagh unpubl. data). Most pellets examined contained some bird and/or invertebrate material. The records of Fleay (1968) and Barker & Vestjens (1989) provide an extensive list of avian prey species.

Vertebrates (mammals and/or birds) appear to dominate the diet of the Barking Owl during the breeding season whereas invertebrates appear to be taken in relatively greater proportion during the non-breeding season. The three owls road-killed during the non-breeding season (in autumn) each had stomachs containing only a large number and variety of invertebrates. It is not known whether these birds were dispersing immatures forced into suboptimal areas or whether this species becomes largely insectivorous during the warmer months of the non-breeding season at southern as well as northern latitudes (cf. Schodde & Mason 1980). Additional data are needed on the diet of this owl at different times of the year and from more habitats, particularly so that comparisons can be made between habitats occupied by the owls on the eastern and western sides of the Great Dividing Range in New South Wales.

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