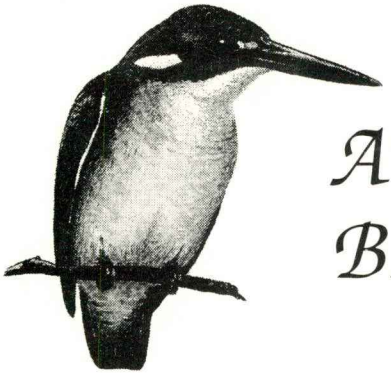

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Back	*Barking Owl, Coongie Lakes*	**Photo**	Stuart Fairbairn

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THE BARKING OWL IN NEW SOUTH WALES

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Summary

Records of the Barking Owl *Ninox connivens* (n=496) were collated, and associated literature reviewed, in order to assess the Owl's distribution, habitat, biology and status in New South Wales. Pellets and prey remains were collected from the breeding territory of one pair on the Northern Tablelands in 1996-97; the Owls' breeding diet consisted of mammals (49% by biomass, mostly arboreal marsupials), birds (50%) and insects (1%), and their non-breeding diet arboreal mammals (53% by biomass), birds (46%) and insects (1%). It is concluded that: (1) the Barking Owl typically inhabits woodland of various red gum *Eucalyptus* species primarily in warmer, lowland areas of the coast, western slopes and plains; (2) it requires dense riparian thickets for roosting and old eucalypts for nesting; (3) it hunts in the woodland canopy and, although eating many birds and insects, also eats mammals including arboreal/scansorial species where rabbit kittens are unavailable; (4) habitat clearance in its likely core distribution and habitat, the fertile riparian flats on private land in inland NSW, is severe and continuing. In view of its apparent rarity and decline, and extreme threats to its remaining core habitat, it is recommended that the Barking Owl be declared threatened in NSW.

INTRODUCTION

The range and status of the Barking Owl *Ninox connivens* in New South Wales have been given as "uncommon, all regions, absent extreme north-west" (Morris et al. 1981), with Taylor & COG (1992) claiming that the Owl is absent from the South Coast despite prior published records from that region. It is considered to be generally sparser or much scarcer than the Southern Boobook *N. novaeseelandiae* and rare in south-eastern Australia (Schodde & Mason 1980, Hollands 1991), a situation confirmed by recent work (e.g. Kavanagh & Peake 1993, Debus 1995 and in press, Kavanagh 1995, Kavanagh & Bamkin 1995, Kavanagh et al. 1995a,b). Records in the Atlas of Australian Birds (Blakers et al. 1984) show it to be more widespread in NSW than the Powerful Owl *N. strenua*, but at a lower average reporting rate than that species. Olsen (in Strahan 1994) considered the Barking Owl "now uncommon" in southern Australia, and destruction of woodland a threat. Cooper & McAllan (1995) considered that the Barking Owl's population has been reduced in NSW through clearing of breeding habitat, yet it should be more common than records suggest. Lindsey (1992) classified it as "possibly endangered" nationally. It

is now classified as threatened in Victoria and South Australia (e.g. Robinson & Traill 1996) and in the Western Division of NSW (Smith et al. 1995), and is considered threatened throughout the temperate woodlands of Australia, owing to massive loss of habitat (Robinson 1994). All these assessments contrast with that of Gould (1843, 1865), who received specimens from "nearly every part of [the colonies of] New South Wales" and stated it to be "far more common" than the Powerful Owl.

While carrying out surveys for the supposedly rare large forest owls (Powerful, Sooty *Tyto tenebricosa* and Masked Owls *T. novaehollandiae*), Debus (1995) failed to find any Barking Owls. Similarly, other owl surveys found the Barking Owl at only a few sites in north-eastern NSW (NSW NPWS 1994, Kavanagh et al. 1995b). This situation prompted a similar survey for the Barking Owl by the Zoology Department, University of New England. Field work for that survey commenced in 1995, concentrating on the North-west Slopes of NSW. Meanwhile, concern was being expressed by others over the apparent rarity and decline of the Barking Owl, particularly in inland NSW and the drier forests and woodlands of Victoria, and its low numbers compared with records for the Powerful Owl (Smith & Smith 1994; Smith et al. 1994, 1995; Robinson 1991, 1994; Harley 1995; Morris & Burton 1995; Kavanagh et al. 1995a). The Barking Owl was also not recorded during surveys for large forest owls in south-eastern NSW (Kavanagh & Peake 1993, Kavanagh & Bamkin 1995), nor in forests of the Central-west and South-west Slopes despite targeted surveys using Barking Owl call playback (Kavanagh 1995, Kavanagh & Stanton in press). Kavanagh et al. (1995a) identified the need for a survey of the Owl's distribution and status in NSW, and posed questions regarding its status east versus west of the Great Dividing Range and on private versus public land.

This paper reviews the distribution, status and biology of the Barking Owl in NSW, particularly with respect to regional patterns, and presents new data on its diet. The paper attempts, in part, to answer some of the questions posed by Kavanagh et al. (1995a). Some preliminary findings of the UNE project are presented elsewhere (Kavanagh et al. 1995a, Debus in press).

METHODS

Records of the Barking Owl in NSW to 1996 were collated from the literature, museums (Australian Museum [AM], Museum of Victoria H.L. White Collection [MV/HLW], Australian National Wildlife Collection [ANWC, CSIRO, Canberra]), the RAOU Atlas of Australian Birds and Nest Record Scheme, mapped NSW Bird Atlassers' records in Cooper & McAllan (1995), colleagues' unpublished data, and personal sightings (unpubl. records in Appendix 1). Literature records (Appendix 2) were obtained from the

following sources: *Emu*, *Corella*, *Australian Bird Watcher*, *Australian Birds* including NSW FOC annual bird reports 1970-1994, *Canberra Bird Notes*, *NSW FOC Newsletter* "unusual records" series by Morris & Chafer and Morris & Gladwin to December 1996, *NSW Bird Atlassers Newsletter, Cumberland Bird Observers Club Newsletter*, and books, reports and other publications (Gould 1843, 1865; North 1911; Mathews 1915-1916; Fleay 1968; Wheeler 1974 [sufficiently precise locations]; Rolls 1981; Morris 1984; Gibson 1989; Davey 1993). Some records were reported by more than one source, therefore care was taken not to double-count records. One record was taken as one bird at one locality in one year (i.e. two birds = two records); fledglings were counted but nestlings were not. As far as possible, the same range of sources was used as for the Powerful Owl (Debus & Chafer 1994 and subsequently published FOC records), so that the results for both owl species are comparable.

Owl sites were located on topographic maps and assigned to the botanic provinces of Anderson (1961). A "site" was taken as a record or cluster of records assumed to represent a single occupied home range.

Regurgitated pellets from one site (Boorolong Creek west of Armidale) were analysed by A.B. Rose, and prey remains from there and another site (Puddledock north-east of Armidale) were identified by comparison with reference material. The minimum number of prey individuals in each pellet sample was determined by counting skeletal parts.

RESULTS

Distribution and habitat

The Barking Owl has indeed been recorded in all the regions of NSW (as defined by Anderson 1961 and adopted by McAllan & Bruce 1989). A record for Sturt National Park (Appendix 1) shows that it is not absent from the extreme north-west (*contra* Morris et al. 1981), though it must be sparse and local, at favourable sites, in the arid zone (see Figure 1). Recent records show that it is not "accidental" to the South Coast (*contra* Morris & Burton 1994); increased observer effort produced "more records S Coast than usual" (Morris & Burton 1996), with recent owl surveys producing further records (Appendix 1).

Available records (n=496, at 317 sites) show that the most important regions for the Barking Owl are the coast (35% of sites), slopes (22%) and plains (27%), with fewer sites on the tablelands (14%) and far western plains (3%) (Table 1, Figure 2). The combined total for the slopes, plains and far west (51% of sites) suggests that the Owl is more numerous west of the Divide than on the coast, given that bird-watching effort is probably

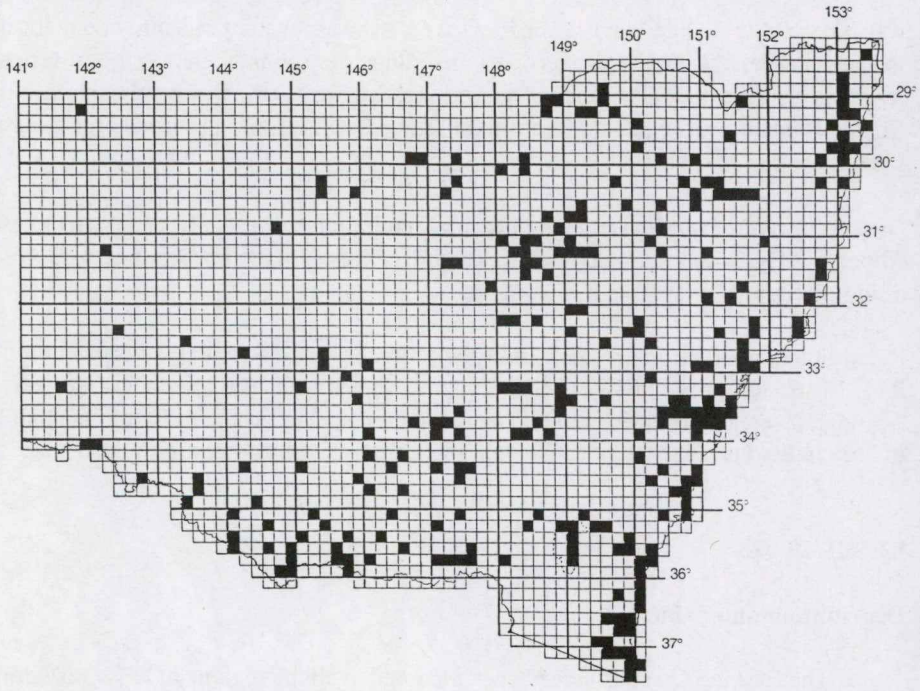

Figure 1. Distribution of the Barking Owl in New South Wales in ten-minute grids, incorporating mapped records of Cooper & McAllan (1995). Ten records not shown because exact localities unknown: Tweed, Richmond/Clarence and Clarence Rivers; Wellington-Dubbo region; Quandialla 1-degree block; Wagga Wagga to Murray R (Appendix 1); Grafton district and Clarence R; Watling drawing from Sydney; Lachlan/Murrumbidgee Rivers (Appendix 2).

much higher on the coast. That is, the probability of encountering Barking Owls seems much higher per unit of observer effort west of the Divide than east.

The totals for each region probably in part reflect the relative sizes of the various regions; the high observer density on the Central Coast and around Canberra (Southern Tablelands), with the Central Tablelands also within easy reach of Central Coast observers; and recent owl surveys particularly on the North and South Coasts. The relative importance of each region, and any changes in the Owl's status within those regions, are difficult to assess because many historical records came from the Central-west Slopes and South-west Plains (= Riverina) where there were resident ornithologists, whereas many Field Atlas and NSW Bird Atlas records came from the North and Central Coasts and/or the North-west Plains where the Owl (at least in recent decades) seems more numerous than elsewhere. Apparent gaps in distribution coincide with the moist forests of the eastern fall of the Northern Tablelands, and the higher elevations of the Southern Tablelands. It appears that the Owl generally reaches its highest densities in the lowland, warmer (i.e. northerly) regions with the strongest Torresian (tropical) influence. In far western NSW the Owl generally appears restricted to the vicinity of the Darling River (Figure 1, cf. Figure 7 of Cooper & McAllan 1995), with outlying occurrences on creeks within low ranges (Mootwingee area and Sturt National Park). It seems to be absent from intervening dry areas with ephemeral surface water (e.g. Peri Lake area between the Darling River and Sturt National Park; P. & J. Smith pers. comm.).

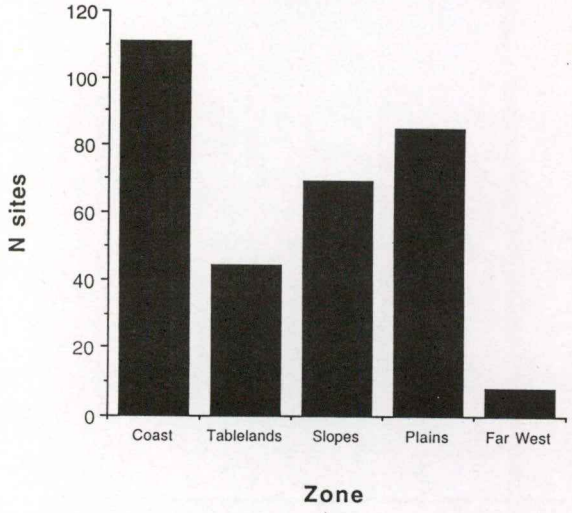

Figure 2. Number of NSW sites (total 317) with Barking Owl records, by botanic/moisture zone (after Anderson 1961 and McAllan & Bruce 1989).

Barking Owl records exist for 21 state forests (26 sites) and 24 national parks and equivalent reserves (29 sites; Appendices 1 and 2). However, the Owl seems to avoid the moist coastal and tableland wood-production forests, with most records in state forests coming from lowland or floodplain open forest on the coast (e.g. forest red gum *Eucalyptus tereticornis*), box/ironbark/cypress woodland on the western slopes and plains, and river red gum *E. camaldulensis* woodland on the plains. Similarly, most records for reserves come from dry, infertile coastal forest or from large woodland remnants on the western slopes and plains. As far as can be ascertained from the data sources, most records (262 sites, 83%) appear to come from woodland on private property or other unprotected land.

Table 1

Number of sites at which the Barking Owl has been recorded in New South Wales, within the botanical regions defined by McAllan & Bruce (1989), from published and unpublished records (Appendices 1 and 2). For clusters of records, a "site" encompasses those assumed to refer to a single occupied owl territory.

Region	n sites	%
North Coast	41	13
Central Coast	42	13
South Coast	28	9
Northern Tablelands	14	4
Central Tablelands	13	4
Southern Tablelands	17	5
North-west Slopes	25	8
Central-west Slopes	34	11
South-west Slopes	10	3
North-west Plains	45	14
South-west Plains	40	13
North Far West Plains	2	1
South Far West Plains	6	2

The few habitat notes associated with the data sources consulted (Appendices 1 and 2, Table 4) support the view that the Barking Owl is particularly associated with coastal, lowland or riparian woodland dominated by various red gum species (also Kavanagh et

al. 1995a). For instance, seven of eight locations occupied by resident pairs of the Owls were timbered creeklines with rough-barked apple *Angophora floribunda,* yellow box *Eucalyptus melliodora*, Blakely's red gum *E. blakelyi*, river she-oak *Casuarina cunninghamiana* and river red gum, sometimes adjoining farmland (Coonabarabran area: Appendix 1, A.K. Morris pers. comm.). The Owl often roosts in associated non-eucalypts or midstorey shrubs: commonly river she-oak gallery forest or riparian cooba *Acacia salicina*/river cooba *A. stenophylla* thickets (also Schodde & Mason 1980). It also roosts in rough-barked apple (Kavanagh et al. 1995a, R. Kavanagh pers. comm.), which has a more densely foliaged canopy than most other eucalypts. There are records of Barking Owls roosting in wilga trees *Geijera parviflora*, in gully rainforest, and in various introduced trees around farm buildings and even in towns (Appendices 1 and 2; Kavanagh et al. 1995a). It appears that, if possible, roost trees are commonly selected that have denser daytime cover than is usually provided by eucalypts (also Hodgon 1996). Nevertheless, Barking Owls also roost in eucalypts, including river red gum (e.g. Kavanagh et al. 1995a). A single record of a Barking Owl roosting in a cave (Chafer 1992) is probably exceptional and biologically insignificant. Foraging and breeding are conducted in red gum woodland contiguous with roosting sites (also Schodde & Mason 1980, Hodgon 1996).

Diet and foraging

In addition to the data of Kavanagh et al. (1995a) on the Boorolong Creek (Armidale) pair of Barking Owls, i.e. Eastern Rosella *Platycercus eximius* and beetle in pellets in August, further pellet fragments and prey remains were collected from that site on 6 and 26 April 1996, and four intact pellets and fragments of others were collected in late April 1997. The four pellets measured 16-27 x 16-32 mm (mean 21.8 x 26 mm). Similar numbers of birds, mammals and insects were represented in the pair's non-breeding diet (Table 2), but mammals (53%) and birds (46%) contributed most by biomass and insects least (1%). The mammal was a native arboreal species, the sugar glider *Petaurus breviceps.* At a Barking Owl roost at Puddledock north-east of Armidale in April 1996 were Pheasant Coucal *Centropus phasianinus* and rabbit *Oryctolagus cuniculus* remains. These data suggest a reliance on vertebrates as prey in the cooler months, as opposed to insects in the warmer months (cf. Kavanagh et al. 1995a).

Pellets and prey remains were collected from the roosts of the Boorolong Creek (Armidale) pair and three fledglings over spring-summer, November 1996 to January 1997. Among 33 pellets or pieces thereof, 15 measurable pellets were 16-32 x 20-64 mm (mean 23.4 x 37.7 mm). The Owl family's diet in the immediate post-fledging phase consisted mostly of insects by number (59%), with the remainder birds (22%) and mammals (20%; Table 3). However, by biomass, birds (50%) and mammals (49%) were more important than

insects (1%). Despite an abundance of rabbits in the district, with the calicivirus having little effect locally (pers. obs.), the mammals taken were mostly native arboreal species, with no rabbits and only one introduced mouse taken. These data confirm that, although insects are taken in large numbers in the warmer months, vertebrates are important through the post-fledging phase of the breeding cycle when the adult Owls are still feeding young. For this adult pair, breeding and non-breeding diets were similar (cf. Table 2).

These results are broadly similar to those for comprehensive pellet samples (>20 prey items) from two other sites in NSW, although there is some regional variation (Glen Alice and Windsor: Kavanagh et al. 1995a). In the combined total for Glen Alice samples (Central Tablelands), mammals contributed 71% of items, birds 15% and insects 14% by number, and 96%, 4% and <1% respectively by biomass (from Kavanagh et al. 1995a, with mammal weights from Strahan 1995 and assuming 500 g for immature rabbits). Rabbits predominated by number (67%) and biomass (92%), with introduced rats contributing the remainder of mammalian captures and biomass. For Windsor (Central Coast), mammals contributed 23% and insects 77% by number, and 99% and 1% by biomass, respectively. Three native mammals were taken versus two rabbits, although the latter contributed most (86%) by biomass.

Table 2

Non-breeding diet of a pair of Barking Owls near Armidale, New South Wales, April 1996 and April 1997: minimum no. of individuals from pellets and prey remains. Mammal weights from Strahan (1995), local bird weights from Ford & Bell (1981), insects assumed to be 1 g.

Prey species	Weight (g)	n
Sugar glider *Petaurus breviceps*	128	**3**
Laughing Kookaburra *Dacelo novaeguineae*	305	1
Double-barred Finch *Taeniopygia bichenovii*	11	1
Small passerine	20	1
Total birds		**3**
Unidentified beetle	1	2
Cricket/grasshopper (Orthoptera)	1	1
Unidentified insect	1	1
Total insects		**4**
Total		**10**

Other, fragmentary data support the impression of a diet mainly of birds and/or mammals, with some insects, in NSW. For a family of Barking Owls on the Castlereagh River at Gulargambone in spring 1980, "all" the pellets beneath the roost and nest trees contained Galah *Cacatua roseicapilla* feathers; Galahs roosted along the river at that point (A.K. Morris pers. comm.). A resident pair on the NSW Central Coast (Mangrove Mountain) preyed on Laughing Kookaburras *Dacelo novaeguineae* (M. Pointer per A.K. Morris). Prey at a site near Deniliquin was mainly birds, particularly cockatoos *Cacatua* sp. and rosellas *Platycercus* sp. (Robinson 1994). Cox (in North 1911 and Mathews 1915-1916) recorded caterpillars, mantis and rabbit as Barking Owl prey at Mudgee. Austin (in North 1911) recorded rabbits, Red-rumped Parrots *Psephotus haematonotus* and large beetles in the Owls' nests at Cobbora. Austin (in Mathews 1915-1916) also observed perch-hunting and successful sallying for small insectivorous bats, which have been recorded in other dietary studies (Calaby 1951, Robinson 1994, Kavanagh et al. 1995a). Pellets from the Grafton region contained two sugar gliders, insects and fish spines (Fleay 1968). One Barking Owl took a domestic chicken *Gallus gallus* (and was consequently shot; Morse 1922). Hobbs (1961) commonly observed Barking Owls hawking for flying insects on evenings in late summer.

These dietary records, together with those of Kavanagh et al. (1995a), show the Barking Owl to be an adaptable and generalised predator that is able to switch to introduced prey species, take more diurnal birds than most other Australian owls, and subsist on insects in the warmer post-breeding months. The birds taken include common, adaptable and increasing species. However, it is possible that immature rabbits are near the upper limit of the Owl's prey size-range and, where these are unavailable or available only seasonally, it requires other suitably sized mammals such as sugar gliders at critical stages of its own life-cycle (e.g. in winter or when breeding). These arboreal mammals require at least some tree cover or extensive woodland, including some reasonably mature trees with cavities, and an understorey of *Acacia* species (e.g. Strahan 1995). Furthermore, the birds taken are species that require woodland at least for roosting purposes, at which times they are probably captured by the Owls; many (e.g. parrots) are also hollow-dependent for breeding purposes.

Of mammalian captures in the summer prey sample at Armidale, seven (86%) were arboreal versus one terrestrial; the former contributed almost all (98%) mammalian prey biomass. Conversely, for mammalian prey at Glen Alice, 94% (96% of mammalian prey biomass) were terrestrial and the remainder scansorial (from Kavanagh et al. 1995a). For mammalian prey at Windsor, three were arboreal or aerial versus two terrestrial, but the latter contributed most (87%) mammalian prey biomass (from Kavanagh et al. 1995a). Although there is great regional variation even within NSW, it appears that where possible the Owl prefers to forage in woodland and capture mammals in the tree canopy.

Table 3

Breeding diet of a family of Barking Owls near Armidale, New South Wales, November 1996 to January 1997: minimum no. of individuals from pellets and prey remains. Mammal weights from Strahan (1995), local bird weights from Ford & Bell (1981), insects assumed to be 1 g.

Prey species	Weight (g)	n	%
Sugar glider *Petaurus breviceps*	128	5	
Squirrel glider *Petaurus norfolcensis*	230	1	
Common ringtail possum *Pseudocheirus peregrinus*	450[a]	1	
House mouse *Mus domesticus*	18	1	
Total mammals		**8**	**20**
Crimson Rosella *Platycercus elegans*	120	1	
Eastern Rosella *Platycercus eximius*	110	1	
Dollarbird *Eurystomus orientalis*	140	1	
Grey Shrike-thrush *Colluricincla harmonica* (juv.) ?	64	1	
Australian Magpie *Gymnorhina tibicen*	387	1	
Pied Currawong *Strepera graculina*	300	1	
Common Starling *Sturnus vulgaris*	78	1	
Small passerine	20	1	
Bird sp	152[b]	1	
Total birds		**9**	**22**
Christmas beetle *Anoplognathus* sp.	1	5	
Other scarabs (Scarabaeidae)	1	13	
Stag beetle (Lucanidae)	1	1	
Longicorn beetle *Phoracantha semipunctata*	1	1	
Unidentified beetle	1	3	
Cricket/grasshopper (Orthoptera)	1	1	
Total insects		**24**	**59**
Total		**41**	

[a] juvenile (assumed to be half adult weight)
[b] mean of identified species

Eight or nine of 496 Barking Owl records (1-2%) were of road-killed birds (Appendices 1 and 2). This is the same as 1-2% of Powerful Owl records (Debus & Chafer 1994), but contrasts with 20% of Masked Owl records (Debus & Rose 1994). These figures suggest that the Barking Owl is much less inclined than is the Masked Owl to hunt from low perches beside roads, and are consistent with the dietary data that the Barking Owl is more active in the woodland canopy, taking birds and arboreal/scansorial as well as terrestrial mammals and hawking for insects. The few recent data on Barking Owl hunting behaviour come from outside NSW, but support such an interpretation (see Aumann 1991, Hodgon 1996).

Morphology

Schodde & Mason (1980) gave the weight range of the Barking Owl as 425-510 g for males and 425-485 g for females. Although their only NSW specimen (ANWC 223) was a 425 g female, most of their weight data derive from tropical Australian specimens in the collection. Individuals from NSW are considerably heavier than northern birds, as revealed by specimens (Australian Museum; see Appendix 2): male of 596 g, females of 676, 680 and 709 g. Furthermore, two fully grown (unsexed) juveniles of northern NSW provenance weighed 580 and 690 g (pers. obs.). Two males from south-east Queensland weighed 639 and 708 g and a female 540 g, and an unsexed bird from north-east Queensland weighed 710 g (Qld Museum data). The combined data give males 596-708 g (mean 648 g, n=3) and females 425-709 g (mean 606 g, n=5) for eastern Australia. These body weights for southern Barking Owls place them in the size range of southern mainland Masked Owls (cf. Debus 1993), and raise questions about niche partitioning between these two similarly sized, sympatric owl species. The Barking Owl is intermediate in size between its sympatric congeners in NSW, the Southern Boobook and the Powerful Owl (cf. Schodde & Mason 1980); its general "mien" is that of small Powerful Owl rather than large Boobook (pers. obs.; also Fleay 1968).

Breeding biology

The few nests described for NSW (Table 4) show that Barking Owls use available hollows with entrances 2-29 m above ground, depending on the forest or woodland structure and canopy height. One hollow was 75 cm deep (North 1911), but in another case the nest chamber was at ground level in a sloping hollow trunk, 2 m below the entrance (Fleay 1968). Most recorded breeding events in NSW have been in live river red gums in riparian woodland of that species, but these are heavily biased by the records of Austin (in North 1911 and associated museum data).

Table 4

Breeding parameters of the Barking Owl in New South Wales. F = forest, W = woodland. *E* = *Eucalyptus*, *A* = *Angophora*. Height = height of nest hollow entrance above ground. Sources: 1 = Cobbora (separate nests: Austin in North 1911, Aust. Museum, Mus. Victoria, Qld Mus.); 2 = Aust. Museum; 3 = Fleay (1968); 4 = Hobbs & Kaveney (1962); 5 = Stannix Park (different years: FOC bird reports, Kavanagh et al. 1995a); 6 = Glen Alice (different years: FOC bird reports, Kavanagh et al. 1995a, A. Ley); 7 = FOC annual bird reports; 8 = RAOU Field Atlas; 9 = Kavanagh et al. (1995a), S. Cook; 10 = R. Webster/RAOU Nest Record Scheme; 11 = Costello (1981); 12 = Rolls (1981).

Habitat	Nest tree sp.	Height (m)	Month	Stage	Clutch/brood size (n)	Source
W	*E. camaldulensis*	16	Aug	eggs	C/3 x 2	1
W	*E. camaldulensis*	?	Aug	hatchlings	B/3	1
?	?	?	Sep	eggs	C/2	1
?	dead	?	Sep	eggs	C/3	1
?	?	?	Sep	nestlings	B/2	1
?	?	?	Sep	nestlings	B/3	1
W	*E. camaldulensis*	16/21	Oct	eggs	C/3 x 2	1
W	*E. camaldulensis*	21	Oct	nestlings	B/2	1
?	?	?	Nov	eggs	C/2	1
?	?	?	Dec	fledged	B/? x 3	1
?	?	?	Aug	egg(s)	C/?	2
?	?	?	Aug	eggs	C/3	2
W	*E. microcarpa*	2.1	Dec	large nestlings	B/3	3
F	*E. pilularis*	29	?	?	?	3
?	?	?	Dec	fledged	B/2	4
W	*E. amplifolia*?	?	Nov	fledged	B/1	5
			Jan	fledged	B/1	5
			Feb	juvenile	B/1	5
W	*A. floribunda*?	?	Aug-Dec	nesting, fledged	B/1	6
			Nov, Jan	fledged	B/2	6
			Feb	juvenile	B/1	6
			Oct	fledged	B/2	6
?	?	?	Oct	fledged	B/2	7
W	*E. camaldulensis*		Nov	fledged	B/3	7
?	?	?	?	juveniles	B/3	7
?	?	?	Feb	juveniles	B/2	7
?	?	?	Jan	juveniles	B/2	8
W	*E. viminalis*	?	Aug	eggs?	?	9
			Oct	fledged	B/3	9
W	?	?	Nov	fledged	B/1	9
F	*E. camaldulensis*	25	Aug-Sep	eggs?	?	10
W	*E. camaldulensis*	?	?	?	?	11
W?	?	?	?	fledglings	B/2	12

Like other *Ninox*, the Barking Owl is a strictly seasonal breeder raising a single (small) brood per year. From the few data (Table 4), it appears that in NSW most eggs are laid in late winter and early spring (three clutches in August, two in September, two in October), with one clutch in November probably representing re-laying after robbery by humans (see North 1911). This interpretation is supported by a record of hatchlings in August, which suggests that laying may occasionally take place in late July; records of nestlings in September (two broods), October (one brood) and December (one brood); and recently fledged young in October (three broods), November (three broods), December (five broods) and January (two broods). Records of dependent juveniles in January and February suggest that the post-fledging dependence period lasts up to 3-4 months.

For data obtained early this century (Table 4), the modal clutch size was three (C/2 x 2, C/3 x 6; mean 2.8) and the modal brood size for nestlings was also three (B/2 x 2, B/3 x 3; mean 2.6). Data for brood size after fledging (B/1 x 5, B/2 x 7, B/3 x 3; mean 1.9) come from recent years, thus precluding any assessment of whether nestling brood reduction occurs or whether fledging success has declined over time in NSW, or both (cf. Kavanagh et al. 1995a). Schodde & Mason (1980) asserted that all of the brood usually survive to fledge. If so, then fledging success may indeed have declined in NSW.

There are records from outside NSW of nests in sheltered tree crotches, rock crevices and rabbit burrows (Schodde & Mason 1980, Hollands 1991). Nevertheless, such unusual and infrequent nest types are probably exceptional, and it is likely that in most areas the Barking Owl is dependent on hollows in old eucalypts for nest sites.

Mortality

There is only one mention, from outside NSW, of a Barking Owl being caught on a barbed-wire fence (Fleay 1968), in contrast with five NSW records of Masked Owls striking fences or wires (Debus & Rose 1994). This suggests that fences and wires may be less of a hazard to the Barking Owl, perhaps related to its greater confinement to woodland cover or to a greater tendency to perch and fly at higher levels. However, Barking Owls have been found dead under powerlines on foggy mornings (Coonabarabran area, NSW: A.K. Morris pers. comm.).

There are also far fewer records of road-killed Barking Owls than of Masked Owls in NSW (see above). Collisions with vehicles seem to be a lesser hazard for the Barking Owl, again perhaps in keeping with its behaviour and greater confinement to the woodland canopy, although it may also be rarer than the Masked Owl in coastal areas of high traffic volume. Similarly, although Barking Owls have been caught in rabbit traps (outside NSW: North 1911), this seems to have been less of a hazard than for the Masked Owl (cf. Debus 1993).

A potential threat to the Barking Owl is secondary poisoning by brodifacoum-based rodenticides ("Klerat", "Talon"). However, the risk may be less for the Barking Owl than for grassland and woodland *Tyto* species, and then only in woodland contiguous with crops suffering heavy rodent damage where brodifacoum is used routinely (Young & De Lai 1997).

Threatening processes

For the Barking Owl, Gilmore & Parnaby (1994) identified threatening processes in north-eastern NSW as ongoing clearing of habitat, particularly on flatter topography on and adjacent to flooplains, and changes to the age structure of tree cover, resulting in decline of old and dead trees. These processes apply statewide, with agriculture and timber or firewood harvesting the major factors.

Timber harvesting in state forests is likely to be less of a concern for the Barking Owl than for the large forest owls, for several reasons: (a) the Barking Owl is marginal to the coastal and tableland wood-production forests; (b) its prey species are mostly not old-growth dependent, although some require hollows; (c) logging prescriptions, designed to protect old trees and riparian zones, apply in inland forests (e.g. Robinson 1994); (d) the Owl's populations fall mainly outside state forests. Although not occurring in regenerating forest <60 years old, the Barking Owl otherwise shows no relationship with forest age-classes (Davey 1993). Nevertheless, the skewed distribution of large hollow trees on farmland versus the heavily logged inland forests is suggested as one reason for the Barking Owl's occurrence on private versus public land in the temperate woodlands (Robinson 1994). Harvesting of trees for firewood rather than timber is a major concern in the inland forests and woodlands (Robinson & Traill 1996).

By far the greatest threat to the Barking Owl is further loss and degradation of habitat, with consequences for the Owl's foraging and breeding requirements (i.e. loss of hunting habitat and potential roosting and nest sites) and for its prey base. The major factor is further clearing for agriculture in inland NSW, compounded by suppression of eucalypt regeneration by grazing, decline of remnant trees in cleared areas, and reduction of prey (decline of small native mammals); in woodland remnants, nest hollows may also be lost to timber or firewood harvesting and to feral honeybees *Apis mellifera* (Smith et al. 1995).

The gravity of the situation is illustrated by recent data on woodland loss in the Barking Owl's likely core NSW distribution, i.e. the inland slopes and plains. About 70% of the woodland in NSW has already been lost (from Lunney 1991). Clearing is most intensive on the western slopes, central plains and Riverina (northern Central Division and east of the Western Division); 90% of the wheatbelt is cleared, and the process is continuing

(Glanznig 1995). Over the 15 years from the early 1970s to mid 1980s, over half the remnant woodland in the central wheatbelt was cleared; over the decade from the mid 1970s to mid 1980s, about 70% of the remnant woodland in the northern wheatbelt (Moree region) was cleared, with 19% of the original vegetation remaining (Glanznig 1995).

Evidence for population decline

Evidence for a decline in the state's Barking Owl population comes mainly from examples of sites where it once occurred but is now absent or rarely reported. The Owl was formerly common in the Coonabarabran area (1977-1980), but is now rare there (A.K. Morris pers. comm.). For instance, Morris knew of resident pairs at eight sites in the district, but the species is no longer or now rarely reported from those sites, including the Warrumbungle National Park often visited by bird-watchers (see Appendices 1 and 2). Morris (pers. comm.) resided near T.P. Austin's property "Cobborah Estate" for eight years 1975-1982, but did not record the Barking Owl from that stretch of the Talbragar River where three pairs were formerly known (cf. North 1911, Mathews 1915-1916). Nor have there been any other records for that area since the time (1970) when Morris began collating NSW bird records for annual bird reports etc. Targeted surveys near the headwaters of the Talbragar River in 1993/1995, using Barking Owl call playback, also failed to record the Owl (Kavanagh 1995).

Hobbs (1961) recorded the Barking Owl as common in river red gum "throughout" his survey area from the eastern Riverina west to Wentworth. Atlas records were well distributed in this region pre-1977 and 1977-81 (Appendix 1), but are sparser in the period 1981-94 (cf. Cooper & McAllan 1995). There also appear to be fewer literature records, e.g. annual bird reports, for the region in recent years (Appendix 2). Recent searches found few Barking Owls in the Murray Valley between Albury and Yarrawonga (Robinson 1994). Similarly, the Owl occurred on the Lachlan and Murrumbidgee Rivers last century but soon declined (Bennett in North 1911); recent searches found few on the Murrumbidgee (Robinson 1994). Recent faunal surveys in the river red gum of the Riverina found few Barking Owls (R. Webster pers. comm.), with the implication that fewer were encountered than expected. I. Taylor (pers. comm.) reported that his colleagues were now finding no Barking Owls in the Albury region (South-west Slopes) in areas where they were known 10 years ago.

Chisholm (1936) regarded a large owl species, assigned to the Barking Owl by Morris (1976), as "probably quite plentiful" in the Pilliga Scrub. During recent targeted surveys, the Barking Owl was recorded at few sites in the Pilliga and was much scarcer than expected (Appendix 1; E.M. Date pers. comm.).

The Barking Owl has declined in the eucalypt woodland of the NSW semi-arid zone generally (Smith & Smith 1994), concomitant with accelerated clearing on the eastern and southern fringes of the Western Division (Smith et al. 1995). From estimates of forest and woodland loss in NSW (i.e. 50% and 70% respectively) and their relative original cover (from Lunney 1991), and given the Barking Owl's apparent preference for woodland over forest, the Owl's population may have declined by almost 70% in NSW, although Owl densities are unknown. The decline may have been less than 70%, given the Owl's ability to survive in some woodland fragments. Rabbits, particularly pre-myxomatosis, may also have supported artificially high Barking Owl numbers. Post-calicivirus, the Owl population may now contract further to those large, healthy woodland patches able to support high numbers of birds and arboreal mammals.

Calling behaviour

Barking Owls have been reported hooting or calling (type unspecified, though probably mainly hooting) throughout the year, with greatest frequency in July-August and least in summer (Appendices 1 and 2). Duetting by pairs has been reported mostly in winter and spring. The scream has been reported twice in July, twice in winter (month unspecified) and once in summer. These results are consistent with previous information on the Barking Owl's calling behaviour (e.g. Schodde & Mason 1980, Hollands 1991, Hodgon 1996).

There were 67 reports of calling birds from 496 records at 317 sites (Appendices 1 and 2), with other detections of the owl probably also by call although this was not specified. It is apparent that the Barking Owl is highly vocal and readily detected by spontaneous (unelicited) calls (also Schodde & Mason 1980), and should be one of the most detectable Australian owls. It is also one of the most responsive to playback or imitation of conspecific calls, in autumn as well as the breeding season (Appendix 1; Debus in press and pers. obs.). Auditory surveys for the species, incorporating a playback component with listening for replies, should therefore be an effective technique in any season. The lack of Barking Owl records during extensive surveys for large forest owls, some admittedly not using Barking Owl playback but incorporating a one-hour listening phase, can only be explained by the Barking Owl's absence from the moister forest types inhabited by Sooty and/or Powerful Owls (e.g. Kavanagh & Peake 1993, Debus 1995, Kavanagh 1995, Kavanagh & Bamkin 1995, Kavanagh et al. 1995b, Kavanagh & Stanton in press). The many examples of Barking Owls, including pairs, calling throughout the year (Appendices 1 and 2) support the view that established Owl pairs are permanently resident and territorial (e.g. Schodde & Mason 1980, Hollands 1991).

A problem with records of the Barking Owl based only on calls is potential confusion with dogs and foxes (e.g. Parker 1977). For instance, calls of Barking Owls and dogs can

sometimes be difficult to distinguish even for experienced observers (R. Kavanagh pers. comm.). Foxes also give a shrill, though abrupt, yelp which might be mistaken for the Barking Owl's scream (pers. obs.). Caution is therefore required when basing Barking Owl records on call only, and verification by other means is desirable.

DISCUSSION

The data collated here on the Barking Owl's ecology in NSW agree with previous data for Australia generally (cf. Schodde & Mason 1980, Hollands 1991). However, the many coastal records challenge the popular misconception that the Barking Owl is rare on the coast. Nevertheless, the results of this review suggest that in NSW the Barking Owl is more common west of the Great Divide than east, although this perception requires testing by comparative surveys.

This review generally supports the conclusions of Kavanagh et al. (1995a) on aspects of the Owl's ecology in NSW. The new dietary data herein suggest that, in its foraging ecology, the Barking Owl behaves much like a forest owl, operating in the canopy of open forest and woodland. The Barking Owl may prey on rabbits only when circumstances force it to do so, e.g. insufficient tree cover and arboreal mammal prey. Although the Owl preys heavily on rabbits in some open areas of Victoria (Calaby 1951, Hollands 1991, Robinson 1994), another (small) Victorian pellet sample contained two sugar gliders, a native mouse *Pseudomys* sp. and beetle(s) (Veerman 1979).

Body-weight data for NSW show that the Barking Owl is heavier in the south than implied by Schodde & Mason (1980), and is therefore a potential competitor of the similarly sized southern Masked Owl. The data suggest some niche partitioning by diet and foraging behaviour, with the Barking Owl actively taking more birds and insects and spending less time listening from low perches beside breaks in ground cover (also Aumann 1991, Hodgon 1996; cf. Debus 1993 for Masked Owl). At least in non-coastal situations, the Barking Owl may also be a more strictly riparian bird. However, the apparently low population density of both suggests that direct competition is unlikely.

The Barking Owl is most abundant in tropical northern Australia and New Guinea (e.g. Schodde & Mason 1980, Hollands 1991). The pattern of its distribution and abundance in NSW is consistent with that of a primarily Torresian species approaching the limit of its ecological tolerance in south-eastern Australia. It seems reasonable to conclude that it prefers drier and more open habitats than does the Powerful Owl, and that it is more tolerant of human activity. The Barking Owl also seems more flexible in diet, with a greater capacity to take terrestrial prey, to eat insects at certain times of year, and to switch to introduced prey animals. However, the Owl's prey base in some remnant woodland areas may now be threatened by the rabbit calicivirus.

With published FOC records of the Powerful Owl for 1993-96 taken into account (649 records from Debus & Chafer 1994 and subsequent FOC newsletters and annual bird reports), the number of Barking Owl records (496) is three-quarters that for the Powerful Owl and from a similar number of sites (317 vs 320), but from about four times the area. This suggests that the Barking Owl occurs at much lower density, albeit over a greater total range. However, there have been many more targeted surveys for the Powerful Owl in recent years. Much of the Barking Owl's NSW distribution coincides with areas of low observer density and, like all nocturnal birds, it may be under-recorded (though inclusion of records in Cooper & McAllan 1995, for Central and Western Divisions only, should redress the regional bias to some extent). Furthermore, observers may have been less inclined to report records of the Barking Owl than of the larger owls. Aspects of the Barking Owl's ecology (e.g. habitat, roost-site, nest-site and dietary tolerances) suggest that it should be more common than it is, and more common than the Powerful Owl (as indeed it evidently was when NSW was settled by Europeans). Reasons for the apparent rarity of the Barking Owl must therefore be sought, particularly in view of its evident decline in NSW.

The data suggest the following working hypothesis. In NSW the Barking Owl, a basically Torresian species, is near its southern limit where it occupies the more open of the biologically richest habitats, in terms of prey diversity and/or biomass, not fully occupied by the Powerful Owl and Sooty Owl. It may be dependent on locally rich sites, like some other scarce woodland species such as the Square-tailed Kite *Lophoictinia isura*, Regent Honeyeater *Xanthomyza phrygia* and Masked Owl. The Barking Owl lives in lowland, warmer areas in riparian and other well-watered situations where it requires open forest or woodland to suit its hunting behaviour and large patches to provide sufficient densities of arboreal/scansorial mammalian prey, to enable it to breed and to tide it over the cooler months when insect prey is scarce. The quality of patches (e.g. understorey *Acacia* for gliders, Robinson 1994) may also be important. The Owl has rather narrow roosting and nesting requirements: it roosts in dense riparian trees, and nests in large hollows in (usually) live old eucalypts within open forest or woodland. It particularly favours red gum associations such as forest red gum on the coastal floodplains and river red gum on the inland slopes and plains (also Kavanagh et al. 1995a).

Habitat loss is identified as a major threat to the Barking Owl. Figures on woodland clearance in inland NSW (Glanznig 1995) illustrate that the situation has by no means stabilised. For instance, at present rates of clearing there will probably no woodland left in the northern NSW wheatbelt by the year 2000. Relatively fertile flats, probably prime Barking Owl habitat, are precisely the areas targeted for clearing (also Robinson & Traill 1996). Not only has the Owl lost a large proportion of its habitat in NSW, but the impact has probably been greatest in the best Barking Owl habitat. The situation is exemplified by the continual pressure to clear remnant coastal floodplain habitat and wheatbelt

woodland, and the incursion of clearing into the Western Division (e.g. expansion of the cotton industry into the black-soil plains on river flats formerly timbered with black box *Eucalyptus largiflorens*, coolibah *E. microtheca* and river red gum). Degradation of remaining habitat by grazing has contributed to the generally deplorable condition of watercourses and their banks on private land in rural NSW (treeless, alga-infested, silted-up, now intermittent flows, etc.). Such a situation not only explains the apparent decline of the Barking Owl, it also explains why the Owl seems less common than expected in the remnants.

In view of the Barking Owl's apparent rarity and decline in NSW, and the extreme threat to most of its remaining habitat (much of which is apparently on private land), it would seem more threatened than the Powerful Owl and even more deserving of special legislative protection. A reasonable recommendation is that the Barking Owl should be added to the NSW *Threatened Species Conservation Act 1995*, Schedule 2: Vulnerable, under the criteria "population reduced; poor recovery potential; threatening processes severe; ecological specialist" [the last reflecting its dependence on riparian woodland and hollows, and "restricted generalist" diet, i.e. carnivore/vertebrates]. Such a move would place the onus on land developers to assess the conservation significance of any Barking Owl habitat that will be affected, and if necessary produce a species impact statement. It would also recognise the Barking Owl as a top predator and management indicator species in the drier, more open habitats not covered by similar considerations for the large forest owls, and oblige the state fauna authority to prepare a recovery plan for the Owl. In keeping with such a role, adequate conservation of populations of the Barking Owl across its range in rural NSW would also ensure conservation of the many other threatened woodland birds that share its habitat. The Barking Owl's calling and response behaviour ensures that it is easily surveyed and monitored for such purposes.

The Barking Owl remains one of our least-known owls, overshadowed by the more "charismatic" and much better known Powerful Owl. There is clearly a need for much better knowledge of the Barking Owl's life history and ecological requirements, as well as a more concerted focus on the conservation of the woodlands and their birds generally (also Robinson 1994, Robinson & Traill 1996). The conclusions herein on the Owl's ecology, distribution and status in NSW, across land tenures, require validation by a more extensive field survey and detailed research, with emphasis on surveys on private land (e.g. Robinson 1994). Meanwhile, interim conservation measures for the Barking Owl should include financial and other incentives from all levels of government to encourage landholders to protect remnant woodland, particularly riparian, from further clearing; to re-establish representative patches; and to rehabilitate rural watercourses and their catchments with the original tree species. To assist in assessing and monitoring the situation, the Barking Owl should be seen as equally worthy as the larger owls of full reporting in the NSW FOC annual bird reports. To that end, observers should report all records to the Records Officer for listing.

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Appendix 2

Details of published records of the Barking Owl in NSW. This is available as an accessory publication from the author. It is also lodged with the NSW Field Ornithologists Club, the NSW Bird Atlassers and the Ornithology Department, Australian Museum.

Appendix 1

Unpublished records of the Barking Owl in New South Wales, approximately in chronological order within the regions defined by McAllan & Bruce (1989). NP = National Park; NR = Nature Reserve; SF = State Forest; AM = Australian Museum; MV = Museum of Victoria; Atlas = RAOU Historical and Field Atlas databases; NRS = RAOU Nest Record Scheme.

Region	Source/comments
North Coast:	
Murwillumbah	Old specimen Tweed R (AM O.3668).
Grafton?	Specimen Clarence R (J. Wilcox) 1866-76 (AM O.23637).
Richmond/Clarence R	1859-88; listed in Ramsay's Tabular List (per Historical Atlas).
Grafton	1960s (?), breeding pair near Pillar Valley, paperbark (*Melaleuca*) swamp and farmland (J. Young per R. Kavanagh).
South Grafton	Aug. 1977 (Atlas).
Nymboida	Spring 1977 (Atlas).
Paterson	Martins Creek 1977-78 (Atlas).
Pacific Palms	Whoota, Coomba Rd 1977-79 (Atlas).
Yuraygir NP	Diggers Headland winter 1978 (screaming), L. Hiawatha 1978-80 (Atlas).
Wauchope	May 1980 (2 sites; Atlas).
Chichester SF	Telegherry Forest Park May 1980 (Atlas).
Mt Nullum	Spring 1981 (Atlas).
Iluka	Autumn 1981 (Atlas).
Bentley	Pair on McKellar Ra north of Bungabbee SF (undated, last 10 years?; S.Gilmore).
Doubleduke SF	Five birds (pair and trio, the latter possibly a family) responded strongly to playback Nov. 1991; floodplain forest red gum *Eucalyptus tereticornis* open forest and woodland (D. Charley).
Casino	Female responded to playback Main Camp, March 1995 (SD): forest red gum floodplain woodland near creek.
Rankin Park	One bird Feb. 1995 (calling; Hunter BOC per A.K. Morris).
Bungawalbin NR	Pair Aug. 1996 (calling; D. Charley).
Banyabba NR	One bird Oct. 1996 (J. Purcell, S. Townley).

Region	Source/comments
Central Coast:	
Liverpool	Specimen Sept. 1903 (MV: HLW5305).
Hornsby	1966-76, late winter/spring 1979 (2 sites; Atlas).
Dharug NP	Jan. 1977 (Atlas).
Upper Lane Cove R	Spring 1977, calling June 1979 (Atlas).
Avalon	Hooting Sept.-Oct. 1978 (Atlas).
Narrabeen	Hooting Deep Creek Sept.-Oct. 1978 (Atlas).
Wollombi	Nov. 1978, Jan. and Mar. 1979 (Atlas).
Kurrajong	Hooting, screaming summer 1980/81 (Atlas).
Kiama	1980 (Atlas).
Berry	Woodhill, calling autumn 1980 (Atlas).
Kenthurst	Undated (Atlas).
Arcadia	Calling once or twice per year, usually autumn, 1991-96 (R. Kavanagh).
Howes Valley	One bird calling Kindarun Aug. 1994 (D. Oliver).
Mangrove Mountain	Pair resident 1995, calling July-Aug. (M. Pointer per A.K. Morris).
Seven Hills	One bird June 1996 (E. Vella per A.K. Morris).
Gerringong	One bird in garden June 1996 (Illawarra BOC per A.K. Morris).
Eastwood	One bird in garden Oct. 1996 (E. Hoskin per A.K. Morris).
Windsor	Recorded Freemans Reach several times 1996 (M. Stanton per R. Kavanagh).
South Coast:	
Jervis Bay NP	One bird Green Patch, undated (last 10 years; F. Kristo).
Bega	Mumbulla, Aug. 1978 (Atlas). One bird 10 km S Mar. 1995 (R.Kavanagh).
Pambula	Reported before 1994 Stanton Rock between Burragate and Wyndham (per R.Kavanagh).
Eden	Undated (recent) records Bittangabee, Towamba River to S (NPWS per R.Kavanagh), Wog Wog R to W (R. & L. Farrell per R. Kavanagh). One bird 5 km S of Wonboyn May 1994, one bird Pericoe Mar. 1995 (R. Kavanagh).
Bemboka	One bird Mar. 1995 (M. Stanton per R. Kavanagh).
Brogo	One bird Bemboka SF 7 km NW May 1994 (M. Stanton per R. Kavanagh).
Northern Tablelands:	
Kings Plains	Egg(s) Aug. 1921 (AM O.52930).
Bundarra	Abington 1977/78 (Atlas) = pair observed by R. Noske (per J. Courtney).

Region	Source/comments
Walcha	Moona Plains 1978/79 (Atlas).
Barrington Tops	Polblue Swamp, Stewarts Brook SF Nov. 1980 (Atlas).
Armidale	Dumaresq 1979 (Atlas); one bird resident for some months near Dumaresq Dam *circa* 1990 (P. Metcalfe). One bird Herbert Park, Gara R, screaming winter 1990 (P. Debus). Undated (recent) record near Hillgrove Creek SF (P. Webber). One bird Newholme Field Lab. mid 1995 (S. Green) and late 1996 (I. Maclean). One bird roosting in English elm *Ulmus* sp. beside derelict building, near wooded creek, Puddledock April 1996 (J. Rose).
Nandewar Ra	One bird calling Ironbark Ck W of Bundarra, May 1995 (D. Oliver).
Torryburn	One bird roosting in river she-oak *Casuarina cunninghamiana*, Gwydir R Oct. 1995 (J. Walters per H. Ford).
Yarrowyck	Pair roosting in river she-oak, Boorolong Creek, April 1996 (SD); with 3 fledglings Oct.-Dec. (S. Cook, B. Shepherd).
Central Tablelands:	
Tarana	Undated old specimen (AM O.12770).
Perthville	Undated old specimen "Poba" (AM O.36846).
Borenore	"Koolewong" 1948-76 (Atlas).
Berrima	1941-50, summer 1977 (Atlas).
Mt Wilson	1966-76, 1977 (Atlas).
Mittagong	Barralier, calling Dec. 1978 (Atlas).
Leura	Dec. 1981 in garden (Atlas).
Bilpin	Mountain Lagoon 1980-81 (Atlas).
Glen Alice	Pair with 2 fledglings Oct. 1996 (A. Ley et al. per D. Oliver, S. Cook).
Southern Tablelands:	
Clyde Mtn	1975-76, 1977-79 (Atlas).
Tharwa	Gudgenby 1975-76 (Atlas).
Mongarlowe	1975/76, Nov. 1977 (Atlas).
Cathcart	One bird Mar. 1993 (R. Kavanagh)
North-west Slopes:	
Gilgandra	Biddon 1940-49 (Atlas).
Gunnedah	Eggs (C/3) Kibah Aug. 1963 (AM O. 61458). Road kill Curlewis winter 1980 (Atlas).

Region	Source/comments
Coonabarabran	Winter 1977 (Atlas), Siding Spring winter 1981 (Atlas). Resident pairs Dandry Road (7 km NE), Timor Rock, Yearinan, Ulamambri 1977-80 (A.K. Morris).
Terry Hie Hie	Spring 1978 (Atlas).
Breeza	Road kill June 1978 (Atlas).
Warrumbungle NP	Winter (2 pairs calling) and Dec. 1977, winter 1981 (Atlas). Resident pair Camp Blackman 1977-80 (A.K. Morris); one bird calling there Aug. 1994 (D. Oliver).
Torrington	One bird screaming Silent Grove July 1979, open forest (SD).
Manilla	Bradleys Downfall Dec. 1979 (Atlas).
Woolomin	Pair 1975-1980, roosting in creekside river she-oaks or willows *Salix babylonica*, often duetting with hooting call (B. Graham/Atlas).
Bingara	Horton Valley winter 1978, spring 1981 (Atlas).
Yarrigan SF	One bird spring 1993 (C. Barker per L. Date).
Linton NR	One bird calling June, Aug. 1994; May, July 1995 (D. Oliver).
Warrabah NP	One bird calling July 1995 (D. Oliver).
Bundarra	One bird calling Gwydir R July 1995 (D. Oliver).
Pilliga East SF	One bird Oct. 1996 (T. Quested per A.K. Morris).
Central-west Slopes:	
Grenfell	Specimen June 1905 (MV: HLW5304).
Scone	"Belltrees": specimen May 1912 (MV: HLW5303), observed 1914-17 (Atlas).
Cobbora	Eggs (C/3) "Cobborah Estate" Aug. 1917 (MV: Favaloro Collection); (C/2) "Narran", Talbragar R Sept. 1917 (AM O.61457).
Wellington-Dubbo	1943 (Atlas).
Temora	1977/78 (Atlas); road kill several km E April 1974 (P. & L. Smith).
Ingalba NR	1971-74, Aug. 1978, Feb. and July 1979 (Atlas).
Mimosa	Summer 1978-79, autumn 1980, Dec. 1981 (Atlas).
Tichborne	Summer 1978/79 (Atlas).
West Wyalong	March 1978 (Atlas).
Giral	1978 (Atlas).
Cowra	Spring 1978 (Atlas).
Widden Valley	April 1979 (Atlas).
Mudgee	Sept. 1981 (Atlas). One bird Oct. 1996 (T. Wilson per A.K. Morris).

Region	Source/comments
Narrandera	Winter 1981 (Atlas).
Quandialla	March 1978 (Atlas).
Back Yamma SF	One bird Dec. 1995 (G. Fry per A.K. Morris).
South-west Slopes:	
Culcairn	Specimen, Nov. 1898, in the AMNH (per Atlas).
Wagga Wagga	1964-76, 1977-80 (Atlas); specimen (road kill?) May 1984 (MV B.18755).
Wee Jasper	Bungongo SF June 1979 (Atlas).
Holbrook	1978-80 (4 sites, including autumn 1978, winter 1980; Atlas).
Rand	Aug. 1979 (Atlas).
Narrandera	Undated (recent) record Buckingbong SF near Morundah (per R. Kavanagh).
North-west Plains:	
Walgett	"Wharparilla" 1901-39, "Riverview" winter 1979 (Atlas).
Cobar	1971-76 (Atlas).
Pallamallawa	Pair and young (B/2) flushed from small group of wilga trees *Geijera parviflora* in chenopod (?) shrubland, Jan. 1977 (Atlas).
Mungindi	"Caidmulla" (?) 1977, "Eulalie" 1977-78 (Atlas).
Baradine	Resident pair "Cumberdeen" 13 km NW 1977-80 (A.K. Morris).
Gilgandra	"Berida" 1977 (Atlas); resident pair there 1977-80 (A.K. Morris).
East Toorale	Calling July 1978 (Atlas).
Warren	"Teasdale" autumn 1979 (Atlas).
Coonamble	"Emby" winter 1979 (Atlas).
Gulargambone	Resident pair "Yarrandale" 1977-80; nested in river red gum *Eucalyptus camaldulensis*, roosted in river she-oak *Casuarina cunninghamiana* (A.K. Morris).
Brewarrina	Darling R 1980; "Glen Acre" March and July (screaming) 1980 (Atlas).
Baan Baa	Bird flushed from roost in "casuarina-dominated wood land" Sept. 1981 (D. Franklin/Atlas).
Pilliga West SF	One bird calling Aloes Well spring 1991; one bird Wooleybah Dam spring 1992 by playback (L. Date).
Sandgate SF	Pair calling spring 1993 and 1994 (L. Date).
South-west Plains:	
Barham	1941-76 (2 sites, breeding 1960-70); summer 1979/80 (Atlas).

Region	Source/comments
Weethalle	1951 (Atlas).
Finley	1953-58 (Atlas).
Moulamein	1953-58 (Atlas).
Balranald	1954-60 (Atlas); 1977-81, breeding 1978; "Benongal" Feb. 1978 (Atlas).
Rankin Springs	"Wandella" 1957 (Atlas).
Caldwell	1961-76 (Atlas).
Darlington Point	"Benerembah" 1963-68 (Atlas).
Deniliquin	1967-76, summer 1978/79. (Atlas). Nesting in river red gum *E. camaldulensis* Aug.-Sept. 1992 (R. Webster/NRS). Wandook Tank most of 1977, hooting summer 1978, calling July 1980; present 1981 (Atlas).
Willandra NP	1974-76 (Atlas).
Ivanhoe	"Bonuna", calling July 1977 (Atlas).
Lake Brewster	Pair duetting July 1977 in river red gum (SD); one bird calling Mar. 1986 (L. Smith).
Wanganella	"Barrata" autumn 1977 (Atlas).
Round Hill	Mar. 1978 (Atlas).
Colleambally	Winter 1979 (Atlas).
Conargo	"Amaroo" May 1980 (Atlas).
Goodnight	Autumn 1981 (Atlas).
Savernake	Winter 1981 (Atlas).
Moira Lakes	Winter and Dec. 1981 (Atlas).
Leeton	"Yarrabimbi", Mt Brobenah 1995 (M. Schultz per A.K. Morris).
Griffith	Two birds June 1996 (B. Moller per A.K. Morris).
North Far West Plains:	
Mootwingee	1960-76 (Atlas).
Sturt NP	Mt King June 1979 (Atlas).
South Far West Plains:	
Kinchega NP	1967-76, Nov. 1977 (Atlas); pair calling 1986-88 Darling R (D. Charley).
Wentworth	"Springwood" 1960-76, 1977-79 (Atlas).
Menindee	"Albermarle" 1978 (Atlas).

Advice to Contributors

Manuscripts should be typed with double spacing and wide margins at top and sides, and submitted initially as an original and two duplicates. Tables and figures must be in the form of reproducable hard copy, having due regard to the journal page size and format. If extensive retyping or drafting is required publication may be delayed or prevented. Photographs should be submitted as glossy black and white prints of size and contrast suitable for reproduction.

Upon acceptance, it is most helpful if the final manuscripts of substantial articles can be submitted in word processor format. The editor will advise details of acceptable formats.

Contributions are considered on the understanding that they are not being offered for publication elsewhere.

Authors are advised to consult a current issue of *Australian Birds* as a guide to style and punctuation, which conform in general to the Commonwealth *Style Manual.* Spelling follows the Macquarie Dictionary. In particular:

dates are written as '1 January 1990', but may be abbreviated in tables and figures;
the **24 hour clock** is used with Eastern Standard Time, e.g.
0630 for 6.30 am and 1830 for 6.30 pm. Daylight Saving time should be corrected to EST;
in the text, single-digit numbers are spelt out; 10 000 and larger numbers are printed with a space (not a comma) separating the thousands;
English names of bird species (but not group names) are written with an initial capital for each separate word.
Scientific names of bird species and their classification should follow Christidis & Boles 1994, *The Taxonomy and Species of Birds of Australia and its Territories*, RAOU Monograph 2.

References to **books** appear in the form :

Marchant, S. & Higgins, P.J.(eds) 1990, *Handbook of Australian, New Zealand and Antarctic Birds,* Vol. 1, OUP, Melbourne.

and to **journals** as

Morris, A.K., Tyler, V., Tyler, M., Mannes, H.& Dalby, J. 1990, 'A waterbird survey of the Parramatta River wetlands, Sydney', *Aust Birds*, **23**:3.

These are cited in the text as Marchant & Higgins (1990) or (Morris et al. 1990), respectively.

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