# Recovery Plan for the Barking Owl *Ninox connivens*

**Draft for Public Comment**
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# Recovery Plan for the Barking Owl *Ninox connivens*

## Foreword

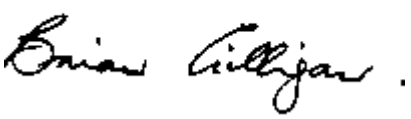
The Barking Owl was listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995* (TSC Act) in June 1998. This document is the draft Recovery Plan for the Barking Owl *Ninox connivens* as required by the TSC Act. It considers the conservation requirements of the species across its known range within NSW. It identifies actions to be taken to enhance the long-term viability of the species in the wild and the parties responsible for undertaking these actions over the next 5 years.

The Barking Owl has suffered a decline in abundance across southern Australia in recent decades. In NSW, it is widespread on the coastal plain and foothills and the inland slopes and plains. It is sparse on the higher parts of the tablelands and in the arid zone west of the Darling River and rare or absent in the dense, wet forests of the eastern fall of the Great Dividing Range. It occurs in some reserves and State Forests but most records are from private or other unprotected land. Habitat loss and degradation is the major threatening process for the Barking Owl, although the ecological and management needs of the species in NSW are not well understood. Actions in this plan aim to increase our understanding of the Barking Owl.

The plan assumes that individual cases of nest failure and mortality are significant to the NSW population. Hence, there are actions in this plan which address threat mitigation at a local level, to protect breeding pairs and individual nest sites immediately, and broadly across the state, to provide longer-term opportunities for the Barking Owl to recover.

The Barking Owl is a flagship species. It is a high-order predator in areas of major human activity. It occurs in areas of mature forest and woodland supporting a high biodiversity, including many other threatened species. Pairs require large home ranges. Barking Owls and some of their prey are dependent on tree hollows. Owl lore is popular worldwide and the Barking Owl is a charismatic species with a distinct and intriguing call. The actions in this plan have strong community involvement and will raise community awareness of the plight of the Barking Owl and the importance of biodiversity more generally. Therefore, the implementation of this plan will have considerable biodiversity benefits across a range of forest and woodland flora and fauna in NSW.

It is intended that this recovery plan be implemented over a five year period, by which time the success of the proposed recovery actions will be able to be assessed and an updated plan prepared. Actions identified in this recovery plan will be principally undertaken by the National Parks and Wildlife Service.



**BRIAN GILLIGAN**
**Director-General**

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# 1 Introduction

The Barking Owl *Ninox connivens* is a moderately large brown owl of open forests and woodlands. The subspecies of Barking Owl inhabiting NSW, *N. c. connivens*, is endemic to eastern and southern Australia. Other subspecies inhabit the Australian tropics (*N. c. peninsularis*), New Guinea (*N. c. assimilis*) and the East Indonesia (*N. c. rufostrigata*) (Higgins 1999).

This Draft Recovery Plan was prepared as required under the New South Wales *Threatened Species Conservation Act 1995* (TSC Act) by the National Parks and Wildlife Service (NPWS). It considers the conservation requirements of the species across its range in NSW and identifies actions to be taken to ensure the long-term viability of the species in nature in NSW.

# 2 Legislative context

## 2.1 Legal status

In NSW, the Barking Owl is listed as vulnerable on Schedule 2 of the TSC Act.

In South Australia, the Barking Owl is listed as rare under the *National Parks and Wildlife Act 1972*. In Victoria, the species is listed as endangered under the *Flora and Fauna Guarantee Act 1988*. In Queensland, it is not listed as threatened under the *Nature Conservation (Wildlife) Regulation* of the *Nature Conservation Act 1994*. Nationally, the species is not listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). However, the southern sub-species *N. c. connivens*, the taxon extant in NSW, was assessed by Garnett and Crowley (2000) as Near Threatened using IUCN criterion *a - Reduced area of occupancy and/or extent of occurrence: Taxa that have disappeared from over 50% of their former area of occupancy and/or extent of occurrence and are at risk of further decline* (IUCN 1994).

## 2.2 Recovery Plan preparation

The TSC Act requires that the Director-General of National Parks and Wildlife prepare recovery plans for all species, populations and ecological communities listed as endangered or vulnerable on the TSC Act schedules. The TSC Act includes specific requirements for both the matters to be addressed by recovery plans and the process for preparing recovery plans. This Recovery Plan satisfies these provisions. As this species is not listed as threatened nationally, there is no requirement to prepare a recovery plan under the EPBC Act.

## 2.3 Recovery Plan Exhibition

This draft recovery plan will be placed on public exhibition and submissions invited from the public. To make your submission as effective as possible, please:

- Refer to the section or action of the plan you wish to address.
- Briefly explain the reasons for your comments, providing source information or examples where possible.
- Provide your name and address to enable receipt of your submission to be acknowledged.

Submissions may be made as letters or other documents, or on the NPWS 'Submissions: Draft Recovery Plan'. This is available in Appendix 2 of the plan or on the NPWS web site www.nationalparks.nsw.gov.au.

The NPWS will consider all submissions to this draft recovery plan received during the exhibition

period and must provide a summary of those submissions to the Minister for the Environment prior to final approval of the plan. Submissions on this plan may contain information that is defined as 'personal information' under the NSW *Privacy and Personal Information Protection Act 1998*, which identifies the person providing the submission. Following adoption of the recovery plan by the Minister, copies of all submissions, including personal details, will be available for public inspection. If any person wishing to prepare a submission does not want their personal details to become public, the submission needs to be clearly marked that personal details need to remain confidential. All submissions are kept in the NPWS record system.

### 2.4 Recovery Plan implementation

The TSC Act requires that a public authority must take any appropriate measures available to implement actions included in a Recovery Plan for which they have agreed to be responsible. Public authorities and councils identified as responsible for the implementation of Recovery Plan actions are required by the TSC Act to report on measures taken to implement those actions. In addition, the TSC Act specifies that public authorities must not make decisions that are inconsistent with the provisions of a Recovery Plan. The only public authority responsible for the implementation of this plan is the NPWS.

### 2.5 Critical habitat

The TSC Act makes provision for the identification and declaration of critical habitat for species, populations and ecological communities listed as endangered. Once declared, it becomes an offence to damage critical habitat (unless the action is specifically exempted by the TSC Act) and a species impact statement is mandatory for all developments and activities proposed within critical habitat unless the impact is deemed trivial or negligible by the Director-General of National Parks and Wildlife. The Barking Owl is not currently eligible for declaration of critical habitat, because it is not listed as Endangered under Schedule 1 of the TSC Act.

### 2.6 Environmental assessment

When exercising a decision-making function under Parts 4 and 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), decision-makers must consider known and potential habitat of threatened species, biological and ecological factors and the regional significance of individual populations.

The following public authorities are currently known to have a decision-making function which is of relevance to the conservation of the Barking Owl:

- NPWS where a concurrence role under the EP&A Act is required, where a Section 91 licence (under the TSC Act) is required, for decisions under Part 5 of the EP&A Act and as a land manager
- DLWC in relation to Crown Land, subject to the provisions of the *Crown Lands Act 1989*
- DLWC in relation to private land under the requirements of the *Native Vegetation Conservation Act 1997* (NVC Act)
- DLWC as a consent authority in relation to the Unincorporated Area of western NSW
- State Forests of NSW as a land manager
- Approximately 115 local councils (see Appendix 1).

Consent and determining authorities are advised that it would be appropriate to give consideration to relevant recovery plans when exercising a decision-making function under Parts 4 and 5 of the EP&A Act. Therefore, consent and determining authorities should take into account the recovery actions

outlined in this plan when considering any activity which may affect Barking Owls or their habitat. Guidelines for the assessment of impacts on Barking Owls are to be finalised as an action in this plan (Action 2.1).

Any other action not requiring approval or development consent under the EP&A Act or meeting other specified exemptions and which is likely to have a significant impact on the Barking Owl or its habitat, will require a Section 91 licence from the Director-General of National Parks and Wildlife under the provisions of the TSC Act. Such a licence can be issued with or without conditions, or can be refused. A licence is not required:

- To carry out routine agricultural activities
- For actions which are carried out in accordance with a consent or approval under the EP&A Act
- For actions carried out in accordance with a property management plan approved by the Director-General of National Parks and Wildlife
- For actions carried out in accordance with an approved Regional Vegetation Management Plan
- For emergency actions authorised under the *Rural Fires Act 1997* or *State Emergency and Rescue Management Act 1989*

As part of the Integrated Forestry Operations Approvals (IFOAs) held by State Forests of NSW, the NPWS has issued licences under the TSC Act for the operation of forestry activities within certain regions. These licences set out minimum measures to protect threatened species and protect their habitat from activities associated with timber harvesting. At the time of writing, IFOAs had been signed for the Lower North East Region, Upper North East Region, Eden Region, and South Coast and Tumut subregions of the Southern Region. IFOAs for the western regions are under negotiation. The IFOA Threatened Species Licences have general and specific conditions for managing the Barking Owl (details in Section 5.2).

The NVC Act provides for the establishment of Regional Vegetation Committees to prepare Regional Vegetation Management Plans (RVMPs) to manage the clearance of native vegetation. RVMPs, once approved by the Minister for Land and Water, override council-prepared Local Environment Plans. The inclusion of appropriate management regimes for Barking Owl habitat within RVMPs is an important step in the overall recovery of the species in NSW (see Action 2.2; draft guidelines provided in Appendix 1).

# 3 Species information

## 3.1 Description

The Barking Owl is a moderately large brown hawk-like owl. It is spotted white on the wings, with barring in the wings and tail, and coarsely streaked brown on white underneath. It has prominent yellow eyes in a flat face and fully feathered legs with large yellow feet (Hollands 1991, Higgins 1999). It is approximately 40 cm from bill-tip to tail-tip. Males weigh approximately 700 g and females 600 g. The larger Powerful Owl *Ninox strenua* is barred rather than spotted dorsally and is barred not streaked ventrally. The smaller Southern Boobook *N. novaeseelandiae* is richer brown, with a dark mask around the eyes, more marbled ventral pattern, duller hazel eyes and small grey feet.

## 3.2 Occurrence

The distribution of the Barking Owl is described in detail in Higgins (1999). It occurs in Australia, East Indonesia and New Guinea. In Australia, the Barking Owl is found in northern, eastern and south-western Australia from the Pilbara and Kimberley, across the Top End and down through Queensland

and the eastern Lake Eyre Basin to southern Victoria, with an isolated population in the south-west corner of WA. In NSW, it is widespread on the coastal plain and foothills and the inland slopes and plains (Figure 1). It is sparse on the higher parts of the tablelands and in the arid zone west of the Darling River and rare or absent in the dense, wet forests of the eastern fall of the Great Dividing Range. It is rare in the ACT with one record every 2-3 years (Taylor and COG 1992). It has declined in density in cleared and settled parts of the state (Debus 1997).

The final determination to list the Barking Owl as vulnerable under the TSC Act concluded that the Barking Owl is in decline in NSW. The evidence is summarised in Debus (1997): Historically, the species was considered common in NSW but in recent decades it has become uncommon to rare. Recent surveys have found it much less numerous than the Powerful Owl in forested areas of eastern NSW. It has declined to the point where it is now absent or rare in some areas where it was found regularly in past decades.

Further evidence of the species' decline comes from studies undertaken since 1998. Surveys of the north-western slopes of NSW detected a total of eight Barking Owls at only five of the 110 locations surveyed (Debus 2001). In southern woodlands of NSW between the Murray and Murrumbidgee Rivers, Taylor and Herring (2001) detected 13 Barking Owls at 8 sites from 113 survey locations. The only known stronghold of the species in NSW occurs in Pilliga West State Forest where there are at least 30 pairs (Milledge 2002). In central Victoria, Taylor *et al.* (2002a) found Barking Owls at 4.3% of 257 sites with potential habitat, including 8% of 75 sites where they had been previously reported.

There are no published estimates for the abundance or population densities of the Barking Owl in NSW. For the species, breeding pairs may be spaced at <1 km to 10 km (Zillman 1964, Higgins 1999). Earlier estimates of home ranges of 30-200 ha reported in Blakers *et al.* (1984) are speculative (Higgins 1999). There is no banding information on the species, no evidence of long-distance movements and no systematic study of dispersal (Higgins 1999).

In north-eastern Victoria, 20 pairs were studied in 17 000 ha of box-ironbark forest/woodland (Taylor *et al.* 2002b); a large proportion of the total population in the state, estimated to be 50 pairs (Silveira *et al.* 1997). Mean neighbour distances between nests was 4.5 km and the nearest neighbours were 1.8 km apart. During October-December 1999, one female was radio-tracked within a radius of 1 km of her nest site and her territory, estimated by minimum convex polygon (mcp), was 225 ha (Taylor *et al.* 2002b). In Goonoo State Forest, central-western NSW, a female was radio-tracked during March-June 2001 and found to have a 95% mcp home range of 6 000 ha (Schedvin *et al.* 2001).

### 3.3 Land tenure and regional distribution

In NSW, the Barking Owl occurs in some NPWS reserves (Table 1, Appendix 1) and State Forests (Table 2, Appendix 1) but Debus (1997) found that most records (83% of 316 sites) were from private or other unprotected land. The NPWS reserves and State Forests with most of the records are on the coastal plain and on the inland slopes and plains. All areas, including State Forests and NPWS reserves, with potential habitat for the Barking Owl will be important for the long-term conservation of the species in NSW. There are Barking Owl records from 115 Local Government Areas (Table 3, Appendix 1), all of the Regional Vegetation Management areas and all of the Interim Biodiversity Regions of Australia (IBRA) Bioregions in NSW.

### 3.4 Habitat

The Barking Owl lives in forests and woodlands of tropical, temperate and semi-arid zones. Its habitat is summarised below from Kavanagh *et al.* (1995a), Debus (1997) and Higgins (1999). The habitat is

typically dominated by eucalypts, often red gum species and, in the tropics, paperbarks *Melaleuca* species. It usually roosts in or under dense foliage in large trees including rainforest species of streamside gallery forests, River She-oak *Casuarina cunninghamiana*, other *Casuarina* and *Allocasuarina* species, eucalypts, *Angophora* or *Acacia* species. Roost sites are often near watercourses or wetlands. It typically breeds in hollows of large eucalypts or paperbarks, usually near watercourses or wetlands. Barking Owls have been recorded in remnants of forest and woodland and in clumps of trees at farms, towns and golf courses.

### 3.5 Life history and ecology

The Barking Owl hunts opportunistically for terrestrial, arboreal and aerial prey between dusk and dawn and occasionally in daylight (Higgins 1999). The diet is summarised from Kavanagh *et al.* (1995a), Debus (1997), Debus *et al.* (1998, 1999) and Higgins (1999). It eats a variety of birds, mammals and large insects. It eats some of the common native and introduced birds such as rosellas and starlings, eats more birds than other large forest owls and eats many insects in the warmer post-breeding months. However, vertebrates seem to be important in its diet during winter and breeding. Rabbits are frequent prey in rabbit-infested areas where there are few other suitably-sized mammals but where possible, the owl appears to prefer native arboreal mammals such as small gliding possums, caught in the tree canopy. These mammals and some of the owl's important bird prey species such as parrots are dependent on tree hollows for at least part of their life cycle. Despite the large number of anecdotal records of dietary items, there has been no systematic study of the diet of the species, particularly the function of dietary preference during breeding.

The breeding ecology of the Barking Owl is summarised below, mostly from Debus (1997), Higgins (1999) and Taylor *et al.* (2002a, b). Barking Owls are presumed to breed as well-dispersed pairs in traditional, permanent territories, although there have been no long-term studies based on marked birds. They are strictly seasonal breeders, laying a single small clutch of 1-3 (usually 2) eggs in late winter or spring. The nest site is a large open hollow, often vertical or sloping, in the trunk or sometimes a spout of a eucalypt or *Melaleuca*, usually a live tree though occasionally a dead tree. Nest-hollow entrances are 2-35 m above the ground with a diameter of 20-46 cm and depth of 20-300 cm. In NSW, laying takes place in August-October or in November for replacement clutches if the first clutch fails. The incubation period lasts 36-37 days and the nestling period is 35-36 days. The young are unable to fly strongly in the first few weeks out of the nest. In successful nests, broods of usually one or two (rarely three) young fledge. Fledged young can be seen with their parents from October to January. They are dependent on the adults for up to 4 months and begin to disperse at the end of summer. Although owls are expected to be long-lived, the longevity of the Barking Owl is unknown.

### 3.6 Ability of the species to recover

The aim of recovery plans under the TSC Act is to recover threatened species, populations and ecological communities to a position of viability in nature in NSW. However, large predators are difficult to recover (Soule 1987, Quammen 1996) and for the Barking Owl, there is insufficient knowledge to predict the ability of the species to recover in the long-term in NSW. Recovery will be dependant on restoration of habitat which may take decades to centuries. The species' requirements for amount, quality and connectivity of the habitat are unknown. Some individuals may be tolerant to some disturbance in their habitat as shown by their occurrence in fragments of woodland or forest in agricultural landscapes and in trees in urban areas. However, their ability to disperse through fragmented woodland and forest is unknown. The Barking Owl is a top-order predator with a wide dietary range. However, its ability to cope with declines in native prey concomitant with the loss of habitat, declines in non-native prey such as rabbits and mice and poisoning from ingestion of pesticides is unknown. The extent to which availability of nesting hollows is a limiting factor is unknown.

This plan assumes that because the distribution of the species in NSW is sparse and declining, individual cases of nest failure and mortality are significant to the NSW population. Hence, threat mitigation will be needed (i) at a local level to protect breeding pairs and individual nest sites immediately and (ii) broadly across the state to provide longer-term opportunities for the Barking Owl to recover.

# 4 Management issues

## 4.1 Level of current understanding

Although the Barking Owl's biology and ecology are known in general terms, with a broad understanding of its habitat preferences, diet and breeding biology, it is one of Australia's least known owls. Major gaps in knowledge concern population size and density, home-range size and habitat use; relative occurrence in coastal versus inland regions and on private versus public land; fledging success and dispersal of juveniles; and survival and mortality. The historic and recent records of the species are held in the NPWS Wildlife Atlas database (Figure 1) but these have not been analysed for temporal patterns, particularly declines in the past few decades. The ability of the species to recover is not well understood. The threatening processes listed below are inferred; there has been no study of the mechanism or population-level effect of any threat to the species.

## 4.2 Threatening processes

Habitat loss and degradation is the major threatening process for the Barking Owl (Garnett and Crowley 2000). The relevant, key threatening processes are Clearing of native vegetation (TSC Act), Land clearance (EPBC Act), Continued net loss of native hollow bearing trees and coarse woody debris due to firewood harvesting practices (being considered under the EPBC Act), Removal of dead wood, dead trees and logs (Preliminary Determination under the TSC Act) and Competition from feral honeybees (TSC Act) and possibly, Predation by the fox and the feral cat (TSC Act and EPBC Act).

Clearing of forest and woodland destroys the Barking Owl's foraging, roosting and breeding habitat and the habitat of important prey species (Kavanagh *et al.* 1995a, 1995b, Debus 1997, Higgins 1999). Habitat fragmentation is accompanied by tree decline in rural areas and loss of prey species in habitat remnants (Smith *et al.* 1995, Debus 1997, Higgins 1999). A particular area of concern is the relatively fertile riparian flats on the western slopes and plains of NSW (Debus 1997). The temperate woodlands are the most threatened type of wooded ecosystem in Australia, with many other bird species threatened or declining (Robinson and Traill 1996). Habitat degradation may be exacerbated where grazing suppresses regeneration of trees (Smith *et al.* 1995). Mortality of dispersing individuals may be high in fragmented habitat.

Logging and firewood harvesting in forests and woodlands destroy hollow trees, which are potential nest or den sites for the Barking Owl and its prey (Smith *et al.* 1995, Debus 1997, Higgins 1999). The cumulative loss of old and dead trees in an area results in a reduction in the age structure of the tree cover. Davey (1993) made 13 detections of the owl in Kialoa State Forest on the south coast of NSW during 1980-1989. He sampled 171 plots and found no Barking Owls in the 12% of plots where the trees had a successional age < 60 years. Based on these data Davey argued that cutting cycles should be increased from 20-60 to 80-100 years. Robinson (1994) contended that the skewed distribution of large hollow trees on farmland versus the heavily logged inland forests, was one reason for the owl's occurrence on private versus public land.

Smith *et al*. (1995) speculated that feral honeybees can occupy Barking Owl nesting hollows. It is also likely that some hollow-dependent Barking Owl prey will be adversely affected by competition from feral honeybees. The extent of these phenomena and their impact upon local populations of Barking Owls and their prey are unknown. Competition from feral honeybees has been listed as a key threatening process in NSW and the threat abatement plan is likely to address research into competition between feral bees and native fauna for nesting hollows at the level of ecological communities.

Predation by goannas at Barking Owl nest sites may be an important threat (I Taylor pers. comm.). Predation by foxes upon the fledglings of owl species, for instance the Powerful Owl and Masked Owl *Tyto novaehollandiae* (McNabb 1996, Debus 1997, Kavanagh 1997), has been observed and the fox is likely to prey upon fledgling Barking Owls (S Debus pers. comm.). However, the population-level impact of fox predation is unknown. The NSW Fox Threat Abatement Plan (TAP) uses a model to prioritise threatened species for fox control programs. The Barking Owl is ranked as a low priority (for details of the model and species rankings see Appendix 1 of the Fox TAP). Similarly, the NSW Feral Cat TAP (in prep.) is likely to rate the Barking Owl as a low priority species. The impact of competition for prey, particularly from the fox and feral cat, has not been studied. Nevertheless, the sparse and declining distribution of the species increases the chance that predation (and competition for prey) will impact significantly on local populations. Hence, mitigation of predation should be considered in the management of individual nest sites.

Owl mortality occurs through collisions with barbed-wire fences, overhead wires and vehicles (Debus 1997). For the Barking Owl, Debus (1997) found one record of a bird caught on a barbed-wire fence and an unspecified number of birds road-killed and dead under powerlines. The impact upon Barking Owl populations in NSW of these and other anthropogenic hazards is unknown. Nevertheless, the sparse and declining distribution of the species increases the chance that such mortality will impact significantly on local populations. Hence, mitigation of such hazards should be considered in the management of individual nest sites.

The direct and secondary effects of agricultural poisons upon raptors, including owls, has been a concern to conservation biologists and managers for decades (Olsen 1995). The best known instances are the reduced reproductive output resulting from eggshell thinning caused by DDT and direct mortality from toxic organochlorines (Olsen 1995). For the Herbert River district of northern Queensland, Young and De Lai (1997) reported declines in the numbers of breeding pairs of six species of rodent-eating raptors: the Barking Owl, four other owls and a harrier. These putative declines were attributed to secondary poisoning by brodifacoum-based rodenticides used from 1992 to control rodents in cane fields. Fatalities from secondary poisoning by rodenticides have also been recorded for the more common, congeneric Boobook Owl (Higgins 1999). As with the hazard of colliding with wires, the population-level impact upon Barking Owls of direct and secondary poisoning from rodenticides and other agricultural poisons is unknown but of concern. Mitigation of this hazard should be considered in the management of individual nest sites and research about the hazard should be supported.

Breeding pairs of Barking Owls are presumed to use well dispersed, traditional territories. The amount of disturbance which pairs will tolerate, particularly during breeding, is unknown, although Hollands (1991) reported nest desertion after minimal disturbance. The terms of the Threatened Species Licences under the IFOAs (see Sections 2.6 and 5.2) require an undisturbed buffer of 50 m around known nest sites. Again, because of the sparse and declining Barking Owl population in NSW, mitigation of human impacts should be considered in the management of individual nest sites.

### 4.3 *In-situ* management

The principal land tenures of concern for *in situ* management of the Barking Owl are NPWS reserves, State Forests and private land. At NPWS reserves, there is consideration of particular threatened species issues in a Review of Environmental Factors (REF) when a development or an activity (eg infrastructure development, fence construction, track maintenance) is proposed. Otherwise, Barking Owls and their habitat are managed by NPWS Regions through general heritage management instruments such as reserve Plans of Management and Fire Management Plans. Consideration of the better-known, large forest owls, the Powerful and Masked Owls and the Sooty Owl *T. tenebricosa*, all of which were listed as vulnerable from the commencement of the TSC Act, may have overshadowed consideration of the Barking Owl in the past. This plan will provide current information for officers in NPWS Regions and Areas to focus consideration of issues specifically related to the Barking Owl.

In forests managed by State Forests of NSW, conservation protocols for threatened owls have been in place since 1990 (see Section 5.2). On private land, including forest plantations and farm forestry operations, there is no specific mechanism for the management of Barking Owls other than the planning provisions for threatened species outlined in Sections 2.4-2.6.

### 4.4 *Ex-situ* management

Captive populations of *N. c. connivens* of south-eastern Australian origin are held at public and private zoos and wildlife parks in NSW and interstate and the species breeds well in captivity. A brood of two captive-bred juveniles of New England Region provenance was hack-released on the Northern Tablelands but the owls' subsequent fate was not ascertained (S. Debus unpubl.). Trials (using Barn Owls) of release training for captive-bred juveniles were undertaken at Currumbin Sanctuary, Queensland (L. Romer pers. comm.). A captive-breeding and release program is not proposed in this plan.

Translocation of a species is the deliberate (i) reintroduction into an area where it once occurred, (ii) introduction to an area where it was not previously recorded or (iii) supplementation of a population with new individuals. Captive breeding may be used as a source of animals to translocate. Translocation programs are proposed in recovery plans when *in situ* actions are inadequate to recover the threatened species (NPWS 2001). Translocation is not proposed for the Barking Owl in this plan.

## 5 Previous management actions

### 5.1 Reservation and restoration

Woodland habitat, particularly the Barking Owl's preferred habitat along watercourses, is poorly reserved on the coastal plain and the western slopes and plains of NSW. In the last decade, the need to conserve remnants of native vegetation and begin to replant has been addressed through legislation, particularly the NVC Act, and on-ground works, for example Landcare and Greening Australia. However, the typical project of replanting trees on tens of hectares of cleared land will not provide sufficient habitat to sustain a breeding pair of Barking Owls. Presumably, increasing the size and connectivity of existing fragments of habitat and tree plantings will ultimately benefit the Barking Owl. Forest habitat for the Barking Owl is reserved within many national parks and other conservation reserves along the coast and ranges in NSW. There have been substantial additions (total area > 1.5 M ha) to the conservation reserve system as a result of Regional Forest Agreements (RFAs). Key factors used for identifying which areas were to be added to the National Park estate included modelled (mapped) habitat for large forest owls, the Powerful, Masked and Sooty Owls, but did not include the Barking Owl due to the paucity of data.

## 5.2 Protocols in State Forests

Threatened owl management (and management for other species) in wood production forests is regulated by conservation protocols that form the terms of Threatened Species Licences for forestry operations. For the majority of forests in NSW, these are TSC Act licences issued under the *Forestry and National Parks Estate Act 1998* for those areas covered by an IFOA. These conservation protocols for timber harvesting within state forests were developed jointly by the NPWS, State Forests of NSW and PlanningNSW.

A summary of the main features of these conservation protocols for the Barking, Powerful, Masked and Sooty Owls is given below.

### 5.2.1 General prescriptions

Special protection is given to forests occurring in all riparian zones where owls nest and roost and their prey are most likely to be found. In addition, old hollow trees are retained within logged areas to reduce logging impacts on the owls and their prey. These conditions apply throughout wood production forests, regardless of whether owls are known to occur.

*Rainforest protocol*: all forest types designated as rainforest are excluded from logging.
*Old-growth forest protocol*: all areas designated as old-growth forest are excluded from logging.
*Tree retention*: live hollow-bearing trees are retained in regrowth and non-regrowth zones at up to 6 per ha, from among the largest trees in the stand. Recruits for a new generation of hollow-bearing trees in the future are also retained in regrowth and non-regrowth zones at up to 6 per ha. Most dead trees are retained.
*Protection of habitat trees*: logging and fire are managed to minimise damage to hollow-bearing trees, recruitment trees and stags.
*Riparian buffers*: disturbance is excluded from strips 10 m, 20 m, 30 m and 50 m wide on each side of streams for first-, second-, third- and fourth or higher-order streams respectively.
*Connection corridors*: each 500 ha block of forest is connected by undisturbed corridors, 40 m wide between second-order streams or 80 m between third-order streams, to link neighbouring catchments.
*Burning*: prescribed fire is managed to reflect the ecological requirements of threatened species in the area, to maintain an understorey mosaic and to minimise impact on the understorey and large fallen logs especially in riparian areas.
*Ground habitat protection*: measures are taken to protect understorey, ground cover and large fallen logs during forestry activities.
*Pre-logging site inspections*: searches are conducted for owl nests, roosts and pellets and nocturnal call playback surveys specifically target the Barking Owl.

### 5.2.2 Specific prescriptions

Additional conditions apply if an owl is recorded. This can take the form of site-specific management, based on individual owl territories, or landscape management in which large blocks of forest are managed to maintain owl populations.

The site-based approach attempts to ensure that sufficient suitable habitat is protected in the vicinity of the record. Protection includes 300 ha of undisturbed habitat retained within a 2 km radius of a site where a Barking, Powerful or Masked Owl is detected and, for the Eden Region, for the Sooty Owl as well. This aims to provide suitable conditions to support populations of prey species and for owl foraging behaviour. Known owl nest sites or permanent roost sites detected during pre-logging surveys

are protected by exclusion zones of 50 m and 30 m radius respectively.

The landscape approach attempts to ensure that a network of habitat is maintained within forestry planning areas. The approach incorporates retention of large patches of habitat in the logging mosaic. At least 25% of the forest area within the landscape (approximately 10 000 ha blocks), which may include areas of national park, is retained unlogged as owl habitat. This approach is most suitable for large forested areas, especially with numerous records of owls.

### 5.3 Protocols on other lands

The Barking Owl is most likely to occur on private lands (Kavanagh *et al.* 1995a, Debus 1997, see Section 3.3). Management of owls and their habitat on privately-owned lands in NSW ranges from non-existent to application of the principles and practices which apply on public forest lands. Few attempts have been made to date to coordinate owl conservation efforts over multiple holdings of private land. Examples of the ways in which conservation protocols for owls have been applied on development sites include the following:

*Highway upgrades*: protection of large hollow trees, pre-clearing surveys and erection of artificial hollows in adjoining forest.

*Mining*: pre-clearing surveys and identification and protection of nest and roost sites.

*Quarries*: pre-clearing surveys and protection of large hollow trees.

*Bushland residential subdivisions*: protection of nest sites, roost sites, patches of habitat and prey bases.

*Vegetation clearance applications*: Clearing of native vegetation that may provide habitat for threatened owls is regulated by the NVC Act. Local governments and the DLWC can refuse applications for clearing where they affect threatened species.

### 5.4 Research

The Barking Owl's distribution, biology and ecology in NSW have been reviewed and management issues identified (Kavanagh *et al.* 1995a, Debus 1997). Surveys for the owl have been conducted in NSW on the Murrumbidgee and Murray Rivers (Robinson 1994); in the Bungawalbyn catchment on the North Coast (Stuart 1995); in state forests of northern, central and southern NSW (Kavanagh 1995, Kavanagh and Bamkin 1995, Kavanagh *et al.* 1995b, Kavanagh and Stanton 1998); in habitat remnants on private land on the South Coast (Kavanagh 1997); on the Northern Tablelands and North-west Slopes (Debus 2001); in western NSW by NPWS (M. Ellis pers. comm.); in southern woodlands of NSW between the Murray and Murrumbidgee Rivers (Taylor and Herring 2001); in the central west in the Goonoo and Pilliga areas (Milledge 2002); and in eastern NSW by NPWS as part of the CRA/RFA process. One pair on the Northern Tablelands was monitored opportunistically over 3 years for territory occupancy, breeding success and dietary data (Debus 1997; Debus *et al.* 1998, 1999). Radio-tracking of a Barking Owl at Goonoo State Forest (Schedvin *et al.* 2001) and another around Dubbo, was undertaken in the central west of NSW.

A long-term, study of the owl's biology and ecology has been under way for two decades in northern Victoria (P. Peake unpubl.). An ecological study is in progress on pairs in the Pilliga Scrub (R. Kavanagh unpubl.). A study of the owl's habitat requirements in the Murray Valley region is well advanced (I. Taylor and N. Schedvin unpubl.).

The Barking Owl is one of a suite of species of temperate woodland birds which is recognised as declining in Western Australia (eg Saunders and Ingram 1995), South Australia (eg Paton *et al.* 1993) Victoria (eg Robinson 1993) and NSW (eg Reid 1999). Much of the general research on this suite of birds has particular relevance to the Barking Owl.

### 5.5 Other

The Birds on Farms project was conducted by *Birds Australia* during 1995-2000. Surveys of 330 farms in southern and eastern Australia were undertaken by volunteers, including approximately 380 people from farming communities. The ten-point "Guidelines for Sustainability" (Barratt 2000) produced as part of the project, advocates farmland management techniques conducive but not specific to the conservation of Barking Owl habitat.

Population viability analysis (PVA) and habitat modelling are useful tools for species and ecosystem management when there are adequate data upon which to base models. There were insufficient records of the Barking Owl to model its habitat in the RFA process (Section 5.1) and the paucity of data on the species is likely to hinder attempts to model its viability and habitat preference for many years to come. The difficulties with PVA for the Powerful Owl in Victoria (McCarthy *et al.* 1999) caution against relying on PVA for the less common Barking Owl in NSW.

## 6 Recovery objectives, criteria and actions

The ultimate aim of recovery planning for the Barking Owl under the TSC Act is to recover the species to a position of viability in nature in NSW. This plan recognises that the recovery of the Barking Owl in NSW will take decades. Hence, the overall objective of this five-year plan is simply to ensure the long-term persistence of the Barking Owl in NSW. This will be achieved by implementing actions under five specific objectives which increase understanding and awareness of the species, undertake threat abatement and mitigation and which allow for efficiencies and coordination of the plan.

The criteria for the overall objective of this plan are that all high-priority actions, most of the medium-priority and some of the low-priority actions will be undertaken; annual reports will be written; the achievements of the five-year plan will be reviewed and a second five-year plan will be prepared.

**Specific Objective 1: Increase understanding of the biology, ecology and management of the Barking Owl**

*Action 1.1 Assess the size, viability and status of the Barking Owl population in NSW*

In the first year of the plan, the size of the NSW population of the species will be estimated using existing survey data and known information on distribution, preferred habitat, home range size and population density. Known clusters of pairs will be documented to assist with the population estimate, habitat protection and population monitoring. Concurrently, the use of a model to assess the viability of the population in NSW may be considered (but see Section 5.4). In the second year of the plan, the legal status of the NSW population will be assessed. It is anticipated that this action will highlight considerable knowledge gaps and inform the protocol for establishing a population monitoring program (Action 1.2).

*Action 1.2 Establish a program to monitor the NSW Barking Owl population and study its demographics*

The abundance of the Barking Owl in NSW appears to be declining, although there is limited rigorous evidence (Section 3.2). The theory of extinction debt, whereby the decline of a species may lag decades behind the loss, fragmentation or degradation of its habitat, may explain the apparent pattern of

the owl's decline in NSW. Therefore, the urgency and priority to manage the recovery of the species needs to take cognisance of population trends.

In the second year of this plan, the NPWS will develop, trial and establish a protocol for high-quality surveys to monitor the Barking Owl across land tenures and habitat types in NSW. The aims of the population monitoring program will be to:

(i) Monitor medium-term (5-10 years) and long-term (> 10 years) population trends.
(ii) Locate active nest sites.
(iii) Monitor annual reproductive rates of known pairs and where possible band offspring.
(iv) Maximise the number of incidental records of the species.

Once the protocol is established, monitoring data will be collected for the remainder of the period of this plan and be available for population viability modelling (see Action 1.4).

In developing the protocol, the NPWS will liaise with State Forests of NSW and the Bird Interest Groups Network (BIGNET). The Barking Owl monitoring program will be linked to monitoring for the three large forest owls along forested areas of the ranges and with Masked Owl monitoring in the western part of its range in NSW. The monitoring program will facilitate the participation of volunteers and maintain a close liaison with BIGNET.

*Action 1.3 Investigate conservation management strategies*

Experimental approaches which investigate strategies to manage the Barking Owl will be supported. Questions of interest include:

(i) The management of threats.
(ii) Suitable methods of habitat restoration (eg relief from overgrazing which is suppressing regrowth).
(iii) The need for and efficacy of hollow supplementation for the Barking Owl and its prey species (eg the enhancement or creation of natural hollows or nest-box trials).

*Action 1.4 Support biological and ecological studies*

The biology and ecology of the Barking Owl throughout its range is not well understood (see Sections 4.1-4.2). Loss and degradation of habitat have caused the decline of the species and some of its prey through clearing, removal of dead wood, competition from feral honeybees and possibly predation by foxes and feral cats as described in the determinations to list these as key threatening processes. However, the factors which currently limit the population and its recovery are unknown. Therefore, this plan will support research including:

(i) Studies which locate and monitor nest sites, characterise breeding habitat and investigate whether availability of nesting habitat is limiting the NSW population of the Barking Owl.
(ii) Radio-tracking studies into the home range, dispersal and habitat needs of the Barking Owl, particularly during breeding.
(iii) Studies of the Barking Owl's diet, particularly in regard to habitat variability and availability of preferred prey and breeding success.
(iv) Studies linking Barking Owl recovery to key threatening processes.
(v) Population viability and habitat modelling studies (but see Section 5.4).
(vi) Studies on reproduction.

In years 3-5 of this plan, the NPWS will make $10 000 available as a scholarship to support a PhD project which studies one or more of the above issues of the Barking Owl's biology and/or ecology in NSW. To implement this action, the NPWS will collaborate with a university and provide an external supervisor of the student's project.

*Action 1.5 Support population genetics studies*

The TSC Act recognises the importance of conserving biological diversity at the level of genetic diversity. Subspecies have been recognised for the Barking Owl on the basis of morphology (Higgins 1999). However, the genetic variation between the eastern and south-western populations of *Ninox connivens connivens* and within the eastern population has not been studied (Garnett and Crowley 2000). These studies will be needed before the genetic diversity of the species can be managed in NSW. The tasks which will be supported under this action include:

(i) Collecting samples from individual owls in NSW. This links with Action 3.5.
(ii) Coordinating the collection of samples from Western Australia, Victoria, Queensland and Northern Territory.
(ii) Developing the species-specific techniques necessary to undertake sample analysis and then undertaking analyses. The cost of sequencing one mtDNA gene and analysing <20 samples was estimated by Southern Cross University at $7 000.

*Action 1.6 Investigate the cultural and historic significance of the Barking Owl*

Owls are popular charismatic animals in folk lore and children's stories in Australia and throughout the world. However, the cultural significance of the Barking Owl to indigenous Australians and rural communities is unknown. In the second year of this plan, the NPWS will make $5 000 available as a scholarship (identified Aboriginal student) to support an honours project which uses the Barking Owl in NSW as a case study to investigate the cultural and historic significance of the species. There may be scope in such a project to include all threatened owls. To implement this action, the NPWS will collaborate with a university and provide an external supervisor of the student's project.

**Specific Objective 2: Increase education and awareness of and involvement in the conservation of the Barking Owl and its habitat in NSW**

*Action 2.1 Develop and distribute the Barking Owl information package*

Within the first year of this plan, the NPWS will prepare and deliver a Barking Owl information package to all relevant local Councils (listed in Appendix 1) and NPWS Area and Regional Offices. The package will contain the Barking Owl species profile (with identification photo and also available electronically), samples of the species' calls (available electronically), Barking Owl survey and assessment guidelines and prescriptions to mitigate the impact of developments and activities. It will also contain information about the NPWS Wildlife Atlas. Multiple copies of the package will also be available to conservation organisations, particularly BIGNET and the Grassy Box Woodlands Conservation Management Network, and the package will be available on the NPWS web site. The package will raise awareness of the conservation issues associated with the species, complement existing information for impact assessment and encourage private landholders to protect and restore Barking Owl habitat. The package will highlight the need to protect the breeding and roosting habitat of the species and its prey. In addition, local Councils, NPWS Area staff, conservation groups and the public will be encouraged to provide records of all detections of Barking Owls for the NPWS Wildlife Atlas.

*Action 2.2 Develop and distribute best practice guidelines for Barking Owl conservation to Regional Vegetation Management Committees (RVMCs)*

Best practice guidelines for Barking Owl conservation will be provided to all relevant RVMCs within the first 6 months of the plan to assist in the preparation of RVMPs. Draft information was prepared

and distributed to some RVMCs previously. This information forms the basis for the draft guidelines, including the best practice guidelines, in Appendix 1. The NPWS encourages the adoption of measures within the best practice guidelines into RVMPs. In the case of approved RVMPs, the best practice guidelines should be used to assist in their implementation and review.

*Action 2.3 Prepare a poster and undertake a community survey and media campaign in rural and regional NSW*

In the first year of this plan, the NPWS will prepare a Barking Owl poster and undertake a community survey and media campaign in rural and regional NSW to raise community awareness of the Barking Owl. The importance of each individual owl, and particularly breeding sites, will be stressed in the context of the recovery of the species in NSW. This follows the same action undertaken successfully for the Bush Stone-curlew in 2002. Articles will be sent to local newspapers and releases will be provided to regional radio and television in anticipation of live interviews. Areas known to support the Barking Owl will be targeted. All members of the public who respond to the survey will received a copy of the poster and information on community conservation programs undertaken by NPWS. Copies of the poster will be distributed to all relevant NPWS offices, Rural Lands Protection Board offices and local councils. The records collected will be included in the NPWS Wildlife Atlas and assist planning for the conservation of the species. The action will provide additional information regarding the current distribution and abundance of the Barking Owl.

*Action 2.4 Establish formal conservation arrangements for properties with Barking Owls*

This plan (Actions 1.1, 1.2, 2.1, 2.2 and 2.3) will lead to current records of the Barking Owl in NSW. Where records, particularly breeding records, occur on private land, the NPWS will provide information to landholders about the range of formal conservation arrangements which can be used to protect wildlife habitat and encourage them to enter into an appropriate arrangement. The conservation arrangements for which the NPWS can provide administrative support and assistance to landholders are Voluntary Conservation Agreements (VCAs), Wildlife Refuges and Land for Wildlife. Property Agreements are administered by DLWC. They are established under the NVC Act and, while they relate to vegetation management, they may be useful to conserve habitat and potential habitat for Barking Owl.

**Specific Objective 3: Undertake threat abatement and mitigation**

Loss and degradation of habitat have caused the decline of the Barking Owl in NSW through clearing, removal of dead wood, competition from feral honeybees and possibly predation by foxes and feral cats as described in the determinations to list these as key threatening processes. However, the factors which currently limit the population and its recovery are unknown. Other potential threats of collision with wires and vehicles, direct and secondary effects of agricultural poisons, predation and human disturbance were discussed in Section 4.2.

This plan assumes that because the distribution of the species in NSW is sparse and declining, individual cases of nest failure and mortality are significant to the NSW population. Hence, threat mitigation will be needed (i) at a local level to protect breeding pairs and individual nest sites immediately and (ii) broadly across the state to provide longer-term opportunities for the Barking Owl to recover. Ideally, all habitat of the Barking Owl in NSW will be protected and conserved until it and the other species for which it is a flagship recover from the threat of extinction (see Section 8).

*Action 3.1 Protect known Barking Owl nest sites and surrounding habitat*

The actions in this plan, particularly Actions 1.2, 1.4 and 2.3, will lead to the documentation of Barking Owl nest sites. There may be situations where the exact location of nest sites needs to remain undisclosed. Notwithstanding, the NPWS will negotiate with individual land managers to achieve appropriate measures to protect all known Barking Owl nest sites in NSW. Protection may need to address some of the listed key threatening processes. Other potential threats of collision with wires and vehicles, direct and secondary effects of agricultural poisons, predation and human disturbance, may also need to be addressed.

*Action 3.2 Assist with the protection of Barking Owl habitat from disturbance due to developments and activities*

The awareness information distributed under Action 2.1 will assist in the identification and protection of Barking Owl habitat which is potentially threatened by developments and activities. In particular, the survey and assessment guidelines will be particularly useful to local Councils.

*Action 3.3 Assess forestry prescriptions and Threatened Species Licences for their effectiveness in conserving the Barking Owl in State Forests*

Confidence in the Threatened Species Licence approach is dependent on a good understanding of the habitat requirements of the Barking Owl and on the effectiveness of owl conservation protocols (see Section 5.2) to ameliorate the impacts of forestry practices on owl habitat. Confirmation is required that the licence conditions are facilitating the desired result; that is, the maintenance of successfully breeding owl populations throughout wood production forests. This assessment for the Barking Owl will be incorporated into and undertaken as part of a similar action in the Recovery Plan for the large forest owls.

*Action 3.4 Incorporate the consideration of Barking Owl habitat and potential habitat as a high priority in the assessment of property for reserve establishment*

The Barking Owl is a large, top-order predator which occupies a large home range (Section 3.2). Conservation reserves encompassing land which is known or potential habitat is one of the ways to address further loss of habitat and to ensure secure habitat in the future. The NPWS assesses and recommends areas for the establishment of new reserves. The Barking Owl recovery plan coordinator will ensure that habitat for the species is a consideration in the reserve establishment process, particularly in areas of mature and regrowth woodland in or adjacent to agricultural areas, with emphasis on fertile soils on the inland slopes and plains and in coastal valleys.

*Action 3.5 Support studies into the effects of agricultural poisons upon the species*

The direct and secondary effects of agricultural poisons upon the Barking Owl is uncertain (Section 4.2). Studies to measure these impacts will be supported by this plan. The cost of such studies will be determined by particular research questions and protocols. Protocols will include collecting specimens (eg road kills, use of surrogate species) storing samples (eg freezing, buffer solutions) and analysing material (eg chromatography). To estimate the cost of this action, one study could be supported with one NPWS officer for one day per month (eg time taken to collect and store samples) for one year plus costs (eg vehicle, office) to the value of $5 000 in kind and an equal amount for a researcher of $5 000 in cash. This can be linked to Action 1.5.

**Specific Objective 4: Gain efficiencies through links with other conservation plans and conservation groups**

*Action 4.1 Integrate the Barking Owl plan with other plans*

A number of threatened species, populations and ecological communities have similar habitat requirements to the Barking Owl or face similar threats. Integrating the recovery actions of this plan with other plans will provide cost efficiencies. Threatened species and populations which occur in similar locations to the Barking Owl include the Bush Stone-curlew, Glossy Black-cockatoo, Koala, large forest owls, Regent Honeyeater, Rufous Bettong, Square-tailed Kite, Superb Parrot, Swift Parrot, Western Blue-tongued Lizard, Turquoise Parrot and the recently listed, declining woodland birds, the Brown Treecreeper, Black-chinned Honeyeater, Diamond Firetail, Grey-crowned Babbler, Hooded Robin and Speckled Warbler. Endangered ecological communities which co-occur with the Barking Owl include White Box Yellow Box Blakley's Red Gum. Habitat loss and degradation is the major threatening process for the Barking Owl. The relevant, listed key threatening processes (KTPs) are discussed in Section 4.2 and the TAPs for all of these KTPs will need to link to the conservation of Barking Owl habitat.

The NPWS prepares Plans of Management for parks and reserves under the *National Parks and Wildlife Act 1974* (NP&W Act). This plan will provide information on the habitat requirements of the Barking Owl which can be incorporated into Plans of Management.

*Action 4.2 Maintain the NPWS threatened owl working group and links with owl researchers*

The recovery plan coordinator will maintain regular liaison with the threatened owl working group, including State Forest of NSW and the Barking Owl research program at Charles Sturt University.

*Action 4.3 Maintain links with the community*

Actions 2.1, 2.3 and 2.4 will facilitate the establishment and maintenance of links with individuals and community groups concerned with the conservation of the Barking Owl.

**Specific Objective 5: Provide organisational support**

*Action 5.1 Coordinate the implementation of the recovery plan*

The NPWS will provide organisational support to coordinate the implementation of the Barking Owl Recovery Plan actions, including the preparation of an annual report to the NPWS Threatened Owl Working Group. A Project Officer will be employed for plan coordination for approximately 28 weeks per year and will require an operating budget of $5000 per year for field trips, including site inspections and community liaison visits. This position could also undertake the coordination of the Bush Stone-curlew Recovery Plan because there are close similarities between the two plans.

*Action 5.2 Review the plan in its final year and prepare a second recovery plan*

The main threat to the Barking Owl of habitat loss and degradation will not be redressed in the short term and the species is not expected to recover in the five years of this plan (Section 3.6). Therefore, this plan anticipates the need for a further recovery plan.

## 7 Implementation

The implementation of the recovery actions specified in this plan is the responsibility of the NPWS for a period of 5 years from the time this recovery plan is adopted (Table 1). The total estimated cost for

the implementation of these actions is $280 500. The majority of funds will be provided by NPWS. Additional funding will be sought from other sources as part of the Recovery Plan.

The plan is costed assuming that a coordinator will be employed to undertake most of the actions in the plan. The coordinator is costed at Project Officer Grade 2 year 3 with on cost of 23% for approximately 28 weeks per year for the five years of the plan. Further details of the costing are available from the Biodiversity Research and Management Division.

## 8 Social and economic consequences and cultural issues

The Barking Owl is sparsely distributed in NSW. Nevertheless, the majority of records of the Barking Owl in NSW are likely to come from private and unreserved land (Section 3.3). Hence, there will be cases when known records of Barking Owls occur in the vicinity of proposed developments and activities. If these proposals are not exempt from the assessment process (see Section 2.6), the economic and social consequences of protecting the species and its habitat will need to be assessed as part of the normal environmental planning and assessment process.

The most direct consequence of this plan will be that more locations of Barking Owls will be identified and protected in NSW. Conservation agreements with private land managers (Action 2.4) may incur opportunity costs, in terms of agricultural production or development proposals modified or forgone, as well as direct costs for fencing and tree re-establishment. However, threats to the Barking Owl's habitat also threaten the viability of agricultural productivity and solutions will involve the whole community by integrating nature conservation and sustainable land management (Robinson and Traill 1996, O'Neill 1999).

Owls are popular charismatic figures in folk lore and children's stories. However, the cultural significance of the Barking Owl to indigenous Australians and rural communities is unknown. This issue is the subject of Action 1.6.

Submissions from the community regarding other likely social and economic consequences of implementing the actions in this recovery plan are welcome during the draft exhibition period.

## 9 Biodiversity benefits

The Barking Owl is a flagship species. It is a high-order predator in areas of major human activity. It occurs in areas of mature forest and woodland supporting a high biodiversity, including many other threatened species. Pairs require large home ranges. Barking Owls and some of their prey are hollow-dependent. Owl lore is popular worldwide and the Barking Owl is a charismatic species with a distinct and intriguing call. The actions in this plan have strong community involvement and will raise community awareness of the plight of the Barking Owl and the importance of biodiversity more generally. Therefore, the implementation of this plan will have considerable biodiversity benefits across a range of forest and woodland flora and fauna in NSW.

## 10 Preparation details

This document was prepared by the NSW National Parks and Wildlife Service Biodiversity Research and Management Division. It is based on a background paper prepared by Stephen Debus, University of New England. The NPWS Officers who contributed to the draft were Deborah Ashworth, James

Dawson, Joanne Edney, Ron Haering, Amelia Hurren, Andrew McIntyre, Joanna Muldoon, Anthony Overs, Deyarne Plowman, Catherine Price, Geoff Robinson and Todd Soderquist. Jack Baker compiled this draft. Some background information prepared for the large forest owls recovery plan by Rod Kavanagh, State Forests of NSW, was utilised in the preparation of the plan. Other non-NPWS who contributed to the plan through the Threatened Owl Working Group were Penny Olsen, Natasha Schedvin, Matthew Stanton and Iain Taylor.

To prepare the actions for this plan the following sources were considered: The research plan for temperate woodlands of south-eastern Australia (Robinson 1994), the Action Plan for Australian Birds (Garnett and Crowley 2000), the draft (dated 2000) of the Victorian Action Statement for the Barking Owl and the Threatened Owl Recovery Workshop held in June 2001.

## 11 Review date

This recovery plan will be reviewed within five years of the date of publication. The review will include an assessment of the success of the actions against the criteria in the recovery plan.

## 12 References

Barratt G (2000). Birds on Farms. Supplement to *Wingspan* **10** (4).

Davey S M (1993). Notes on the habitat of four Australian owl species. Pp. 126-142 in Olsen, P (ed.), *Australian Raptor Studies*. Australasian Raptor Association, RAOU, Melbourne.

Debus S J S (1997). The Barking Owl in New South Wales. *Aust. Birds* **30**: 53-80.

Debus S J S (2001). Surveys of the Barking Owl and Masked Owl on the north-west slopes of New South Wales. *Corella* **25**: 5-11.

Debus S J S, Shepherd R B and Rose A B (1998). Diet of The Barking Owl *Ninox connivens* near Armidale, New South Wales. *Aust. Bird Watcher* **17**: 302-305.

Debus S J S, Shepherd R B and Rose A B (1999). Non-breeding diet of the Barking Owl near Armidale, New South Wales. *Aust. Bird Watcher* **18**: 43-45.

Garnett S and Crowley G (2000). *The Action Plan for Australian Birds*. Environment Australia, Canberra.

Higgins P J (ed.) (1999). *Handbook of Australian, New Zealand and Antarctic Birds* Vol. 4. Oxford University Press, Melbourne.

Hollands D (1991). *Birds of the Night.* Reed, Sydney.

IUCN (1994). IUCN Red List Categories. International Union for the Conservation of Nature, Species Survival Commission, Gland.

Kavanagh R P (1995). Nocturnal Forest Birds and Arboreal Marsupials of Coolah Tops, Warrung Management Area, Western Region. *Forest Resources Series* No. 28, State Forests of NSW, Sydney.

Kavanagh R P (1997). Ecology and Management of Large Forest Owls in South-eastern Australia. PhD thesis, University of Sydney.

Kavanagh R P and Bamkin K L (1995). Distribution of nocturnal forest birds and mammals in relation to the logging mosaic in south-eastern New South Wales. *Biol. Cons.* **71**: 41-53.

Kavanagh R P and Stanton M A (1998). Nocturnal forest birds and arboreal marsupials of the South-western Slopes, New South Wales. *Aust. Zool.* **30**: 449-466.

Kavanagh R P, Debus S J S, Rose A B and Turner R J (1995a). Notes on the diet and habitat of the Barking Owl *Ninox connivens* in New South Wales. *Aust. Bird Watcher* **16**: 137-144.

Kavanagh R P, Debus S, Tweedie T and Webster R (1995b). Distribution of nocturnal forest birds and mammals in north-eastern New South Wales: relationships with environmental variables and management history. *Wildl. Res.* **22**: 359-377.

McCarthy M A, Webster A, Lyon R H and Lowe K W (1999). Uncertainty in assessing the viability of the Powerful Owl *Ninox strenua* in Victoria, Australia. *Pac. Conserv. Biol.* **5**: 144-154.

McNabb E G (1996). Observations on the biology of the Powerful Owl *Ninox strenua* in southern Victoria. *Aust. Bird Watcher* **16**: 267-295.

Milledge D (2002). A survey of large owls in the Cypress pine / Ironbark forests and woodlands of central western NSW. Unpublished consultant's report to NSW NPWS.

NPWS (2001). Threatened Species Management Policy for the Translocation of Threatened Fauna in NSW. NSW National Parks and Wildlife Service, Sydney.

Olsen P D (1995). *Australian Birds of Prey*. University of NSW Press, Sydney.

O'Neill G (1999). Renaissance on Lanark. Supplement to *Wingspan* **9**(1).

Paton D C, Carpenter G and Sinclair R G (1993). A second bird atlas of the Adelaide region. Part 1: changes in the distribution of birds: 1974-75 vs 1984-85. *S. Aust. Ornith.* **31**: 151-193.

Quammen D (1996). *The Song of the Dodo: Island Biogeography in an Age of Extinctions*. Simon and Scuster, New York.

Reid J R W (1999). Threatened and declining birds in the NSW Sheep-wheat Belt. I Diagnosis, Characteristics and Management. Consultant's report to NPWS. CSIRO, Canberra.

Robinson D (1993). Vale Toolern Vale. *Wingspan* **9**: 1-3, 20.

Robinson D (1994). Research Plan for Threatened Woodland Birds of Southeastern Australia. *Arthur Rylah Institute for Environmental Research Tech. Rep.* 133.

Robinson D and Traill B J (1996). Conserving Woodland Birds in the Wheat and Sheep Belts of Southern Australia. RAOU Conservation Statement 10 [supplement to *Wingspan* **6**(2)].

Saunders D A and Ingram J A (1995). *Birds of Southwestern Australia. An Atlas of Changes in the*

*Distribution and Abundance of the Wheatbelt Avifauna*. Surrey Beatty and Sons, Sydney.

Schedvin N, Soderquist T, Baker J and Taylor I (2001). One Barking Owl – 6000 ha of Forest. Poster paper, Australasian Wildlife Management Society Conference, 2001 and Australasian Ornithological Congress, 2001.

Silveira C E and 7 others (1997). Fauna of the box-ironbark study area. Unpublished report to the Land Council. Arthur Rylah Institute for Environmental Research, Melbourne.

Smith P J, Smith J E, Pressey R L and Whish G L (1995). Birds of particular conservation concern in the Western Division of New South Wales: distributions, habitats and threats. *Occ. Pap. NSW NPWS* 20.

Soule M (ed.) (1987). *Viable Populations for Conservation*. Cambridge University Press, Cambridge.

Stuart W (1995). The distribution and habitat requirements of owls in the Bungawalbyn catchment, north-eastern New South Wales. B.App.Sc. project report, Southern Cross University, Lismore.

Taylor I R and Herring M (2001). Distribution and habitat of the Barking Owl in southern NSW. Consultants' report to NSW NPWS, Hurstville.

Taylor I R, Kirsten I and Peake P (2002a). Distribution and habitat of Barking Owls (*Ninox connivens*) in central Victoria, Australia. Pp. 107-115 in Newton I, Kavanagh R, Olsen J and Taylor I (eds.), *Ecology and Conservation of Owls*. CSIRO Publishing, Collingwood.

Taylor I R, Kirsten I and Peake P (2002b). Habitat, breeding and conservation of the Barking Owls (*Ninox connivens*) in northeastern Victoria, Australia. Pp. 116-124 in Newton I, Kavanagh R, Olsen J and Taylor I (eds.), *Ecology and Conservation of Owls*. CSIRO Publishing, Collingwood.

Taylor M and COG (1992). *Birds of the Australian Capital Territory – An Atlas*. Canberra Ornithologists Group and the National Capital Planning Authority.

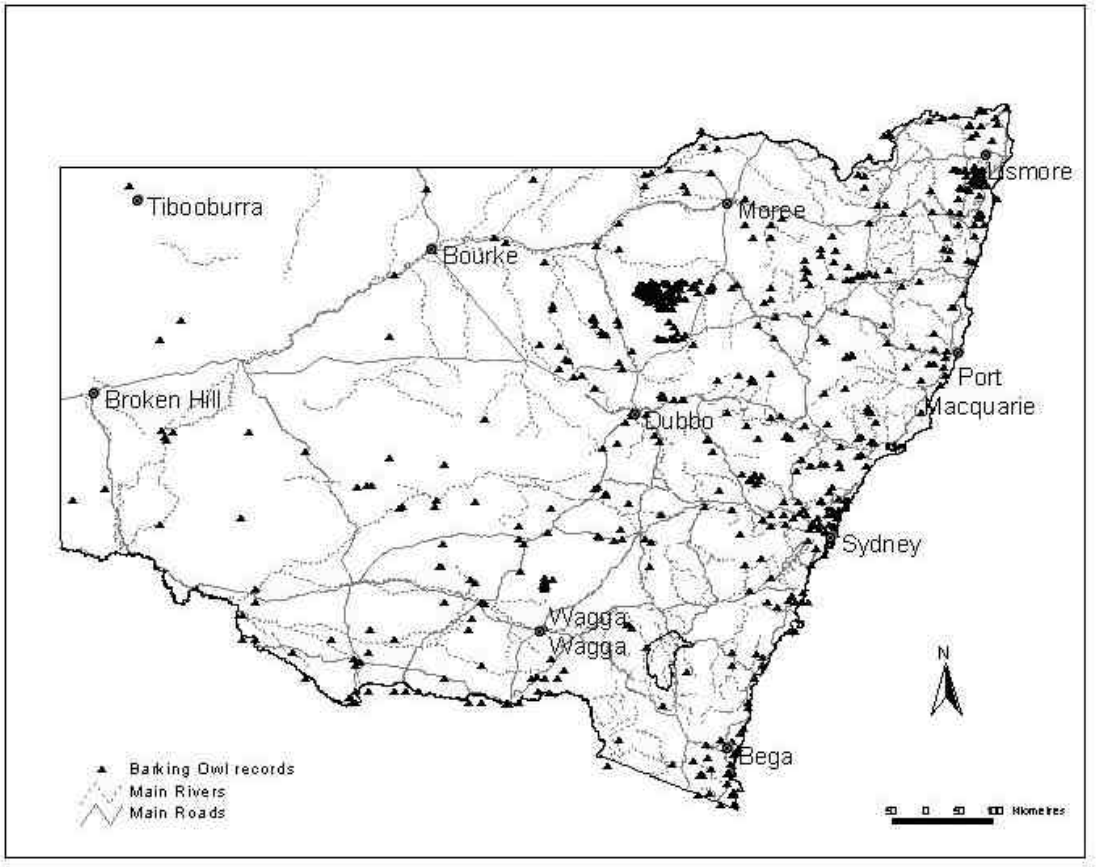
Young J and De Lai L (1997). Population declines of predatory birds coincident with the introduction of Klerat rodenticide in North Queensland. *Aust. Bird Watcher* **17**: 160-167.

Zillman E E (1964). Observations on the Winking or Barking Owl. *Aust. Bird Watcher* **2**: 102-104.

## 13 Acronyms and abbreviations used in the plan

BIGNET - Bird interest groups network
DLWC - Department of Land and Water Conservation
EP&A Act - *Environmental Planning and Assessment Act 1979*
EPBC Act - Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*
LGA - Local Government Area
NP - National Park
NP&W Act - *National Parks and Wildlife Act 1974*
NPWS - NSW National Parks and Wildlife Service
NR - Nature Reserve
NVC Act - *Native Vegetation Conservation Act 1997*
RVMC - Regional Vegetation Management Committee
RVMP - Regional Vegetation Management Plan
TSC Act - NSW *Threatened Species Conservation Act 1995*

**Figure 1 Records of the Barking Owl in NSW**




The records of the Barking Owl shown in this figure include historic and recent records from multiple data sources as indicated below. The species is not currently distributed as widely or densely as this map indicates. The records cannot be considered as a comprehensive inventory and may contain errors and omissions.

Map compiled from species records from:

NPWS Atlas of NSW Wildlife Database
Australian Bird and Bat Banding Scheme
RAOU Atlas of Australian Birds 1
Birds Australia Atlas of Australian Birds 2
Australian Museum Specimen Register
CSIRO Australian National Wildlife Collection
QLD Wildnet Fauna
State Forests of NSW

Roads and Rivers data from AUSLIG

## Table 1: Estimated costs of implementing the actions identified in the Barking Owl recovery plan.

Priority ratings are: 1- Action critical to meeting plan objectives, 2 - Action contributing to meeting plan objectives, 3 - Desirable, but not essential action.
'In-Kind' Funds represent salary component of permanent staff and current resources.
'Cash' Funds represent the salary component for temporary staff and other costs such as the purchasing of survey equipment.

| Action No. | Action | Priority | Year 1 $ | Year 2 $ | Year 3 $ | Year 4 $ | Year 5 $ | Total $ | Responsibility | In-kind | Cash $ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.1 | Population assessment | 1 | 5400 | 5400 | 0 | 0 | 0 | 10800 | NPWS | 0 | 10900 |
| 1.2 | Population monitoring | 1 | 0 | 10800 | 20000 | 20000 | 20000 | 70800 | NPWS | 0 | 70800 |
| 1.3 | Management strategies | 2 | 0 | 0 | 0 | 0 | 0 | 0 | unfunded | 0 | 0 |
| 1.4 | Biol/ecological studies | 2 | 0 | 6750 | 16750 | 16750 | 16750 | 57000 | NPWS | 0 | 57000 |
| 1.5 | Genetic studies | 3 | 0 | 0 | 0 | 0 | 0 | 0 | unfunded | 0 | 0 |
| 1.6 | Cultural significance | 2 | 0 | 10400 | 0 | 0 | 0 | 10400 | NPWS | 0 | 10400 |
| 2.1 | Information package | 1 | 5400 | 0 | 0 | 0 | 0 | 5400 | NPWS | 0 | 810 |
| 2.2 | Best practice guidelines | 1 | 1350 | 0 | 0 | 0 | 0 | 1350 | NPWS | 0 | 2770 |
| 2.3 | Community survey/campaign | 1 | 22800 | 0 | 0 | 0 | 0 | 22800 | NPWS | 0 | 3850 |
| 2.4 | Conservation agreements | 1 | 5400 | 5400 | 2700 | 2700 | 2700 | 18900 | NPWS | 0 | 18900 |
| 3.1 | Protect nest habitat | 1 | 5400 | 5400 | 2700 | 2700 | 2700 | 18900 | NPWS | 0 | 18900 |
| 3.2 | Developments and activities | 1 | 0 | 0 | 0 | 0 | 0 | 0 | NPWS | 0 | 0 |
| 3.3 | Forestry prescriptions | 3 | 0 | 0 | 0 | 0 | 0 | 0 | unfunded | 0 | 0 |
| 3.4 | Reserve establishment | 1 | 1350 | 1350 | 1350 | 1350 | 1350 | 6750 | NPWS | 0 | 6750 |

| Action No. | Action | Priority | Year 1 $ | Year 2 $ | Year 3 $ | Year 4 $ | Year 5 $ | Total $ | Responsibility | In-kind | Cash $ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.5 | Agricultural poisons | 3 | 0 | 0 | 0 | 0 | 0 | 0 | unfunded | 0 | 0 |
| 4.1 | Integrate with other plans | 1 | 1350 | 1350 | 1350 | 1350 | 1350 | 6750 | NPWS | 0 | 6750 |
| 4.2 | Owl working group | 1 | 1350 | 1350 | 1350 | 1350 | 1350 | 6750 | NPWS | 0 | 6750 |
| 4.3 | Community links | 1 | 1350 | 1350 | 1350 | 1350 | 1350 | 6750 | NPWS | 0 | 6750 |
| 5.1 | Plan coordination | 1 | 5000 | 5000 | 5000 | 5000 | 5000 | 25000 | NPWS | 0 | 25000 |
| 5.2 | Review and rewrite plan | 1 | 1350 | 1350 | 1350 | 1350 | 6750 | 12150 | NPWS | 0 | 12150 |
| | **TOTAL** | | **57500** | **55900** | **53900** | **53900** | **59300** | **280500** | | **0** | **280500** |

**Appendix 1**


**NSW NATIONAL PARKS AND WILDLIFE SERVICE**

# *Best practice guidelines for conservation of the*

# *The Barking Owl*
# Ninox connivens

**The following information is designed for use when carrying out the provisions of the *Native Vegetation Conservation Act* 1997 (eg preparation of regional vegetation management plans, assessing clearing applications that require consent and preparing property agreements).**

# *The Barking Owl*

The Barking Owl *Ninox connivens* is listed as vulnerable in NSW on Schedule 2 of the *Threatened Species Conservation Act* 1995 (TSC Act). However, there are currently grave concerns about the future of this species as a result of declines in its abundance in recent years and its current rarity across its range. The preferred habitat of the species is the more productive, lower lying areas of the landscape which are also the areas that have been predominantly cleared. It is essential that remaining habitat on fertile soil be protected from further clearing, (especially along major river systems- 3rd and 4th order streams and above).

### *Distribution*

The Barking Owl is distributed across most of NSW from the coastal plains and foothills of northern NSW to the inland slopes and plains of northern and southern NSW. It is sparse on the higher parts of the tablelands and in the arid zone west of the Darling River and rare or absent in the dense, wet forests of the eastern fall of the Great Dividing Range. In NSW, the Barking Owl occurs in some reserves and State Forests (Tables 1 and 2) but most records are from private or other unprotected land. There are Barking Owl records from 115 Local Government Areas and all of the Regional Vegetation Management Plan areas in NSW (Table 3).

All areas with potential habitat for the Barking Owl will be important for the long-term conservation of the species in NSW. Because the distribution of the species in NSW is sparse and declining, individual cases of nest failure and mortality are significant to the NSW population. Hence, conservation will be needed (i) at a local level to protect breeding pairs and individual nest sites immediately and (ii) broadly across the state to provide longer-term opportunities for the Barking Owl to recover. Ideally, all habitat of the Barking Owl in NSW will be protected and conserved until it and the other species for which it is a flagship recover from the threat of extinction.

### *Habitat*

The Barking Owl inhabits dry, box-dominated forest and woodlands, including Cypress-Box-Ironbark and River Red Gum forest with adjacent Box forest. The following species are key species of these forests and woodlands:

River Red Gum (*Eucalyptus camuldulensis*)
Blakely's Red Gum (*E. blakelyi*)
Forest Red Gum (*E. tereticornis*)
Grey Box (*E. moluccana*)
White Box (*E. albens*)
Yellow Box (*E. melliodora*)
Red Box (*E. polyanthemos*)
Apple Box (*E. bridgesiana*)
Western Grey Box (*E. microcarpa*)
Western Red Box (*E. intertexta*)
Pilliga Box (*E. pilligaensis*)
Fuzzy Box (*E. conica*)
Black Box (*E. largiflorens*)
Mugga Ironbark (*E. sideroxylon*)
Narrow-leaved Ironbark (*E. crebra*)
Broad-leaf Ironbark (*E. fibrosa*)
Red Stringybark (*E. macrorhyncha*)
Spotted Gum (*E. maculata*)
Blackbutt (*E. pilularis*)
Cabbage Gum (*E. amplifolia*)
Ribbon Gum (*E. viminalis*)
Western Coolibah (*E. microtheca*)
Rough-barked Apple (*Angophora floribunda*)
River Sheoak (*Casuarina cunninghamiana*)
Black Cypress-Pine (*Callitris endlicheri*)
White Cypress-Pine (*Cal. glauca*)
*Melaleuca* species

## Critical habitat components

### *Breeding*

Breeding requires nest sites in large hollows in large live trees. Breeding sites need to be supported by an adequate prey base.

### *Feeding*

Feeding requirements of the Barking Owl include a variety of birds, mammals and large insects. Where possible, particularly during breeding, the Barking Owl appears to prefer native arboreal mammals (e.g. brushtail and ringtail possums, sugar and squirrel gliders). These mammals, and some of the Barking Owl's important bird prey species such as parrots, are also dependent on tree hollows for at least part of their life cycle. Consequently, tree hollows of all sizes in Barking Owl habitat are important to maintain prey populations, as is adequate ground cover, to support terrestrial prey.

### *Roosting*

Roosting sites need to give adequate cover. This is especially important for juvenile survivorship. Roosting habitat includes dense clumps of canopy foliage in large trees or tall, densely foliaged understorey trees including eucalypts, *Melaleuca* species, River Sheoak, other *Casuarina* and *Allocasuarina* species, *Angophora*, *Acacia* and *Exocarpus* species, as well as rainforest species of streamside gallery forests. Roost sites are often near watercourses or wetlands.

## Areas of high significance

- Mature forest and woodland habitat, in particular forest and woodland near rivers, streams, drainage lines and swamps. Mature forests contain a high percentage of large diameter trees and a high density of tree hollows of all sizes, including the size range used by the owls and their prey.

- Substantial-sized forest and woodland blocks and smaller forest fragments within a few kilometres of such blocks are essential for breeding. It is essential to have very extensive areas of tree cover with an abundance of hollows to support adequate populations of prey.

- Remnant forest and woodland vegetation on private land adjacent to wooded areas along roads, tracks, creeks and paddock boundaries is essential to maintain connectivity across the landscape, to facilitate hunting for the Barking Owl and to maintain populations of its prey.

## Recommendations

### *Broad landscape management recommendations*

- Focus on protecting from further clearing the more productive, lower lying areas of the landscape, (usually valley systems and along drainage lines).
- Ensure that substantial-sized blocks of mature forest and woodland are maintained and protected from clearing as well as smaller forest fragments within a few kilometres of such blocks.
- Protect all habitat within a 1 km wide buffer on both sides of major river systems. This should emphasise connecting suitable areas of old woodland.
- Protect from further clearing all mature forest remnant habitat on private land adjacent to forests, along road and track sides, along creeks and paddock boundaries. This will help to maintain a network of habitat across the landscape.
- Protect from clearing all large old trees on both public and private land, including old paddock trees. These are likely to have hollows suitable for Barking Owls and/or hollow-dependent mammals and birds. In areas known to support Barking Owls**,** it is possible that the felling of even individual hollow-bearing trees could impact upon the local Barking Owl population.
- Use tree planting and vegetation regeneration to connect existing remnants of vegetation.
- Prohibit removal of dead and fallen timber (especially large trees and logs) for firewood in forest and woodland areas that support Barking Owls. Dead standing trees have hollows that may be used and fallen timber provides important habitat for terrestrial prey. Furthermore, dead standing timber provides superior foraging sites for some prey species, such as Phascogales, and potentially develops exposed hollows as branches are shed.

## *Specific recommendations for Regional Vegetation Management Plans*

| Habitat/vegetation types | Protection/status under RVMPs | Enhancement and/or regeneration |
|---|---|---|
| Stands* dominated by mature trees featuring large hollows, on plains and foothills, or dense riparian or gallery communities near creeks, rivers, lakes or swamps. Dense understorey shrubs which provide roosting habitat and habitat for prey species. | Protect from all clearing activities. | Fence and manage grazing pressure to prevent dieback and allow ongoing regeneration of overstorey and understorey. Control weeds where practicable. |
| Stands dominated by mature trees featuring large hollows, on plains and foothills, or dense riparian or gallery communities near creeks, rivers, lakes or swamps. Few understorey shrubs. | Protect from all clearing activities. | Fence and manage grazing pressure to prevent dieback and allow ongoing regeneration of overstorey and understorey. Control weeds where practicable. Supplement with understorey plantings. |
| Stands dominated by mature trees featuring large hollows, on plains and foothills, or dense riparian or gallery communities near creeks, rivers, lakes or swamps. No understorey shrubs. | Protect from all clearing activities. | Fence and manage grazing pressure to prevent dieback and allow ongoing regeneration of overstorey and understorey. Control weeds where practicable. Supplement with understorey plantings. |
| Open Woodland / scattered trees featuring many large hollows, little or no die back/senescence, some understorey shrubs. | Protect from all clearing activities. | Fence and manage grazing pressure to prevent dieback and allow ongoing regeneration of overstorey and understorey. Control weeds where practicable. Supplement with understorey plantings. |
| Open Woodland / scattered trees featuring many large hollows, little or no dieback/senescence, no understorey shrubs. | Protect from all clearing activities. | Fence and manage grazing pressure to prevent dieback and allow ongoing regeneration of overstorey and understorey. Control weeds where practicable. Supplement with understorey plantings . |
| Open Woodland / scattered trees featuring some large hollows, some die back/senescence, some understorey shrubs. | Limit activities to on-farm use[#]. Hollow bearing trees should be protected. Consent required when other clearing activities are proposed. | Fence and manage grazing pressure to prevent dieback and allow ongoing regeneration of overstorey and understorey. Control weeds where practicable. Supplement with understorey plantings. |
| Open Woodland / scattered trees featuring some large hollows, some dieback/senescence, no understorey shrubs. | Limit activities to on-farm use[#]. Hollow bearing trees should be protected. Consent required when other clearing activities are proposed. | Fence and manage grazing pressure to prevent dieback and allow ongoing regeneration of overstorey and understorey. Control weeds where practicable. Supplement with understorey plantings. |
| Isolated paddock trees (>50m from nearest other tree) featuring large hollows. | Consent required. | Fence off individuals located in paddock corners or close to fence and drainage lines. Supplement with overstorey and understorey plantings. |
| Trees in which Barking Owls have been recorded. | Protect trees where birds recorded from all clearing activities. Nest trees should be protected by a 50 m buffer zone. | |

* Note: 'stands' refers to any area that can reasonably be described as having the character of 'closed forest', 'open forest', 'woodland' or 'open woodland' as defined by Groves (1981) and including small remnants of less than one hectare. Each of these four categories have the following "foliage projective cover": 'closed forest' 100-70%, 'open forest' 70-30%, 'woodland' 30-10%. (From Australian Vegetation. Ed. Groves, R. H. Cambridge Uni Press, Cambridge, 1981). The category 'open woodland / scattered trees' ranges from a foliage projection cover of < 10% ('open woodland') to trees which are separated by < 50 metres ('scattered trees').

[#] "limit activities to on-farm use" means timber can only be used as firewood and/or fence posts on the property where it was felled.

The above information has been prepared by the NSW National Parks and Wildlife Service with the assistance of Dr I. Taylor (Charles Sturt University), Mr S. Debus (University of New England), and Dr R. Kavanagh (State Forests of NSW) and using other expert opinion collated from New South Wales CRA/RFA

owl expert workshops and the NPWS' June 2001 Threatened Owl Workshop.

**Table 1 State forests with records of the Barking Owl**

Data compiled by NSW NPWS from Debus (1997) and data held by NSW NPWS GIS Division at 8 August 2001 from the following sources: NSW NPWS Atlas of NSW Wildlife records; NSW NPWS Darling Riverine Plains Surveys (Western Biodiversity Assessment); Australian Bird and Bat Banding Scheme; Birds Australia Atlases; CSIRO; and Australian Museum (Sydney).

Attunga
Avondale
Back Yamma
Bemboka
Broken Bago
Buckingbong
Bulga
Bungawalbin
Bungongo
Camira
Carabost
Chichester
Clouds Creek
Clyde
Cumbil
Denobollie
Doubleduke
Enfield
Euligal
Gibberagee
Goonoo
Kelvin
Kialoa
Merriwindi
Mogo
Moira
Mount Topper
Mumbulla
Nadgee
Narraway
Newfoundland
Nullica
Orara East
Pilliga East
Pilliga West
Pine brush
Quegobla
Royal Camp
Sandgate
Stewarts Brook
Strickland
Tallegar
Tuggolo
Tumbarumba
Wild Cattle Creek
Yambulla
Yarrigan

**Table 2 NPWS managed estate with records of the Barking Owl**

Data compiled by NSW NPWS from Debus (1997) and data held by NSW NPWS GIS Division at 8 August 2001 from the following sources: NSW NPWS Atlas of NSW Wildlife records; NSW NPWS Darling Riverine Plains Surveys (Western Biodiversity Assessment); Australian Bird and Bat Banding Scheme; Birds Australia Atlases; CSIRO; and Australian Museum (Sydney).

Banyabba Nature Reserve
Barren Grounds Nature Reserve
Barrington Tops National Park
Ben Boyd National Park
Berowra Valley Regional Park
Blue Mountains National Park
Boomi West Nature Reserve
Border Ranges National Park
Boronga Nature Reserve
Bouddi National Park
Budderoo National Park
Bungawalbin Nature Reserve
Bungawalbin National Park
Conimbla National Park
Coolah Tops National Park
Dharug National Park
Eurobodalla National Park
Garigal National Park
Goobang National Park
Goulburn River National Park
Goulburn River National Park
Ingalba Nature Reserve
Ironbark Nature Reserve
Kanangra-Boyd National Park
Killalea State Recreational Area
Kinchega National Park
Lane Cove National Park
Linton Nature Reserve
Monga National Park
Murramarang National Park
Mutawintji National Park
Myall Lakes National Park
Nadgee Nature Reserve
Nangar National Park
New England National Park
Numinbah Nature Reserve
Pulletop Nature Reserve
Royal National Park
Scheyville National Park
South East Forest National Park
Sturt National Park
Tarawi Nature Reserve
The Charcoal Tank Nature Reserve
The Rock Nature Reserve
Wallingat National Park
Wambina Nature Reserve
Warrabah National Park
Warrumbungle National Park
Watagans National Park
Willandra National Park
Wollemi National Park
Yengo National Park
Yerranderie State Recreational Area
Yuraygir National Park

**Table 3 Local Government Areas with records of the Barking Owl**

Data compiled by NSW NPWS from data held by NSW NPWS GIS Division at 8 August 2001 from the following sources: NSW NPWS Atlas of NSW Wildlife records; NSW NPWS Darling Riverine Plains Surveys (Western Biodiversity Assessment); Australian Bird and Bat Banding Scheme; Birds Australia Atlases; CSIRO; and Australian Museum (Sydney).

Albury
Armidale Dumaresq
Balranald
Barraba
Bathurst
Baulkham Hills
Bega Valley
Berrigan
Bingara
Blacktown
Bland
Blayney
Blue Mountains
Bogan
Bombala
Bourke
Brewarrina
Cabonne
Carrathool
Central Darling
Cessnock
Cobar
Coffs Harbour
Conargo
Coolah
Coolamon
Cooma-Monaro
Coonabarabran
Coonamble
Copmanhurst
Corowa
Cowra
Deniliquin
Dubbo
Dungog
Eurobodalla
Evans
Forbes
Gilgandra
Glen Innes
Gosford
Grafton
Great Lakes
Greater Taree
Griffith
Gundagai
Gunnedah
Guyra
Hastings
Hawkesbury
Holbrook
Hornsby
Hunters Hill
Inverell
Kiama
Ku-ring-gai
Kyogle
Lachlan
Lismore
Lithgow
Liverpool
Maclean
Maitland
Manilla
Merriwa
Moree Plains
Mudgee
Murray
Murrumbidgee
Murrurundi
Muswellbrook
Nambucca
Narrabri
Narrandera
Narromine
Newcastle
Oberon
Parkes
Parramatta
Parry
Penrith
Pittwater
Port Stephens
Pristine Waters
Richmond Valley
Rylstone
Scone
Severn
Shellharbour
Shoalhaven
Singleton
Snowy River
Sutherland
Tallaganda
Temora
Tenterfield
Tweed
Uralla
Urana
Wagga Wagga
Wakool
Walcha
Walgett
Warren
Warringah
Weddin
Wellington
Wentworth
Windouran
Wingecarribee
Wollongong
Wollondilly
Wyong
Yallaroi
Yass

## Appendix 2

# SUBMISSION
# DRAFT RECOVERY PLAN

NSW NATIONAL PARKS AND WILDLIFE SERVICE

Name
Individual/Organisation: ----------

---

Postal Address: ----------

---

Postcode: ---------- Contact Number(s): ----------

Date: ----------

**Draft Recovery Plan: Barking Owl**

*The NPWS will consider all written submissions received during the period of public exhibition and must provide a summary report of those submissions to the Minister for the Environment prior to final approval of this recovery plan.*

*Please note, that for the purposes of the NSW* Privacy and Personal Information Protection Act 1998 *any comments on this draft plan of management, including your personal details, will be a matter of public record and will be stored in NPWS records system. Following approval of the plan by the Minister, copies of all submissions, unless marked "confidential", will be available, by arrangement, for inspection at the NPWS Office responsible for the preparation of the recovery plan .*

*Should you not wish to have your personal details disclosed to members of the public once the plan of management has been adopted, please indicate below whether you wish your personal details to remain confidential to NPWS and not available for public access. Further information on the* Privacy and Personal Information Protection Act 1998 *may be obtained from any office of the NPWS or available from the web site: www.nationalparks.nsw.gov.au*

❒ Yes, please keep my personal details confidential to NPWS

Submissions should be received no later than the advertised date. Submissions should be addressed to:

The Director-General of the NSW National Parks and Wildlife
C/o Barking Owl Recovery Planning Coordinator
NPWS
Biodiversity Management Unit
Locked Bag 1967,
Hurstville NSW 2220.

**SUBMISSION:**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