The Vertebrate Fauna of Wollondilly River Nature Reserve

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Biodiversity Survey Priorities Program

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Cover Photos

Feature Photo (Elizabeth Magarey)

White-striped Freetail-bat (Michael Todd),
Rock Plate-Heath Mallee (DEC)
Black Crevice-skink (David O'Connor)
Tall Moist Blue Gum Forest (DEC)
Rainforest (DEC)
Short-beaked Echidna (D. O'Connor)
Grey Gum (Daniel Connolly)
Red-crowned Toadlet (Dave Hunter)

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OVERVIEW

The Wollondilly River Nature Reserve is a relatively small reserve, covering just over 900 hectares. It is divided into two portions that lie in the Wollondilly Valley bordered by the Wollondilly and Wingecarribee Rivers. The reserve was gazetted in 2002 and information on its fauna values had not been formally recorded. This project sought to address this information shortfall as identified in the Central Directorate Biodiversity Survey Priorities Program.

The Nature Reserve represents a small example of the rugged Wollondilly Valley landscape. It is characterised by very steep slopes, rocky outcrops, clifflines and scree slopes. The vegetation of the reserve was mapped in NPWS (2003c), which identified seven communities within the reserve. The most widespread communities are Red Gum-Box Woodlands typical of the porphyry soils and dry, cool climate. Small areas of riverine flat have been cleared for grazing and much of the accessible land in the reserve exhibits evidence of disturbance.

A systematic fauna survey was completed over several periods between September 2002 and March 2004. Six systematic survey techniques were employed at 42 survey sites targeting diurnal birds, forest owls, reptiles, bats and arboreal mammals. Incidental records were also collected, and some effort was made to look for evidence of Brush-tailed Rock-wallabies. The information gathered on the reserve has been supplemented by an extensive fauna survey also underway across the Warragamba Special Area, of which the reserve forms a part. Because of the small size of Wollondilly River NR and the inaccessibility of much of the terrain and the potential for future additions in the area, this report considers records within both the reserve and a five kilometre radius of the two portions of the reserve.

The main results of the project are:

- A total of 133 species have been recorded within the reserve, 77 of which had not been recorded previously. An additional 65 species, many of which are likely to occur within Wollondilly River NR, were recorded in the surrounding areas.
- The total number of records for Wollondilly River NR was increased from 73 to 536.
- Fifteen threatened species have been recorded within or around the reserve. These include seven diurnal birds, two large forest owls, three arboreal mammals and three insectivorous bats. Profiles are provided for fifteen that are likely to occur within habitats within Wollondilly River NR, providing details of existing records, potential habitat and likely threats.
- Glossy Black-cockatoos proved to be particularly widespread in and around the reserve, and new records of the Koala were also made, confirming anecdotal evidence of this species in the Wollondilly Valley.
- No evidence of Brush-tailed Rock-wallabies was found, though anecdotal reports suggest they may still occur in small numbers to the north and west of the reserve.
- Goats were found to be widespread and abundant, and are likely to be having a significant impact on the vegetation of the reserve. Records of other introduced mammals and birds were collected to help Area staff plan where to undertake management programs.
- The importance of the corridor of vegetation connecting the eastern portion of Wollondilly River NR with Joadja NR was noted.
- A list of future survey work was included, to cover shortfalls of the current survey and to allow targeted research to be conducted in the future.

CONTENTS

1 INTRODUCTION

1.1 PROJECT AIMS

The Central Directorate Parks and Wildlife Division (PWD) of the NSW Department of Environment and Conservation (DEC, formerly NSW National Parks and Wildlife Service (NPWS)) has for the first time established a biodiversity survey priorities program for all NPWS managed estate within the Directorate. This program recognises that Wollondilly River Nature Reserve (NR) is characterised by very low levels of information on both flora and fauna values (NPWS 2003a). The decision to sample Wollondilly River NR at this point further benefited from the opportunity to integrate new survey work into a broader study examining the biodiversity values of the Warragamba and Metropolitan Special Areas (DEC in prep.).

The fauna survey program seeks to address the shortfall of information on vertebrate fauna within and immediately surrounding Wollondilly River NR. Improved information will enable park managers to better integrate local information into planning decisions and to become more active in promoting the values of the reserve. It will provide the opportunity to develop more focused strategies on threatened species management, monitoring programs and community education. Importantly it will expand the ability of management to understand the role the reserve plays in conserving fauna within the greater Sydney Region.

Specific objectives of this report are to:

1. Document, review and collate existing fauna data.
2. Identify and profile threatened fauna species and other regionally significant fauna that are known or likely to occur.
3. Identify broad-scale patterns in fauna occurrence and habitat use across the reserve and identify habitats of particular conservation significance.
4. Highlight areas where further survey work may need to be carried out.

Plate 1: View across Horse Flat to Mt. Hickson from Bowman's Hill, Wollondilly River NR ©DEC

1.2 BACKGROUND

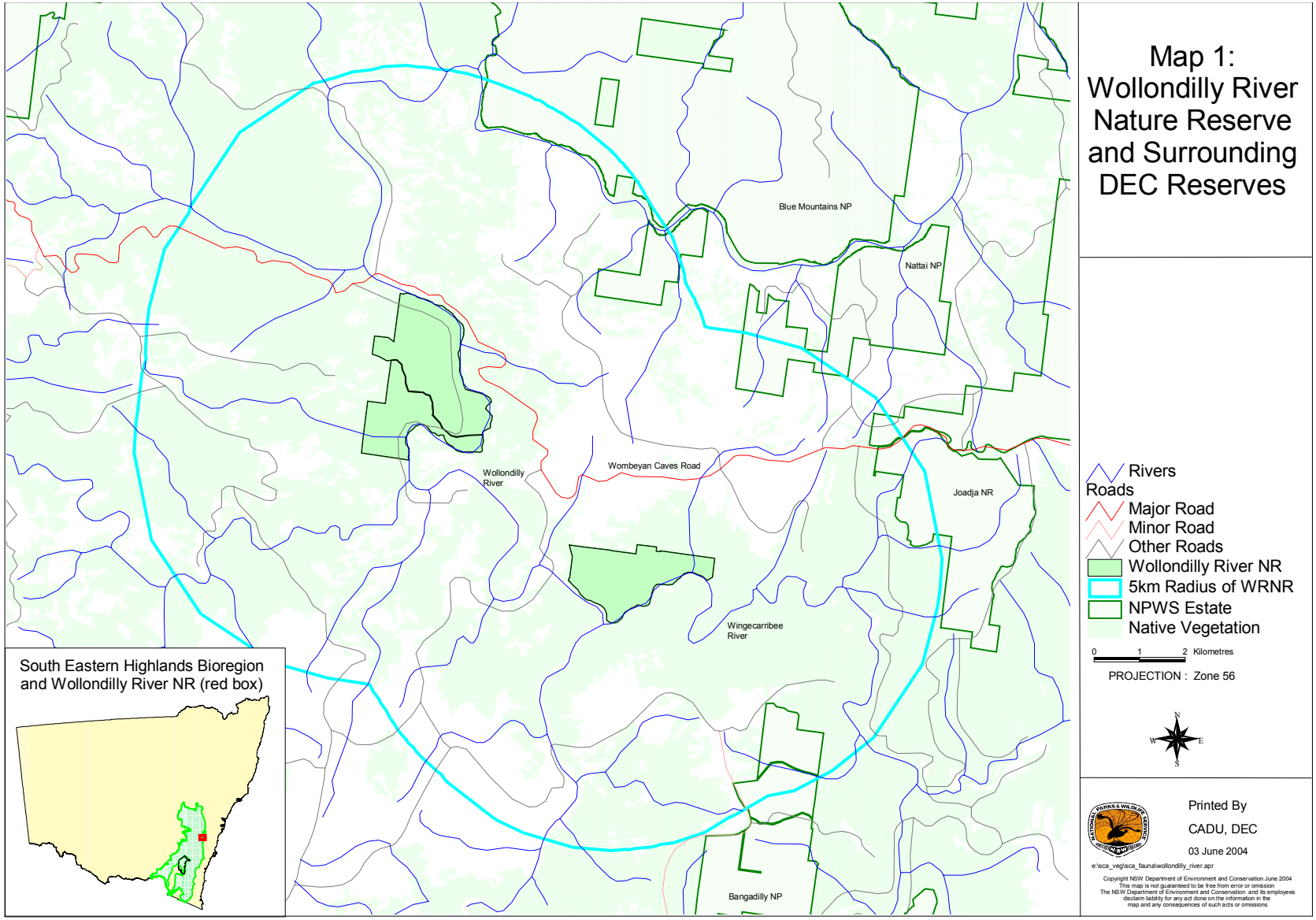
Wollondilly River NR currently consists of two portions of land in the Wollondilly Valley approximately 40 kilometres west of Mittagong on the Southern Highlands. The reserve is primarily surrounded by freehold tenures, although additional Crown Land portions are found on the south side of the Wollondilly River and a number of DEC reserves to the north and east including Nattai, Blue Mountains and Bangadilly National Parks (NP) and Joadja NR (Map 1).

The south eastern portion is just under 300 hectares in area and consists of steep country to the north of the Wollondilly and Wingecarribee River junction (Plate 2). It is accessed through private land south of Wombeyan Caves Road near the locality of Bullio. The rugged terrain of this area means that clearing has been restricted to the very northern boundary. The second, larger portion is 613 hectares of land extending from the western bank of the Wollondilly River towards Tallygang Mountain (Plate 1). The main access is along the Wollondilly River from Goodmans Ford along a fire trail that extends to the southern boundary. A homestead and various sheds have been retained from previous occupation on Horse Flat and these have been used as a base for both DEC and Sydney Catchment Authority (SCA) staff.

Plate 2: Rocky country near the confluence of the Wollondilly and Wingecarribee Rivers. ©DEC

Wollondilly River NR falls into the Warragamba Special Area that is managed by the SCA to retain the quality of Sydney's drinking water. In 2002, some land with the Special Area that had been identified as of suitable conservation value were transferred to NPWS management. Wollondilly River NR was gazetted as part of this process. Some investigations have been made towards acquiring further crown land on the southern side of the Wollondilly River and, if acquired, it is likely to be added to this reserve. No attempt has been made to survey this land at this stage.

In 2001 DEC was commissioned by the SCA to investigate the biodiversity values of the Warragamba and Metropolitan Special Areas. Systematic flora surveys were undertaken within the park in November 2001 as part of this program and are reported in NPWS (2003c). In addition, a review of biodiversity data across the DEC Central Directorate Reserves identified Wollondilly River NR as a high priority area for the collection of fauna data (NPWS 2003a) and the Central Directorate Parks and Wildlife Division (PWD) provided funding under the Biodiversity Survey Priorities Survey Program. Systematic fauna surveys were undertaken within and around the park between September 2002 and March 2004.


Map 1:
Wollondilly River Nature Reserve and Surrounding DEC Reserves
Blue Mountains NP
Nattai NP
Wollondilly River
Wombeyan Caves Road
Joadja NR
Wingecarribee River
Bangadilly NP
South Eastern Highlands Bioregion and Wollondilly River NR (red box)
Rivers
Roads
Major Road
Minor Road
Other Roads
Wollondilly River NR
5km Radius of WRNR
NPWS Estate
Native Vegetation
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1.3 ENVIRONMENT

Wollondilly River Nature Reserve is comprised almost entirely from Bindook porphyry, an igneous rock formed during the Upper Devonian age. This is granite-like in appearance and erodes to form a clay-loam soil. These soils are highly erodable and form significant instability on the steepest slopes where landslips and scree slopes are common. The rugged nature of the landscape is illustrated by the fact that many slopes reach over 50 degrees. The highest point in the reserve is 790 metres at Mt. Hickson, in the western portion. The lowest point is Horse Flat on the narrow levee plain that hugs a bend of the Wollondilly River. Deeper alluvial soil is found here, and as a result, most of the original vegetation has been cleared for agriculture.

Wollondilly River NR lies on the extreme eastern boundary of the South Eastern Highlands Bioregion (Thackway and Creswell 1995) (inset Map 1). This Bioregion covers an extensive area of the Central Tablelands and slopes of New South Wales and Victoria. The Bioregion is dominated by a temperate climate characterised by mild to warm summers and no dry season (NPWS 2003b). Approximately fifteen percent of the Bioregion is reserved for conservation (in National Parks, Nature Reserves, Karst Conservation Reserves and State Conservation Areas) (NPWS 2003b). Just to the east of the reserve is the Sydney Basin Bioregion that is typified by the sandstone landscapes that surround the Sydney metropolitan area.

1.4 CLIMATE

The average annual rainfall for the Wollondilly River NR ranges between 680 and 830 millimetres. This is typical of areas within the rainshadows in the Wollondilly and Burragorang Valleys. Temperatures are more extreme than in coastal environments, with warm summers and cool winters. The mean daily minimum temperature ranges from 4°C in higher elevations to 18°C on the river flats, whilst the mean maximum temperature ranges from 25°C at higher elevations to 30°C on the flats. The climate appears to be much more typical of areas on the south west slopes of NSW rather than the typical coastal and tableland climates found in the areas surrounding the reserve.

Plate 3: Devonian Red Gum-Yellow Box Woodland on the southern boundary of Wollondilly River NR. ©DEC

1.5 VEGETATION

Wollondilly River NR was mapped at the northern extent of the forest ecosystem mapping undertaken as part of the Southern Comprehensive Regional Assessment (CRA) (NPWS 2000). This was a broad-scale mapping exercise that mapped five communities occurring within the reserve. As part of the vegetation mapping of the Warragamba Special Area (NPWS 2003c), Wollondilly River NR was once again mapped, with far greater precision. This report described seven native vegetation communities within the reserve, plus areas of cleared, modified or regenerating vegetation. Many of the communities show no correlation with those mapped in 2000 so site selection was based on NPWS (2003c) as this was the more accurate and recent layer, and was also based on survey sites done within the reserve. Map 2 shows the vegetation communities listed within NPWS (2003c) and all references to vegetation communities from this point follow terminology used therein.

The most extensive vegetation community within the reserve is Devonian Red Gum-Yellow Box Woodland (Plate 3). This is found on the steep slopes and is characterised by a few Eucalypt species and an open canopy with clearly visible shrub layer. Forest Red Gum (*Eucalyptus tereticornis*) and Yellow Box (*E. melliodora*) are commonly the dominant canopy species, whilst the shrub layer is dominated by species such as Wallaby Weed (*Olearia viscidula*) and Native Blackthorn (*Bursaria spinosa*). It is widespread in both portions of the reserve. On the lower slopes Grey Box (*Eucalyptus moluccana*) is dominant with Forest Red Gum although a very similar understorey persists. At the higher elevations in both portions Highlands Slopes Grey Gum-Stringybark Forest is found. The forest is dominated by a variety of eucalypt species including Grey Gum (*Eucalyptus punctata)*, and Blue-leaved (*E. agglomerata*) and Thin-leaved Stringybarks (*E. eugenioides*), though the former species is uncommon in the eastern portion. The shrub layer is usually not as dense as the previous community but similar species are often present.

The most common community bordering the Wollondilly and Wingecarribee Rivers is Tablelands River Oak Forest characterised by tall River Oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*). The canopy cover is quite variable in this community, as is the understorey, which is dependent on factors such as time since flooding, soil depth and disturbance. Grey Myrtle Dry Rainforest and Sheltered Porphyry Forest develops in some of the steeper gully lines, particularly in the eastern portion, and the former community is also common on scree slopes.

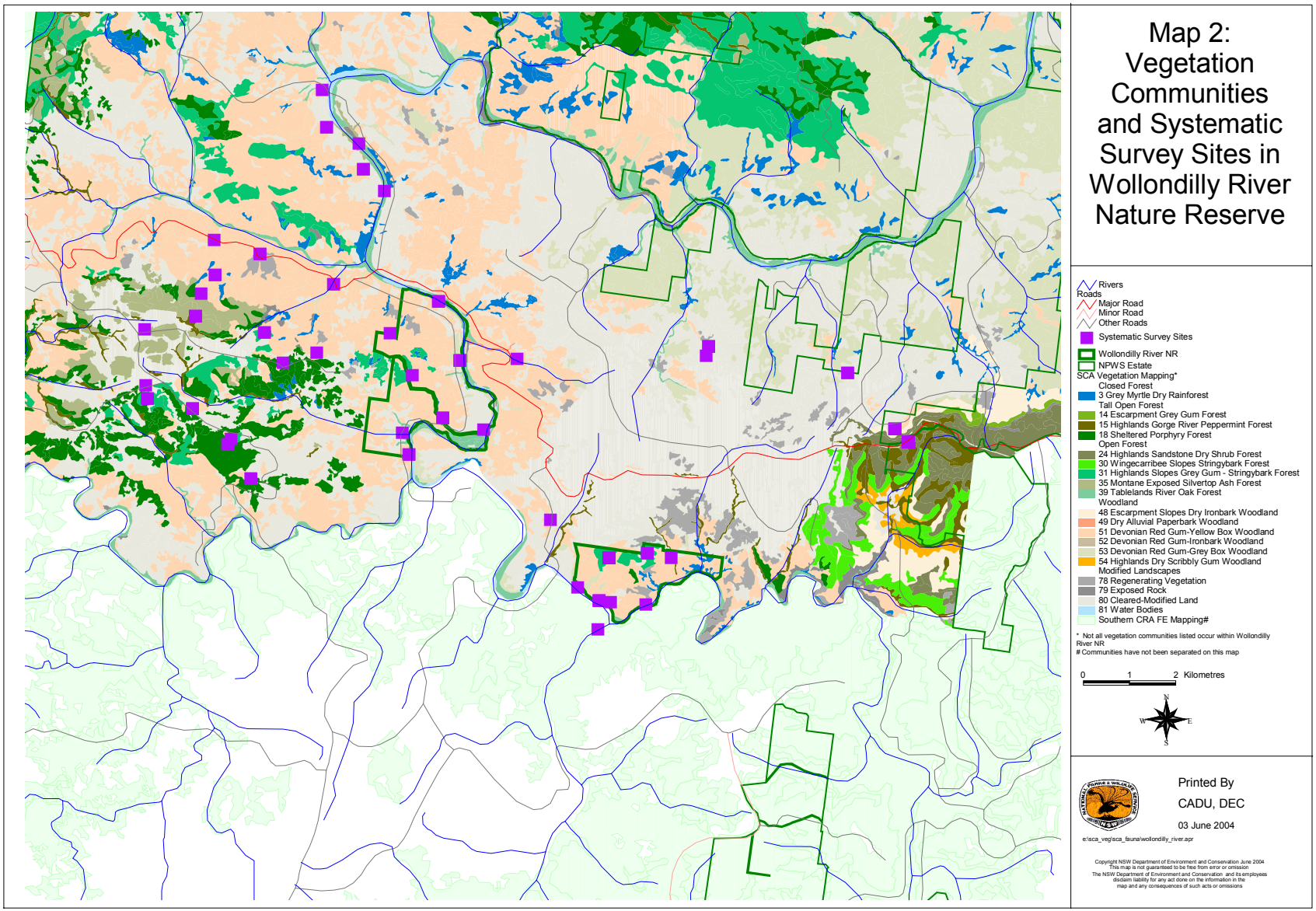
1.6 DISTURBANCE

The primary landuse in the Wollondilly Valley over the last 100 years has been agriculture, particularly grazing. River flat environments have been extensively cleared and on lower slopes the native vegetation has been extensively modified. Similar trends are found on the flat ridgetops of Tallygang Mountain where modification is evidenced by cleared areas and regenerating vegetation. While much of the reserve is steep, bridle trails that connect the river with the mountains provided tracks that stock once traversed. Feral animals may continue to use these trails to disperse through the reserve.

Land clearing and grazing pressure has caused degraded areas and infestations of weeds, most notably of Serrated Tussock (*Nassella trichotoma*), Blackberry (*Rubus* spp.) and Fireweed (*Senecio madagascariensis*). The lower elevations are often characterised by large areas of cleared and modified land or regenerating vegetation. This is most notable in the vicinity of Bowman's Hill Hut.

1.7 FIRE

There have been no recent wildfires in the area of the Wollondilly River NR. The last known wildfire was in 1979 on Tallygang Mountain (R. Pedroza pers. comm.) before the area became a nature reserve. Fire has been used to attempt to reduce the weed problems on Horse Flat, but the areas burnt have been minimal. Vegetation throughout much of the reserve is sparse and open, with very little fuel build up, despite the long fire interval (see Plate 3).


Map 2:
Vegetation Communities and Systematic Survey Sites in Wollondilly River Nature Reserve
Rivers
Roads
Major Road
Minor Road
Other Roads
Systematic Survey Sites
Wollondilly River NR
NPWS Estate
SCA Vegetation Mapping*
Closed Forest
3 Grey Myrtle Dry Rainforest
Tall Open Forest
14 Escarpment Grey Gum Forest
15 Highlands Gorge River Peppermint Forest
18 Sheltered Porphyry Forest
Open Forest
24 Highlands Sandstone Dry Shrub Forest
30 Wingecarribee Slopes Stringybark Forest
31 Highlands Slopes Grey Gum - Stringybark Forest
35 Montane Exposed Silvertop Ash Forest
39 Tablelands River Oak Forest
Woodland
48 Escarpment Slopes Dry Ironbark Woodland
49 Dry Alluvial Paperbark Woodland
51 Devonian Red Gum-Yellow Box Woodland
52 Devonian Red Gum-Ironbark Woodland
53 Devonian Red Gum-Grey Box Woodland
54 Highlands Dry Scribbly Gum Woodland
Modified Landscapes
78 Regenerating Vegetation
79 Exposed Rock
80 Cleared-Modified Land
81 Water Bodies
Southern CRA FE Mapping#
* Not all vegetation communities listed occur within Wollondilly River NR
# Communities have not been separated on this map
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2 METHODOLOGY

2.1 EXISTING FAUNA DATA

The DEC Atlas of NSW Wildlife was the primary source of existing data. This data has been collated from casual observations made by park workers, residents and recreational observers. There had been no systematic fauna surveys conducted in the Wollondilly River Nature Reserve prior to these surveys. Included within this database are records collected as part of the Birds Australia Atlas, which collated data from around the country between 1998 and 2002 (Barrett *et al.* 2003).

2.2 SURVEY STRATIFICATION AND SITE SELECTION

The map of vegetation communities described by NPWS (2003c) covering the Warragamba Special Area and surrounds formed the primary stratum for the majority of survey planning (Map 2). Sites were planned using Geographic Information Systems (ArcView 3.2) and were selected in order to sample all of the major vegetation communities in the reserve. Site selection in the field was based on the following parameters:

- Consistent vegetation community throughout the site
- Vegetation community representative of the mapped community
- Accessible by either car or foot

The preferable sampling strategy would have aimed to sample the mapped vegetation communities proportionately according to the mapped area of each community within the reserve *and* have included enough repeated sampling within each vegetation community to provide reasonable reliability that potential variations within widespread stratum were captured. However, due to the relatively small size of the reserve, there were difficulties in replicating sites within vegetation communities whilst maintaining sufficient distance between sites to ensure they were independent from one another (one kilometre apart). Consequently, data from sites that were placed outside the reserve but within a five kilometre radius have also been included in this report. Records of species that were collected outside the reserve area are specified as such throughout the report.

The majority of sites were placed on or near access trails to maximise the number that could be accessed during the limited survey time. Nevertheless, considerable effort was put into the establishment of sites away from trails. Off road sites were placed where walking access was possible, which sometimes included access through adjoining private land. Some vegetation types were inaccessible during the time allocated for the survey period and therefore were not sampled.

Table 1 shows the number of sites conducted for each vegetation community. Generally, all survey methods were conducted at each site, though this was not always the case. Often sites were chosen specifically for a harp trap or Anabat placement based on suitability. Map 2 shows the locations of all survey sites in relation to mapped vegetation. A full list of site locations and associated surveys is provided in Appendix A.

2.3 SURVEY METHODS

Systematic fauna survey methods undertaken were based on those described by NPWS Biodiversity Survey Coordination Unit (NPWS 1997). This details the specifications of timed searches within fixed areas for all survey techniques. Six of these techniques were used to sample each of the following vertebrate fauna groups: reptiles, diurnal birds, bats (two techniques), arboreal mammals and nocturnal birds. Consistency in the use of these techniques will allow future comparisons with consistent surveys of environments elsewhere. Amphibians were not surveyed systematically due to the dry conditions during, and in the several months preceding, the survey period. Creeklines and soaks were dry, with the Wollondilly River the only permanent source of water on the fringe of the reserve. The river is fast flowing in many locations and has many fish, making it poor breeding habitat for many species of frog, so this group was examined opportunistically. Due to time and budget constraints, small ground mammals were surveyed only by analysis of predator scats.

Table 1: Areas of mapped vegetation communities within Wollondilly River Nature Reserve (NPWS 2003c) with allocation of systematic survey method. Numbers in parentheses indicate sites done in the vegetation community outside the Nature Reserve.

Vegetation community	Mapped area of vegetation community within Wollondilly River NR[1]	Proportion of vegetation community within NR (%)	No. of Diurnal Bird sites	No. of Diurnal Herpetofauna sites	No. of Anabat detector sites	No. of Harp Trapping sites	No. of Spotlight sites for Arboreal Mammals	No. of Nocturnal Call Playback sites	No. of Elliott Trap sites
Devonian Red Gum-Yellow Box Woodland	561.08	61.5	3(5)	3(5)	1(1)	1(0)	2(4)	1(1)	0(0)
Highlands Slopes Grey Gum-Stringybark Forest	57.49	6.3	2(2)	2(2)	1(0)	0(1)	1(1)	1(0)	0(0)
Tablelands River Oak Forest	52.55	5.8	3(0)	2(0)	0(1[2])	0(0)	2(1)	1(1)	0(0)
Devonian Red Gum-Grey Box Woodland	45.54	5.0	0(2)	0(0)	0(0)	1(0)	0(0)	0(1)	0(0)
Grey Myrtle Dry Rainforest	18.90	2.1	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Sheltered Porphyry Forest	2.96	0.3	0(3)	0(2)	0(0)	0(1)	0(2)	0(0)	0(0)
Highlands Gorge River Peppermint Forest	1.50	0.2	0(2)	0(1)	0(1)	0(0)	0(1)	0(2)	0(1)
Regenerating vegetation	18.71	2.1	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Cleared/Modified land	147.78	16.1	1(3)	1(1)	0(1)	0(2)	1(2)	1(2)	0(0)
Water Bodies	5.32	0.6	0(0)	0(0)	0(1)	0(0)	0(0)	0(0)	0(0)
Exposed Rock	0.27	0.0	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Montane Exposed Silvertop Ash Forest[3]	0*	-	0(1)	0(1)	0(0)	0(1)	0(1)	0(0)	0(0)
Total	**912.10**	**100**	**9(18)**	**8(12)**	**2(5)**	**2(5)**	**6(12)**	**4(7)**	**0(1)**

[1] area based on GIS data layers does not equal gazetted area of reserve
[2] one site undertaken outside the SCA mapping area, but vegetation the same as Tablelands River Oak Forest
[3] not within Wollondilly River NR, but a site was done within five kilometres of the reserve boundary
* vegetation community not in Wollondilly River NR, but sites within five kilometres of the reserve

Standard sampling methods were based on a two hectare (100 by 200 metre) site. Some methods were only applied to a subplot of this site. Field survey teams were supplied with field proformas to facilitate comprehensive, consistent recording of field data and to increase accuracy and efficiency of data entry to the DEC Biodiversity Survey Subsystem (BSS) of the Atlas of NSW Wildlife computer database. The names of observers and recorders were noted on every data sheet to aid data verification and entry.

2.4 STANDARD SITE-BASED METHODS

Diurnal bird survey

Diurnal bird censuses comprised a twenty minute observation and listening search within the two hectare site, conducted by an experienced bird surveyor. Censuses were conducted only during periods of relatively high bird activity (preferably early morning) and reasonable detectability (eg. low wind and cicada activity). All bird species and numbers seen or heard were recorded. Individuals were scored as on-site if they were detected within the two hectare site and individuals recorded outside the plot, in adjacent vegetation types or flying overhead were recorded as off-site.

Diurnal herpetofauna census

A half hectare area (50 by 100 metres) based on a subplot of the site, was searched for one person-hour at each site (standardised regardless of the number of persons searching). Censuses were restricted to the period between mid-morning to late afternoon, when temperature and insolation are sufficient to ensure maximum reptile activity. Surveying was not conducted on overcast or rainy days.

This census technique entailed active searching of potential reptile and frog microhabitats within the subplot. Active or basking reptiles were identified by sight or captured and identified by the use of keys. Sheltering or cryptic species were detected by searching around, under and within fallen logs,

litter, decorticating and fallen bark, rock outcrops and other likely substrates. Incidental observations of other fauna were also recorded.

Foot-based spotlighting

Surveys for arboreal marsupials were undertaken by walking through the centre of the site and scanning each side with a 50 Watt spotlight. The site was searched for half a person-hour (standardised regardless of the number of person searching). All fauna estimated to be within 50 metres either side of the centre that could be seen or heard was recorded as on-site. Fauna recorded outside the plot was scored as off-site.

Nocturnal call playback

Nocturnal birds and mammals are often detected only when they vocalise for territory or social contact. This behaviour is exploited when surveying for these species by broadcasting pre-recorded calls to elicit a response. Forest Owls, Australian Owlet-nightjar (*Aegotheles cristatus*), Sugar Glider (*Petaurus breviceps*) and Koala (*Phascolarctos cinereus*) are all known to respond to calls of their conspecifics and, in some cases, also to calls of other species (Kavanagh and Peake 1993). A standard survey census involved broadcasting the calls of each of the four large forest owls – Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*), Sooty Owl (*T. tenebricosa*) and Barking Owl (*N. connivens*) - from the centre of the site.

Prior to those broadcasts, on arrival at the site, the surrounding area was searched by spotlight to detect any fauna in the immediate vicinity and a fifteen minute period of listening was undertaken. A pre-recorded compact disc of each species' call series was played on a Teac® portable CD player, amplified through a nine volt Toa® transistor megaphone. Calls of each species were played for five minutes, followed by a five minute listening period. The surrounding area was again searched by spotlight after a final ten minute listening period. After the census, the response or presence of any fauna, the date and time that response occurred, the approximate location if not within the two hectare site and weather details, such as amount of cloud cover, was recorded. Very windy and rainy periods were avoided where possible, while censuses conducted in poor weather were noted.

Bat ultrasonic ('Anabat') call recording and bat (harp) trapping

Insectivorous microchiropteran bats were sampled by two techniques: ultrasonic recording and harp trapping.

Ultrasonic recorders (Corben 1989) are an important tool in bat surveys. They are particularly useful for detection of high-flying species, which often comprise more than one third of an area's bat species (Parnaby 1992a), but are under sampled by harp trapping (Richards 1992). It also avoids having to handle the detected bats whose wings are delicate. The method requires the recording and identification of high frequency, echolocation "calls" made by bats, which, except for one or two species, are ultrasonic and inaudible to humans.

The recording equipment for the surveys consisted of an Anabat II® detector and a Zcaim flash-card recorder unit. The Anabat units were activated at dusk and left on site to record bat activity overnight. This method allows the possibility of detecting all species of microchiropteran bats present in a particular area but has only become a possible survey method due to improvements in technology of echolocation recording units. Previously, Anabat detectors were attached to a tape recorder and placed on site for a 30 minute survey. Anabat recordings were analysed by a recognised expert in this field. Identification was designated as definite, probable or possible, following the methodology of Parnaby (1992a).

Harp trapping complemented bat ultrasonic call recording. While ultrasonic recorders were used principally to detect high flying bat species, collapsible bat traps, known as harp traps (Tidemann and Woodside 1978), captured low flying species. Two nights of trapping were conducted at each bat trap site. Sites were selected for their perceived potential to interrupt bats along their flight paths, and were usually along tracks or in gaps between trees where adjacent vegetation might force bats to fly.

Traps were checked each morning. Captured bats were identified by external morphology, forearm measurement and body weight, and keyed out where necessary using Churchill (1998). Animals were released on the following night at the point of capture.

2.5 OPPORTUNISTIC METHODS

Predator and herbivore scat search

The analysis of predator scats and pellets to identify prey remains has proven to be an efficient sampling technique in many fauna survey programs. The large numbers of hairs, and occasionally skeletal remains, in predator scats results in a high level of confidence in identifications of prey species. However, the immeasurable time delay between prey ingestion and defecation means that the location in which the prey lived cannot be accurately known. For predictive modelling purposes such records are obviously of lower value than actual known localities, although they may be a useful supplement to more accurately located records. Some species are only known from a particular area by scat records. In addition, the recording of predator or non-predator scats constitutes records for the species that deposits the scat, providing locality records for these species.

Several predator scats and scats of other fauna were collected. Each scat was identified and analysed by a specialist and hair samples within a scat were identified using the techniques described by Brunner and Coman (1974). This identification was undertaken by an expert in the field, Barbara Triggs. Identifications were classified into three levels of reliability: definite, probable and possible.

Incidental records

Teams driving or walking through survey areas record the location when interesting fauna was seen or heard. In order to facilitate accurate mapping and recording of sampling locations, Global Positioning Satellite (GPS) readings were taken for each opportunistic record.

Brush-tailed Rock-wallaby survey

Some time was spent searching for evidence of Brush-tailed Rock-wallabies (*Petrogale penicillata*) within Wollondilly River NR. In the western portion, the bridle trail connecting Mt. Hickson and Horse Flat was traversed and any suitable habitat (clifflines, scree slopes and rocky fissures) were examined for scats. Within the eastern portion, time was spent examining suitable habitat on either side of the Wingecarribee River with binoculars from a clifftop within the Nature Reserve.

2.6 SURVEY TIMING

The survey of Wollondilly River Nature Reserve and its surrounding environs were undertaken on various dates between September 2002 and March 2004. Nocturnal Call Playback was undertaken in July 2003 as previous owl data indicates that this is when owls are most responsive to broadcast calls (DEC, unpublished data). Some spotlighting was also undertaken at the same time. All other survey techniques were conducted in Spring/Summer with surveys in September 2002 (south western Nattai NP), November 2003 (eastern Wollondilly River NR), December 2003 (south western Nattai NP), January 2004 (western Wollondilly River NR) and March 2004 (Special Area to the west of Wollondilly River NR).

3 RESULTS AND DISCUSSION

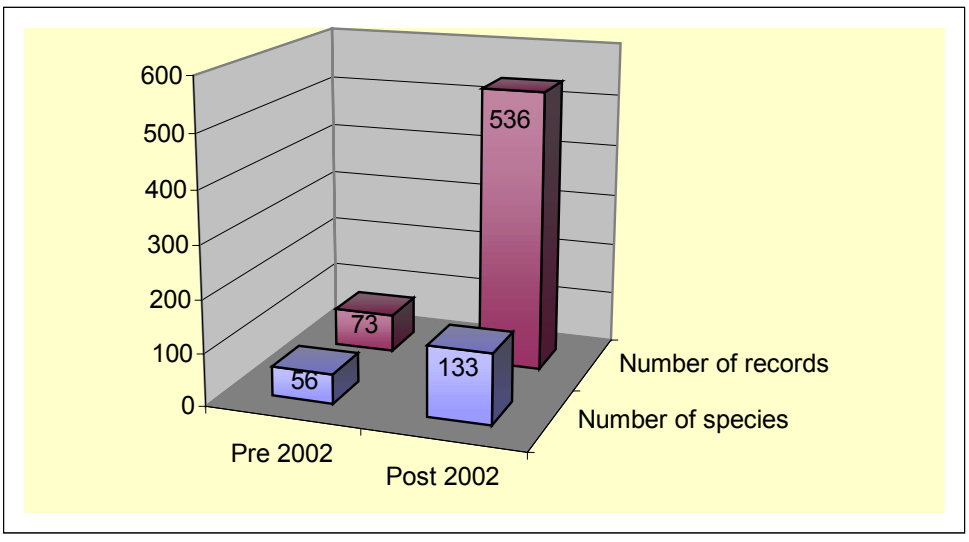
3.1 OVERVIEW

The following summarises the findings from the field surveys between September 2002 and March 2004 in Wollondilly River Nature Reserve with references to pre-existing records and information from species within five kilometres of the reserve. At least seven systematic sites were completed for most fauna groups in and around the reserve, with greater numbers achieved for diurnal bird and herpetofauna searches and site spotlighting. The sampling strategy resulted in four vegetation communities within the reserve being sampled by at least three techniques and another three having the same sampling effort outside.

Altogether, 133 species of fauna have been recorded within the Wollondilly River Nature Reserve and 65 additional species are known to inhabit the surrounding environs. Five species listed on the NSW Threatened Species Conservation (TSC) Act (1995) have been recorded within the reserve and an additional ten species have been recorded in adjoining country. A complete species list for all vertebrate fauna groups is provided in Appendix B.

These surveys have more than doubled the number of species recorded on the Atlas of NSW Wildlife for the Wollondilly River Nature Reserve since before 2002. Similarly the number of records in the database has increased seven-fold from what was recorded before 2002 (Figure 1). Some of the species previously not recorded in the reserve are relatively common native or feral species, reflecting the lack of previous survey work carried out in the reserve and its surrounds. The Nature Reserve is now much more comprehensively surveyed than many reserves of similar sizes. For example, in 2003, the similarly sized Garawarra State Conservation Area had only 51 fauna species recorded (NPWS 2003a). These figures demonstrate the importance of systematic survey work in increasing the knowledge of fauna in an area.

Figure 1: Number of species and records within the Wollondilly River NR before and after systematic surveys.



3.2 DIURNAL BIRDS

The Wollondilly River NR has a remarkable diversity of birds for a relatively small reserve. A total of 128 diurnal bird species have been recorded in the area with 87 of them occurring within the boundaries of the reserve. This total includes twenty species not previously recorded in or around the reserve and seven species listed on the NSW TSC Act (1995). The high diversity can be attributed to the range of habitats, which range from gully forests to woodland slopes, as well as a large number of water birds present due to the proximity of the Wollondilly and Wingecarribee Rivers. Many of the species present are uncommon within the South Eastern Highlands Bioregion, reflecting the atypical

habitat of the area for this Bioregion and the occurrence of the reserve near the boundary of the Sydney Basin Bioregion.

The four threatened species found on reserve were the Brown Treecreeper (eastern subspecies) (*Climacteris picumnus victoriae*), Glossy Black-cockatoo (*Calyptorhynchus lathami*), Hooded Robin (south-eastern subspecies) (*Melanodryas cucullata cucullata*) and Diamond Firetail (*Stagonopleura guttata*). Three more species have been recorded around the reserve: Turquoise Parrot *(Neophema pulchella*), Speckled Warbler (*Pyrrholaemus sagittatus*) and Regent Honeyeater (*Xanthomyza phrygia*). The latter is listed as Endangered, with all the others ranked as Vulnerable on the NSW TSC Act (1995). These species are described in greater detail in the species profiles in Section 5.

Reid (1999) reported on declining woodland birds within the NSW Wheat-Sheep Belt. Many of the species highlighted in this report have been included in the Schedules of the NSW Threatened Species Act and will be dealt with in Section 5. A few that have not been listed, however, have been recorded in Wollondilly River NR and these include Rufous Whistler (*Pachycephala rufiventris*), Eastern Yellow Robin (*Eopsaltria australis*), Dusky Woodswallow (*Artamus cyanopterus*) and Varied Sittella (*Daphoenositta chrysoptera*). These species are amongst those listed that are the least restricted to woodland habitats (Pizzey and Knight 1997).

The recent publication of data collected by Birds Australia (Barrett *et al.* 2003) also lists a number of species that appear to have declined since the publication of the first bird atlas (Blakers *et al.* 1984). Species on this list that have been recorded within Wollondilly River NR include Rockwarbler (*Origma solitaria*), White-winged Chough (*Corcorax melanorhamphos*) and Gang-gang Cockatoo (*Callocephalon fimbriatum*). The former is the only bird species endemic to NSW and is reliant on sandstone habitats (Higgins and Peter 2002) and is probably near the western extremity of its range.

Among the most commonly occurring and abundant birds were members of the honeyeaters, of which thirteen species were recorded. These include some of the most frequently recorded bird species, namely Noisy Friarbird (*Philemon corniculatus*), Yellow-faced Honeyeater (*Lichenostomus chrysops*) and Eastern Spinebill (*Acanthorhynchus tenuirostris*). Also found in and around the reserve in decreasing regularity were Red Wattlebird (*Anthochaera carunculata*), New Holland Honeyeater (*Phylidonyris novaehollandiae*), White-eared Honeyeater (*Lichenostomus leucotis*), Brown-headed Honeyeater (*Melithreptus brevirostris*), Noisy Miner (*Manorina melanocephala*), Lewin's Honeyeater (*Meliphaga lewinii*), Regent Honeyeater, White-plumed Honeyeater (*L. penicillatus*), Bell Miner (*Manorina melanophrys*) and Scarlet Honeyeater (*Myzomela sanguinolenta*).

The reserve is also host to a number of different parrot and cockatoo species including Crimson Rosella (*Platycercus elegans*), Glossy-Black-cockatoo, Eastern Rosella (*P. adscitus eximius*), Australian King-parrot (*Alisterus scapularis*), Gang-gang Cockatoo (Plate 4), Sulphur-crested Cockatoo (*Cacatua galerita*), Galah (*Eolophus roseicapillus*) and Turquoise Parrot. The following four species of pigeon have also been recorded: Wonga Pigeon (*Leucosarcia melanoleuca*), Peaceful Dove (*Geopelia placida*), Crested Pigeon (*Ocyphaps lophotes*) and Common Bronzewing (*Phaps chalcoptera*).

Plate 4: Gang-gang Cockatoo ©Kylie Madden/ DEC

Given the proximity to two major rivers, it is no surprise that seventeen species of waterbird have been found in or around the reserve. Those that have been recorded in the reserve include Australian Wood (*Chenonetta jubata*) and Pacific Black (*Anas superciliosa*) Ducks, Black Swan (*Cygnus atratus*), Great (*Phalacrocorax carbo*) and Little Pied (*P. melanoleucos*) Cormorants, Purple Swamphen (*Porphyrio porphyrio*) and Dusky Moorhen (*Gallinula tenebrosa*). Other species that are strictly not waterbirds but associate with water habitats, such as Azure Kingfisher (*Alcedo azurea*) and Australian Reed-warbler (*Acrocephalus australis*) have been recorded from around the reserve.

3.3 NOCTURNAL BIRDS

Four nocturnal bird species were recorded within Wollondilly River NR. Of these species only the Tawny Frogmouth (*Podargus strigoides*) had previously been recorded in the reserve. The other three species recorded within the reserve were Australian Owlet-nightjar, Southern Boobook (*Ninox boobook*) and White-throated Nightjar (*Eurostopodus mystacalis*). The Australian Owlet-nightjar appears to be fairly common as it was recorded at eight different locations within the reserve.

Compared to some areas within Warragamba Special Area, the response by threatened owl species to nocturnal call playback was relatively poor and while none were recorded within the reserve, two were recorded within five kilometres. Of the eleven surveys, only one individual of Masked Owl responded, at a site west of the reserve along Wombeyan Caves Road. A single Powerful Owl was also heard on the Wollondilly River downstream from the reserve. Both these records are significant as they are near the western limit of their distribution. More details on each of these species will be provided in Section 5.

3.4 ARBOREAL MAMMALS

The density of arboreal mammals in Wollondilly River NR is low compared to the taller forests found in the gullies of nearby Joadja NR and Nattai NP. Despite this, two species of threatened arboreal mammal, the Koala and Squirrel Glider (*Petaurus norfolcensis*) have been recorded within the reserve. The only other mammal regularly detected was the Common Brushtail Possum (*Trichosurus vulpecula*) which has a preference for open forests and woodlands (How and Kerle 1995). Greater Glider (*Petauroides volans*) and Common Ringtail Possum (*Pseudocheirus peregrinus*) were both detected in the Tallygang area and may occur within the reserve in this vicinity. Sugar and Yellow-bellied (*Petaurus australis*) Gliders have both been recorded to the east of the reserve (in Joadja NR), though it is highly unlikely that the latter species will be recorded in Wollondilly River NR. Most records were collected while undertaking site spotlighting survey, with the number of sightings being low compared to much of the Warragamba Special Area.

Individual Koalas were recorded on two consecutive nights during surveys of the eastern portion. The first was spotlit near the northern boundary, while the second was heard near the junction of the Wollondilly and Wingecarribee Rivers. Another had been heard calling near Lord's Mountains (to the north west of the reserve) during vegetation surveys. This supports the anecdotal records of Koala in the valley and in the vicinity of Tallygang Mountain (D. Connolly pers. comm.). The single record of Squirrel Glider was made prior to the current survey and the species probably exists at extremely low densities in and around the reserve.

3.5 BATS

As no bat survey had been undertaken prior to this survey, it is no surprise that nine new species were added to the reserve. Additionally, another five species were detected within five kilometres of the reserve. Table 2 summarises the different species detected utilising harp trapping and Anabat both within and around the reserve. Species that were identified only to the level of possible were excluded from the data used for this report.

The most commonly recorded bat was the Little Forest Bat (*Vespadelus vulturnus*) which was trapped in large numbers. This common species is one of Australia's smallest bats and usually roosts in tree hollows and feeds on insects below the tree canopy (Churchill 1998). The next most common bat was the Chocolate Wattled Bat (*Chalinolobus morio*) though this was only detected within Wollondilly River NR by Anabat detector. Similar to the previous species, they are widespread in woodland and forest habitats, usually roost in tree hollows and feed between the shrub layer and canopy (Churchill 1998).

Plate 5: White-striped Freetail-bat ©Michael Todd

The White-striped Freetail-bat (*Nyctinomus*

australis) (Plate 5) was also regularly recorded, though only five of its sixteen records were from systematic bat surveys. The call of this species is audible to humans and is often detected incidentally while working at night. Also, as it usually feeds high above the canopy it is rarely captured in harp traps. Two species of Mastiff-bat in the taxonomically difficult genus *Mormopterus* have been identified from Anabat detection. The first *Mormopterus* sp. 1 (equivalent to Eastern Freetail-bat in Churchill (1998)) was identified as definitely occurring at two sites on the Wollondilly River and probably at a site closer to Nattai NP. Another species, identified as probably *M. planiceps* (equivalent to Southern Freetail-bat in Churchill (1998)), was recorded at the same two sites on the Wollondilly River. If these identifications are correct, the area surrounding Wollondilly River NR may be approaching the boundaries of both these species distributions and may be a useful site to try and help solve the confusion over the taxonomy of this genus.

Table 2: Breakdown of the different survey methods for bats.

Scientific Name	Common Name	Harp Trapping		Anabat Detection		
		Within WRNR	Within 5km radius	Within WRNR	Within 5km radius	Highest level of identification
Rhinolophus megaphyllus	Eastern Horseshoe-bat	0	0	1	2#	Definite
Mormopterus planiceps	Little Mastiff-bat	0	0	0	2#	Probable
Mormopterus sp 1	Undescribed Mastiff-bat	0	0	0	3#	Definite
Nyctinomus australis	White-striped Freetail-bat°	0	0	2#	3#	Definite
Chalinolobus dwyeri	Large-eared Pied Bat	0	0	0	3#	Definite
Chalinolobus gouldii	Gould's Wattled Bat	0	0	2#	3#	Definite
Chalinolobus morio	Chocolate Wattled Bat	0	7	2#	5#	Definite
Myotis adversus	Large-footed Myotis	0	0	0	1#	Definite
Nyctophilus geoffroyi	Lesser Long-eared Bat	2	2	0	0	
Nyctophilus gouldi	Gould's Long-eared Bat	2	1	0	0	
Nyctophilus sp.*	Long-eared bat	0	0	1#	2#	Definite
Falsistrellus tasmaniensis	Eastern False Pipistrelle	0	0	0	1#	Probable
Scotorepens orion	Eastern Broad-nosed Bat	0	0	0	1#	Probable
Vespadelus darlingtoni	Large Forest Bat	0	2	2#	2#	Definite
Vespadelus regulus	Southern Forest Bat	2	2	1#	1	Definite
Vespadelus sp.*	Unidentified Eptesicus	0	0	1#	3#	Definite
Vespadelus vulturnus	Little Forest Bat	18	11	0	5#	Definite

* Indicates that identification using 'call' analysis is difficult and that identity can only be made to genus level. Highly likely to be one of the species detected during harp trapping.
# Indicates that at least one of the records at this location is of the highest level of identification.
° As this bat is audible to the human ear, additional records will have been obtained incidentally while undertaking other surveys.

Three threatened bats were recorded during the current surveys, though they were only identified from calls detected using Anabat. The Large-eared Pied Bat (*Chalinolobus dwyeri*) was recorded at two sites along the Wollondilly River near the eastern portion (one definite, one probable) and also in Joadja NR to the east (definite - Mills 2002). The two other species Large-footed Myotis (*Myotis adversus*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) were both only recorded at separate sites along the Wollondilly River. The former species was a definite record and probably uses the river as a flyway and as foraging habitat, while the latter was only recorded as a probable identification. All these species will be discussed in greater detail in Section 5.

Additional bat survey work was undertaken in both portions of the reserve but was unsuccessful for two reasons. Harp traps were located along the Wollondilly River in the eastern portion but unfortunately fell over due to strong wind and did not make any captures. Anabat detectors were used at a number of sites in the western portion, but due to the settings on the detectors being incorrect these calls have not been identified at this stage. It is possible that they will be analysed in the future

(N. Williams, pers. comm.) but not before completion of this report. If calls are identified from this the records will be included within the Atlas of NSW Wildlife.

3.6 OTHER NATIVE MAMMALS

The macropods are perhaps the most characteristic fauna group of the park. Three species (Eastern Grey Kangaroo (*Macropus giganteus*), Common Wallaroo (*M. robustus*) and Swamp Wallaby (*Wallabia bicolor*)) are abundant with the reserve, whilst the Red-necked Wallaby (*M. rufogriseus*) was seen near the reserve on two occasions. The first species can be in seen in large numbers, particularly around Horse Flat, but individuals and smaller groups were recorded throughout both portions of the reserve. Wallaroos were also commonly seen in the reserve, particularly around the wooded slopes surrounding the access trail from Goodmans Ford to "Bowmans Hill." Two were also seen on the upper slopes of the eastern portion. Swamp Wallabies were seen as individual animals, most often around the access trails. Red-necked Wallabies were only seen in the Tallygang area to the west of the reserve.

No evidence of Brush-tailed Rock-wallabies was made within or adjoining the reserve. This endangered species was formerly known from around the Wombeyan Caves, though the last known individual from this population was captured and taken to Jenolan Caves in 1995 (R. Humphries pers. comm.). Anecdotal records from the area around Wombeyan Caves persist, with possible sightings in the Guineacor Creek and Top of the World area (D. Ashton pers. comm.) though these have not been confirmed. More recent survey on the slopes above the Wollondilly Caves Road west of Goodman's Ford have discovered old scats (R. Pedroza pers. comm.), so potential habitat for this species may still exist near the reserve. The recent discovery of a population further down the Wollondilly River (DEC 2004b) indicates that the species may still persist in small numbers in the vicinity of Wollondilly River NR.

Perhaps the most exciting mammal detected during the survey was the Platypus (*Ornithorhynchus anatinus*). An individual was spotted in the Wollondilly River downstream from the eastern portion of the reserve and another was seen in the Wingecarribee River within the same portion. Platypus are known to exist in areas of the Wollondilly River but are quite cryptic and often only detected during targeted trapping. Visitors to the nearby River Island Nature Retreat however, regularly observe them. The other monotreme, the Short-beaked Echidna (*Tachyglossus aculeatus*), was also recorded within both portions of the reserve. The Common Wombat (*Vombatus ursinus*) was regularly recorded within and around the reserve. Four individuals were seen and many more locations were recorded in the way of burrows and scats.

Due to the lack of Elliott or pitfall trapping within the reserve, no small native mammals were definitely detected. Scats of an Antechinus (*Antechinus* spp.) were collected at two different sites, both outside the reserve on the western side of the Wollondilly River. One record was to the north of the reserve, the other to the west in the Tallygang area. The identity of this species would be confirmed by trapping, but an individual Yellow-footed Antechinus (*A. flavipes*) was seen further west along the Wombeyan Caves Road at Bowen Glen (Bellbird Corner). This species is more typically found on the western slopes and so would be near the eastern extremity of its distribution.

3.7 REPTILES

Prior to these surveys, there had been no reptile species recorded within Wollondilly River NR and only one species, Pale-flecked Garden Sunskink (*Lampropholis guichenoti*), had been recorded within five kilometres. The current surveys found ten species of reptile within the boundaries of the reserve and another four species in the surrounding areas. The number of species and individuals per systematic site were found to be generally lower than at many other locations within the Warragamba Special Area (DEC in prep.). This could be because the habitat naturally has a low species diversity, or may reflect the extremely hot and dry conditions when the surveys were undertaken.

Unsurprisingly, there were three species that are often found in or around water bodies: Eastern Water-skink (*Eulamprus quoyii*) (Plate 6), Eastern Water Dragon (*Physignathus lesueurii*) and Eastern Snake-necked Turtle (*Chelodina longicollis*). The first species listed above was the most common species recorded, with the other two abundant lizards being Dark-flecked Garden Sunskink (*Lampropholis delicata*) and Jacky Lashtail (*Amphibolurus muricatus*). The latter species was only recorded once in the reserve, though a number were also seen near the Wollondilly River adjoining the eastern portion, as well as near Tallygang and Nattai NP. Most of the other small lizard species recorded in the reserve were found incidentally.

Within the reserve, Lace Monitors (*Varanus varius*) were only recorded in the western portion where they were usually detected incidentally along roads and tracks. Other sightings were made around Tallygang and in the vicinity of Nattai NP. One of the individuals seen to the west of the reserve was of the "Bell's" form that displays a distinctive thick black and yellow band colouration. This form is more typically found further west in dry parts of NSW and Queensland (Wilson and Swan 2003). The only snake seen, the Red-bellied Black Snake (*Pseudechis porphyriacus*) was encountered near the river in both portions of the reserve. Further survey work may detect additional snake species.

Plate 6: Eastern Water-skink ©David O'Connor

3.8 FROGS

The success of frog surveys is largely dependent on the immediate weather, season and recent climatic conditions. In the lead up to and during the survey season the conditions were very dry and warm, hence no systematic surveys were carried out in Wollondilly River NR. Four species were however recorded opportunistically in the reserve and an additional two were recorded in the surrounding area. All these species apart from Lesueur's Frog (*Litoria lesueuri*) constituted new species records for the reserve and surrounding area, once again reflecting the lack of survey work in the area. The most frequently recorded species were Peron's Tree Frog (*Litoria peronii*), Lesueur's Frog and Common Eastern Froglet (*Crinia signifera*). The former was only recorded in or near the Wollondilly and Wingecarribee Rivers in eastern portion, while the other two were recorded in both sections. Individual Bullfrogs (*Limnodynastes dumerilii*) were recorded twice along the Wollondilly River in the eastern portion. Keferstein's Tree Frog (*Litoria dentata*) was recorded twice to the north of the eastern portion of the reserve while Spotted Marsh Frog (*Limnodynastes tasmaniensis*) was heard near Tallygang Creek.

3.9 INTRODUCED SPECIES

DEC has inherited a significant pest management issue with the transfer of these lands from the SCA. Goats (*Capra hircus*) are abundant, with groups of up to fifteen, including kids, seen both in and around the reserve. Thirty two were counted whilst looking for Brush-tailed Rock-wallabies along the Wingecarribee River. Evidence of their presence is widespread across every environment, in particular of cliffs and rock outcrops.

On the valley flats Feral Pigs (*Sus scrofa*) are also common, with one startling sighting of six half grown piglets boldly wandering past the Bowman's Hill Hut. The Wollondilly River also appeared to be a favoured wallowing site, with much of the understorey along the riverbank highly disturbed. Cattle (*Bos taurus*) were also seen on Horse Flat, though they were more likely to be wandering stock from an adjoining property than truly feral animals. Rabbits (*Oryctolagus cuniculus*) were also common, although, apart from around Horse Flat, most sightings were of scats.

Foxes (*Vulpes vulpes*) proved to be the most common introduced predator within the reserve with four seen and two scats collected. Hairs within these scats were identified as Swamp Wallaby and Eastern Grey Kangaroo. An individual Cat (*Felis catus*) was also seen while spotlighting in the western portion. A Dog (*Canis lupus*) scat was also seen in this portion, though it is likely to be a dog or hybrid than a native Dingo which are still found further into the Warragamba Special Area (DEC in prep.).

These introduced species are likely to be having a significant negative impact on the native terrestrial flora and fauna of the reserve. Five of the species are listed, or are pending finalisation, as a Key Threatening Process on the NSW TSC Act (1995), as they are known to adversely affect threatened

species and have the potential to cause other species to become threatened. The threats posed to native fauna by each animal are summarised as follows:

- Feral Rabbits impact negatively on indigenous species via competition for resources, alteration of the structure and composition of vegetation, and land degradation. Competition and land degradation by feral rabbits is also listed as a Key Threatening Process on the NSW TSC Act (NSW Scientific Committee 2002).
- Predation by the Fox is a major threat to the survival of native Australian fauna, with non-flying mammals weighing between 35 and 5500 grams and ground-nesting birds at greatest risk. Fox predation has been implicated in limiting habitat choice and population size of a number of medium-sized marsupials (NSW Scientific Committee 1998).
- Feral Pigs compete for food resources with native fauna, actively predate upon native birds, reptiles, bird and reptile eggs, and frogs, and are capable of significant habitat degradation as a result of their behaviour and feeding habits (NSW Scientific Committee 2004a). Predation, habitat degradation, competition and disease transmission by Feral Pigs is also listed as a key threatening process under the EPBC Act.
- Feral Goats were given a preliminary determination as a Key Threatening Process in June 2004. They cause habitat degradation and have the ability to significantly alter the habitat of native fauna. Goats may compete with native fauna for food, water and shelter (NSW Scientific Committee 2004b).
- Feral Cats threaten native fauna by direct predation. Cats are carnivorous and capable of killing vertebrates up to three kilograms. Preference is shown for mammals weighing less that 220 grams and birds less than 200 grams, but reptiles, and amphibians are also eaten (NSW Scientific Committee 2000).

Five species of introduced birds have been recorded in the vicinity of Wollondilly River NR, though only one species has been recorded within the reserve. This was a record of a small flock of Common Starling (*Sturnus vulgaris*) that was seen at Bowman's Hill Hut during January 2004. This area is probably the most likely location for any of the four other species (House Sparrow (*Passer domesticus*), European Goldfinch (*Carduelis carduelis*) Eurasian Blackbird (*Turdus merula*) and Common Myna (*Acridotheres tristis*)) to be recorded. All these species probably only provide a minor threat to native bird species occurring in the reserve, with competition for nest hollows possibly the only significant impact.

4 FUTURE WORK

Every effort was made during the recent systematic fauna surveys to sample the full variety of habitat types and fauna groups within Wollondilly River NR, and hence obtain a comprehensive picture of terrestrial vertebrate fauna within the park. The surveys were, however, subject to a number of constraints, leading to limitations in results and a recommendation that further work by undertaken within the area in coming years. Areas of endeavour that should be targeted in the future include:

- Small mammal surveys. No Elliott trapping or pitfall trapping was undertaken within the reserve. Some trapping would probably confirm the identity of the *Antechinus* present, and may add additional Dasyurid and native rodent species to the reserve list.
- Systematic frog surveys. The nocturnal streamside search method described in NPWS (1997) was not undertaken as weather conditions were not ideal. A high number of species were detected opportunistically. However, systematic survey when weather conditions are appropriate (after an extended period of rain on warm, humid nights in spring or early summer) may add additional species. Winter surveys may also need to be undertaken to detect species that breed at this time of year.
- Additional bat work. Confirmation, by either capture or definite call recordings, of the threatened species detected will provide a better understanding of the distribution limits of these species and identification of the *Mormopterus* species in the area may provide a better understanding of this complex taxonomic group.
- Continued survey for Brush-tailed Rock-wallabies, particularly on the northern slopes of Mount Hickson (within Wollondily River Nature Reserve) and areas to the west (Lanagans Creek and Killicrankie Pass.
- If additions are made to the reserve, further survey work should be undertaken as soon as possible to determine the value of the additions to the fauna of the area. Survey effort was concentrated on areas within the Warragamba Special Area, so further significant finds may be made in the areas to the south.

4.1 MANAGEMENT RECOMMENDATIONS

Feral Goat Control

The large numbers of goats observed within the vicinity of Wollondilly River Nature Reserve, particularly around the eastern portion, are having a serious impact on the vegetation of the reserve. The high density of goats means that vegetation is suffering from high grazing pressure and regeneration is highly likely to be reduced. As goats can access even the steepest locations, their effects are likely to be in all areas of the reserve, including areas that have not been used for grazing of domestic stock in the past. Brush-tailed Rock-wallabies are also suspected of being threatened by competition with feral goats (NSW Scientific Committee 2004b). The removal of goats may also assist with any vegetation rehabilitation work that may be planned for such areas as Horse Flat.

Detailed mapping and management implications for goats and other introduced species will be undertaken as part of the report on biodiversity within the Warragamba and Metropolitan Special Areas (DEC in prep.). However, given the high densities of goats in Wollondilly River NR, targeted control of this species is recommended. As many of the goats were found on land adjoining the reserve, a successful program would need the cooperation of neighbours. The method of control undertaken is beyond the scope of this report, although field management staff will be aware of the best methods for humane control within the steep country in and adjoining the reserve.

Reserve Connectivity

Although the two portions of Wollondilly River NR are separated by cleared or highly disturbed vegetation, each is still connected to significant areas of vegetation that would be used for dispersal by fauna. For example, the steep slopes to the north of Tallygang Mountain remain vegetated and this connects with the western portion of the reserve. Both species of threatened owl recorded in this area may use this vegetation as part of their territory. Given the steep nature of this vegetation it is highly unlikely that clearing will happen in the future and if the threat from goats is reduced, the vegetation will continue to provide habitat for many species.

The presence of the Koala in the eastern portion shows the significance of the corridor of vegetation that connects this area with the larger reserves to the east (Joadja NP and Nattai NP). Koalas may exist to the south of the study area (very little survey effort has been undertaken in this area) but definitely occur to the east in Nattai NP (DEC 2004b). The existence of vegetation between the population in the High Range area and Wollondilly River NR (including Joadja NR) means that animals can move between the two areas. The retention of vegetation within this corridor in the future will be important for retaining sustainable populations of the Koala and other species within the Southern Highlands area.

5 THREATENED SPECIES PROFILES

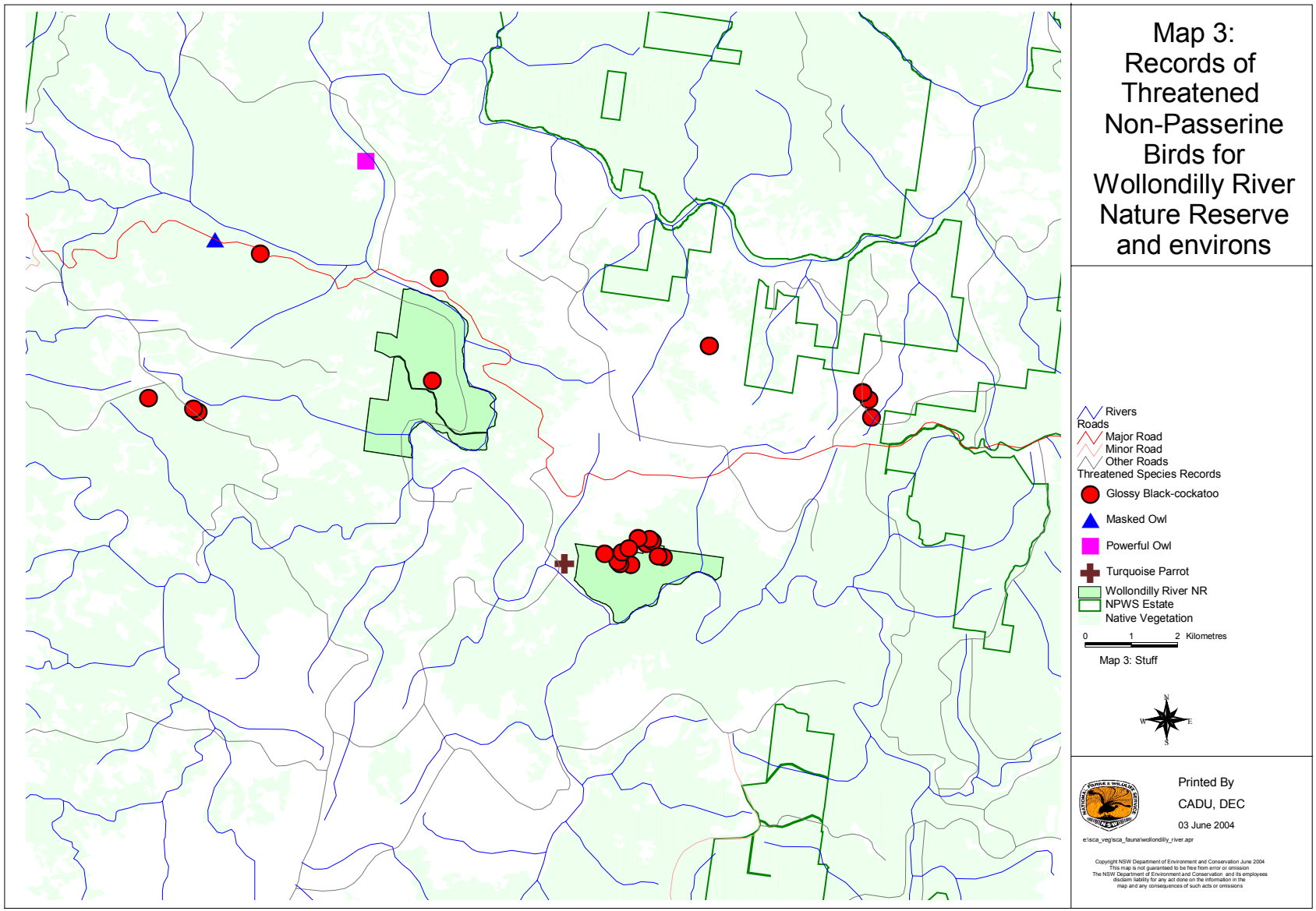
This section provides a profile of each of the threatened fauna species that are known to occur within Wollondilly River NR, together with a few additional threatened species that are considered highly likely to occur. The aim of these profiles is to provide:

- A background on the species biology.
- A summary of threats to the species.
- An assessment of the species' distribution in the Sydney Basin and South Eastern Highlands Bioregions.
- A map of known records of the species in the park and the surrounding five kilometres.
- An appraisal of the distribution and status of the species in Wollondilly River NR and the surrounding area.

Table 3 presents all of the threatened species listed on the Atlas of NSW Wildlife within five kilometres of reserve. During these surveys four threatened bird species and one threatened mammal species were recorded within the Wollondilly River NR. One other species (Squirrel Glider) had been previously recorded in the reserve but was not recorded during the surveys. A further three of both threatened bird and mammal species were recorded outside the reserve in these surveys, while two other threatened bird species have been previously recorded in close proximity but were not during these surveys. The Yellow-bellied Glider has been recorded in Joadja NR (Mills 2002) but as it is unlikely to occur in Wollondilly River NR, no profile has been written (though records are included in Map 5). A profile has been included for Brush-tailed Rock-wallaby, though no records are in the Atlas at this stage.

Table 3: Threatened Species recorded in and around Wollondilly River NR.

Scientific Name	Common Name	Profile	Conservation Status	Within Nature Reserve		Outside, but within 5 km, of Nature Reserve	
				Current Survey	Other sources	Current Survey	Other sources
Calyptorhynchus lathami	Glossy Black-cockatoo	Yes	V	9	0	13	4
Neophema pulchella	Turquoise Parrot	Yes	V	0	0	0	1
Ninox strenua	Powerful Owl	Yes	V	0	0	1	0
Tyto novaehollandiae	Masked Owl	Yes	V	0	0	1	0
Climacteris picumnus victoriae	Brown Treecreeper (eastern subsp.)	Yes	V	1	0	0	3
Pyrrholaemus sagittatus	Speckled Warbler	Yes	V	0	0	1	1
Xanthomyza phrygia	Regent Honeyeater	Yes	E1	0	0	0	5
Melanodryas cucullata cucullata	Hooded Robin (south-eastern subsp.)	Yes	V	2	0	0	3
Stagonopleura guttata	Diamond Firetail	Yes	V	3	0	1	4
Phascolarctos cinereus	Koala	Yes	V	1	0	2	0
Petaurus australis	Yellow-bellied Glider	No	V	0	0	3	0
Petaurus norfolcensis	Squirrel Glider	Yes	V	0	1	0	0
Petrogale penicillata	Brush-tailed Rock-wallaby	No	E1	0	0	0	0
Chalinolobus dwyeri	Large-eared Pied Bat	Yes	V	0	0	3	0
Falsistrellus tasmaniensis	Eastern False Pipistrelle	Yes	V	0	0	1	0
Myotis adversus	Large-footed Myotis	Yes	V	0	0	1	0


Map 3:
Records of
Threatened
Non-Passerine
Birds for
Wollondilly River
Nature Reserve
and environs
Rivers
Roads
Major Road
Minor Road
Other Roads
Threatened Species Records
Glossy Black-cockatoo
Masked Owl
Powerful Owl
Turquoise Parrot
Wollondilly River NR
NPWS Estate
Native Vegetation
0 1 2 Kilometres
Map 3: Stuff
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Copyright NSW Department of Environment and Conservation June 2004
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GLOSSY BLACK-COCKATOO

Species Profile

The Glossy Black-cockatoo (*Calyptorhynchus lathami*) is a medium-sized black cockatoo, which has a diagnostic black-brown head, with yellow patches in the female, and red tail panels. Usually seen in pairs or trios (with dependant young) in eucalypt woodland or forest, where they nest in hollows. Feeds almost exclusively on She-oak (*Allocasuarina* species including *A. verticillata, A. torulosa* and *A. littoralis*) (Higgins 1999). Two subspecies are restricted to eastern Australia between Queensland (Eungella) and eastern Victoria, with the nominate *lathami* found in NSW, and a third, isolated, endangered subspecies on Kangaroo Island (South Australia) (Higgins 1999).

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Threats

Habitat destruction for agriculture or residential development appears to be one of the main threats, due to both removal of nesting and feeding sites, and also from competition from more open habitat species such as Galahs (*Eolophus roseicapillus*). Because many *Allocasuarina* species are fire sensitive, inappropriate burning regimes may effect food supplies. Illegal trapping for aviculture may be a localised, minor threat (Garnett and Crowley 2000).

Local and Regional Conservation Status

The Glossy Black-cockatoo is listed as Vulnerable on the NSW TSC Act (1995). Relatively large areas of the Sydney Basin provide suitable habitat for Glossy Black-cockatoos and there are a large number of records for this species throughout the Bioregion. Records of the species are much more scattered over the South Eastern Highlands Bioregion, with records in Kanangra-Boyd National Park and the western margins of Morton National Park (DEC 2004a). It has been found to be widespread throughout the Warragamba Special Area (DEC in prep.).

Interestingly enough, the most frequent opportunistically recorded bird during these surveys was the Glossy Black-cockatoo. This is not indicative however, of the number of birds in the area. Many of the recorded sightings of Glossy Black-Cockatoos were chewed *Allocasuarina* cones, which indicates that the bird is in the area, but gives little idea of the number of animals present. Drooping She-oak (*Allocasuarina verticillata*) was the most common feed tree species recorded and it would be expected that wherever this species is recorded, particularly within the Devonian Red Gum-Box Woodlands, Glossy Black-cockatoos can be expected. One pair was observed feeding in these trees, within the northern boundary of the eastern portion of the reserve. Other birds were seen on either side of Goodmans Ford on the Wombeyan Caves Road. Birds Australia had also recorded this species in the Bullio region prior to the DEC surveys. Map 3 indicates the location of all records of this species in and around Wollondilly River Nature Reserve. The habitat protected in the reserve complements the habitat protected in Joadja Nature Reserve and Nattai National Park.

TURQUOISE PARROT

Species Profile

The Turquoise Parrot (*Neophema pulchella*) is a small, brightly coloured parrot, distinguished by its bright green upper parts, yellow under parts and blue face and shoulder patch. The male is considerably brighter than the female, and also has a red shoulder band. Usually occurs in pairs or small family parties in eucalypt woodlands and open forests that have a ground cover of grasses. It nests in tree hollows, and has a usual clutch size of two to five eggs (Higgins 1999). It is restricted to eastern Australia, where its range has contracted by over 50 percent since the 1890s (Garnett and Crowley 2000).

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Threats

Garnett and Crowley (2000) summarise the main threats as: past clearing for agriculture, which has greatly reduced the overall distribution; predation by cats and foxes; loss of hollows that are used for nesting in managed forests; and inappropriate burning regimes that may favour a shrubby rather than a grassy understorey.

Local and Regional Conservation Status

The Turquoise Parrot is listed as Vulnerable on the NSW TSC Act (1995). There are only scattered records of this species within the South Eastern Highlands Bioregion, although it is more widely recorded across the adjoining Sydney Basin and NSW South West Slopes Bioregions. Records from within NPWS estate in the South Eastern Highlands are also rare with only Gardens of Stone and Woormagama National Parks including this species (DEC 2004a).

No sightings have been made of this species inside the reserve and none were recorded in adjoining country during these surveys. The sole record, shown on Map 3, for the area is a record from the Birds Australia Atlas recorded at the River Island Nature Retreat immediately west of the eastern portion of Wollondilly River Nature Reserve in April 2000. The species has been recorded further down the Burragorang Valley, particularly in the Jooriland area of Warragamba Special Area (DEC in prep.). Turquoise Parrots may exist in small numbers around Wollondilly River Nature Reserve, particularly in Devonian Red Gum-Box Woodlands.

POWERFUL OWL

Species Profile

The Powerful Owl (*Ninox strenua*) is the largest owl in Australia and is distinguished by its relatively small, round head and long tail. It is dark brown above with prominent off-white barring, and paler underneath with diagnostic dark chevrons. It inhabits various forest habitats, though usually breeds and roosts in closed forest, including rainforest and wet sclerophyll. It hunts in more open forests, where it feeds mainly on arboreal mammals, particularly Common Ringtail Possums and Greater Gliders. Usually nests in a hollow in a eucalypt within or below the canopy, and usually lays two eggs. They usually maintain a territory of between 300 and 1500 hectares, with size dependent on habitat quality and prey density. It is endemic to eastern Australia, being recorded between Eungella (Queensland) to near the South Australia-Victoria border (Higgins 1999).

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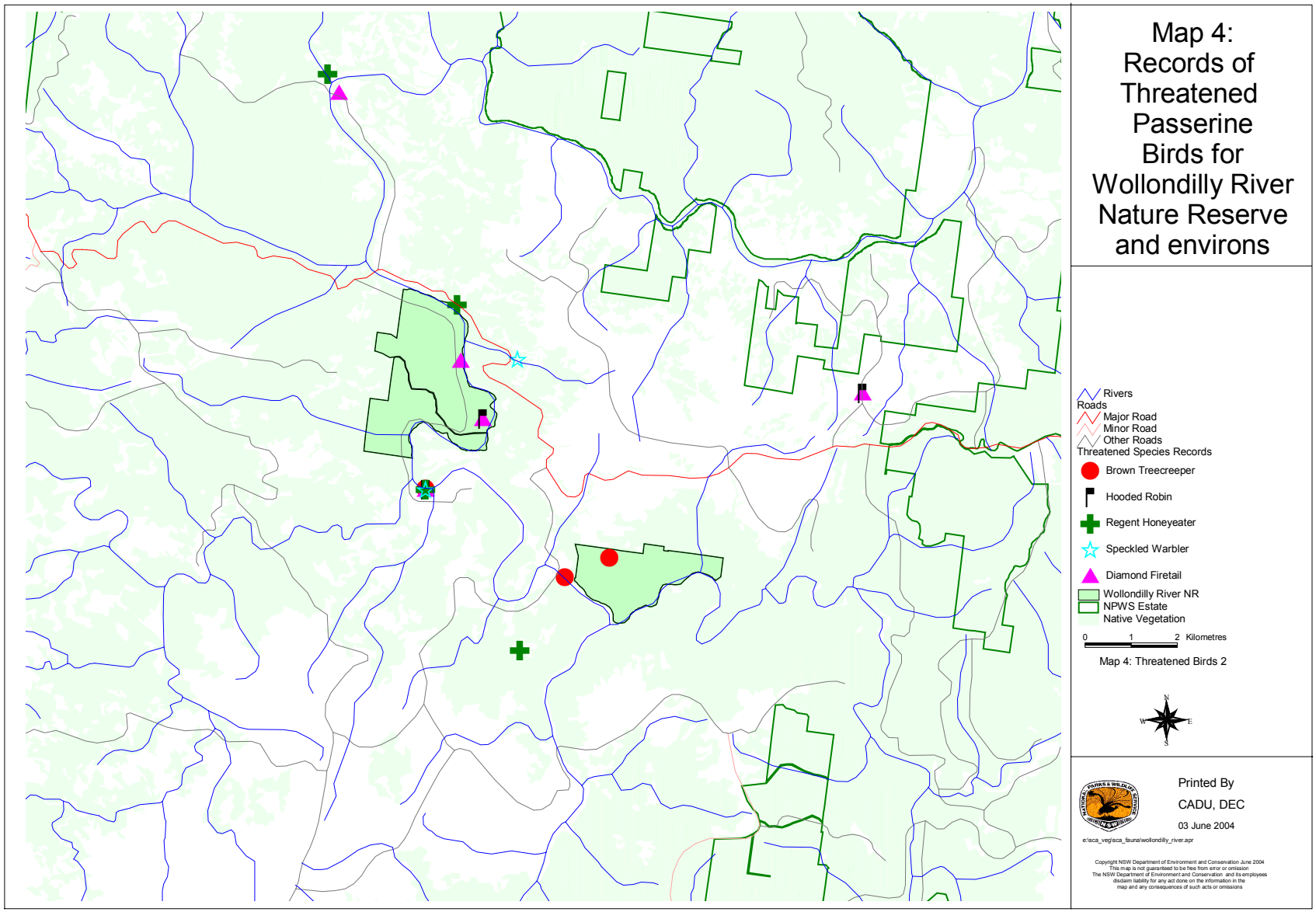
Threats

Past land clearance for agriculture has reduced the area of habitat available for the Powerful Owl (Garnett and Crowley 2000), particularly the availability of roost sites. It can, however, manage to survive in areas with some levels of disturbance, such as in selectively logged forests (Kavanagh 1997) and it is also still recorded in suburban areas of Brisbane, Sydney and Melbourne (Garnett and Crowley 2000, DEC 2004c). Two of the determining factors for the species persistence in disturbed areas is the presence and suitable abundance of prey species (Chafer 1992) and nesting/roosting sites (Debus and Chafer 1994).

Local and Regional Conservation Status

The Powerful Owl is listed as Vulnerable on the NSW TSC Act (1995). It is found throughout the Sydney Basin Bioregion extending west from the rural-urban fringes of Sydney Metropolitan area into the Central Tablelands. Most reserves of the region support known territories of this species. The species is less widespread in the South Eastern Highlands Bioregion, with concentrations of records immediately west of the Sydney Basin (Central Tablelands), around Tallaganda and in western Kosciuszko National Park. A number of reserves in this Bioregion, however, do contain records of this species, including Turon, Kanangra-Boyd, Gourock and Woomargama National Parks (DEC 2004a).

One individual was recorded on the western side of the Wollondilly River approximately two and a half kilometres downstream from Goodmans Ford during the fauna surveys. Potential prey species were located in the Tallygang area, however this species was not detected here. Powerful Owls probably occur at low densities (possibly even only one pair) in the vicinity of Wollondilly River Nature Reserve, particularly in the taller forest types in moister areas.


Map 4: Records of Threatened Passerine Birds for Wollondilly River Nature Reserve and environs
Rivers
Roads
Major Road
Minor Road
Other Roads
Threatened Species Records
Brown Treecreeper
Hooded Robin
Regent Honeyeater
Speckled Warbler
Diamond Firetail
Wollondilly River NR
NPWS Estate
Native Vegetation
0 1 2 Kilometres
Map 4: Threatened Birds 2
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MASKED OWL

Species Profile

The Masked Owl (*Tyto novaehollandiae*) is a large 'barn' owl, which has three colour morphs (with intermediates), but is distinguished from the similar Barn Owl (*T. alba*) by its larger size, more thickset and hunchbacked appearance, fully feathered legs and larger feet. It inhabits a wide range of woodland habitats with large hollows for roosting and open areas for hunting. It feeds mainly on ground-dwelling mammals, such as Rats (*Rattus* spp.) and Antechinus (*Antechinus* spp.). It nests in hollow trees, usually eucalypts, where two to three eggs are the normal clutch (Higgins 1999). The nominate subspecies *novaehollandiae* was formerly found around the southern coast of Australia between Fraser Island (Queensland) and Carnarvon (Western Australia), though its range has contracted, particularly in Western Australia (Garnett and Crowley 2000). Other subspecies occur in Tasmania, northern Australia and extralimitally in New Guinea and adjoining islands, some of which are sometimes considered separate species (Higgins 1999).

Threats

Clearance of native forest for agriculture and urban development, and the resulting fragmentation of habitat, has negatively affected the abundance of Masked Owls (Kavanagh 2002, Garnett and Crowley 2000). The species does not persist within fragments of forest less than 200 hectares (Kavanagh 2002). The species may be affected by logging, through removal of hollows or reduction in foraging habitat due to vigorous regrowth (Garnett and Crowley 2000), though it has been suggested that modern mosaic logging operations do not cause major changes to the abundance of the species (Kavanagh 2002).

Local and Regional Conservation Status

The Masked Owl is listed as Vulnerable on the NSW TSC Act (1995). Most records for the species in NSW are located in the NSW North Coast, Sydney Basin and South East Corner Bioregions, with a few scattered records west of the Divide. Records of the species in South Eastern Highlands are restricted to the eastern extremity of the Bioregion including Blue Mountains and Morton National Parks and Bungonia State Conservation Area (DEC 2004a).

One individual has been recorded during this survey, within five kilometres of the Nature Reserve boundary. This animal was heard during a nocturnal call playback survey on the Wombeyan Caves Road west of Goodmans Ford (Map 3). The surrounding vegetation on this site was largely Devonian Red Gum-Yellow Box Woodland complex. This sighting was the first recorded for this animal in the area, though it has also been recorded at a number of new locations throughout the Warragamba Special Area and Nattai National Park (DEC 2004b, DEC in prep.). Further survey work may find that this species is sparsely populated throughout the various woodlands in the Southern Highlands area.

BROWN TREECREEPER

Species Profile

The Brown Treecreeper (*Climacteris picumnus*) is a medium-sized brown bird that is superficially similar in appearance to the Red-browed (*C. erythrops*) and White-throated (*Cormobates leucophaeus*) Treecreepers. It is distinguished from both by its slightly larger size, distinctive pale supercilium (eyebrow stripe) and by call. Typically a bird of Eucalypt woodlands with a grassy or open shrub understorey, and abundant fallen timber and/or dead trees. Unlike most treecreepers, they spend approximately half of the time on the ground where they feed on insects, particularly ants and beetles, taken from live and dead trees, fallen branches and off the ground. Occurs in pairs or small groups in permanent territories where tree hollows are utilised for breeding (Higgins *et al.* 2001). The subspecies (*victoriae*) occurs along the coast and ranges in Victoria, New South Wales and south-east Queensland, with the other two subspecies occurring either west (*picumnus*) or north (*melanotus*) (Schodde and Mason 1999).

Threats

The eastern subspecies of the Brown Treecreeper is one of a suite of woodland birds that have declined throughout their range due to habitat clearance (Reid 1999). Traill and Duncan (2000) stated that the population was estimated to have declined by at least twenty percent in the last fifteen years. Studies have shown that populations can not persist in habitat fragments smaller than 300 hectares, mostly because females either disperse or suffer from preferential mortality. As with most treecreepers, once extinction occurs in a remnant, natural recolonisation is unlikely (Garnett and Crowley 2000). The lack of hollows may also be a limiting factor as they are known to compete with introduced species like the Common Starling (*Sturnus vulgaris*) (Higgins *et al.* 2001) and European Honeybees (*Apis mellifora*) (NSW Scientific Committee 2001a). Grazing also has impacts by decreasing the diversity of ground-dwelling invertebrates which reduces the levels of food availability (NSW Scientific Committee 2001a).

Local and Regional Conservation Status

The eastern subspecies of the Brown Treecreeper is listed as Vulnerable on the NSW TSC Act (1995). Though it is found through all the eastern Bioregions in New South Wales, it is least common in the South East Coast and Australian Alps, and has declined significantly within the Sydney Basin and NSW North Coast. Similarly, within the South Eastern Highlands Bioregion, there are records scattered throughout, though it appears to have declined in the north and east. Reserves that have records in this Bioregion include Gardens of Stone and Woomargama National Parks, and Coornartha and Mundoonen Nature Reserves (DEC 2004a).

During the current surveys, one individual was heard within the northern boundary of the eastern section of Wollondilly River Nature Reserve. Previous records from the Birds Australia Atlas exist for the areas surrounding both portions of the reserve. The two localities for these records are at the River Island Nature Retreat adjoining the eastern portion, and on a property near the junction of Wollondilly River and Guineacor Creek (Murphys Flat), south of the western portion. These records are plotted in Map 4. The preferred habitat of this species, both around Wollondilly River Nature Reserve and further down the Wollondilly River in the Warragamba Special Area (DEC in prep.) appears to be the Devonian Red Gum-Box Woodlands.

SPECKLED WARBLER

Species Profile

The Speckled Warbler (*Pyrrholaemus sagittata*) is a small, ground-dwelling scrubwren-like bird. It is similar in size and shape to the Buff-rumped Thornbill (*Acanthiza reguloides*) but can be identified by its boldly streaked underbody, distinctive facial pattern and noticeably longer tail. The female differs from the male by having a chestnut, rather than black, streak in the eyebrow. Usually occurs in grassy understorey of dry sclerophyll forests and woodlands dominated by eucalypts, often with scattered shrubs. They feed on insects and seeds with most foraging occurring on the ground. Pairs, and occasionally trios, live permanently in large (up to twelve hectare) territories where a well concealed domed nest is built on the ground in grass tussocks. Two to four (usually three) eggs are laid, though breeding success can be low. The Speckled Warbler is endemic to south eastern Australia, being found between Maryborough (Queensland) and the Grampians (Victoria) (Higgins and Peter 2002).

Threats

The Speckled Warbler is one of a number of woodland birds that has declined in density throughout its range due mainly to agricultural land clearing (Reid 1999). Speckled Warbler populations are estimated to have declined by at least twenty percent in the last fifteen years (Traill and Duncan 2000). Small patches may result in local extinction due to natural fluctuations (Garnett and Crowley 2000) with extinction occurring in areas in patches smaller than 100 hectares (NSW Scientific Committee 2001b). Weed invasion, nest predation by exotic mammalian predators and a loss of ground cover by grazing by stock, kangaroos and rabbits are other notable threats (NSW Scientific Committee 2001b, Garnett and Crowley 2000).

Local and Regional Conservation Status

The Speckled Warbler is listed as Vulnerable on the NSW TSC Act (1995). It is widespread in the eastern Bioregions of the state, extending as far west as the Cobar Peneplain, but is scarce or absent from the South East Coast and Australian Alps. Within the South Eastern Highlands Bioregion most records are from the far north (around Winburndale Nature Reserve) and around Canberra, with scattered records elsewhere and few records from around the Oberon area. It is not well recorded in reserves, but is listed for Kosciuszko National Park, Barton Nature Reserve and Yerranderie SCA (DEC 2004a).

During the current surveys, one individual was observed in Horse Creek, on the Wombeyan Caves Road east of Goodmans Ford. Birds Australia have another record from a property near the junction of Wollondilly River and Guineacor Creek (Murphys Flat) in 2001. These records are shown in Map 4. This species has been more regularly reported further downstream in the Burragorang Valley (DEC in prep.). Once again, this species appears to be linked with Devonian Red Gum-Box Woodlands, and so may be expected to occur within Wollondilly River Nature Reserve, particularly along gullies where the shrub layer is denser.

REGENT HONEYEATER

Species Profile

The Regent Honeyeater (*Xanthomyza phrygia*) is a medium-sized honeyeater with a striking black and yellow plumage. It typically favours box-ironbark woodland, though it also utilises River Oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) Forests and coastal habitats such as Swamp Mahogany (*Eucalyptus robusta*) or Spotted Gum (*Corymbia maculata*). The population seems to undertake complex movements, generally dependent on where flowering food trees are available. It feeds mainly on nectar, and nests in the crowns of Eucalypts where it usually lays two or three eggs. It is endemic to south eastern Australia, formerly between Rockhampton (Queensland) and Adelaide, though it is now rare in Queensland and probably extinct in South Australia, with a general contraction of range in the other two states (Higgins *et al.* 2001).

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Threats

Land clearance for agriculture has removed about three quarters of the suitable habitat of the Regent Honeyeater. The remaining vegetation is fragmented, and is still being affected by the removal of larger trees. Habitat alteration may also advantage more aggressive honeyeaters, such as miners (*Manorina* spp.) and friarbirds (*Philemon* spp.) with resulting competition. The population is estimated to be no more than 1500 individuals (Garnett and Crowley 2000, Higgins *et al*. 2001).

Local and Regional Conservation Status

The Regent Honeyeater is listed as Endangered on the NSW TSC Act (1995) and as Endangered on the Commonwealth EPBC Act (1999). There are scattered records across the entire eastern third of New South Wales, with many records within the Sydney Basin Bioregion. It has been regularly recorded within the South Eastern Highlands Bioregion, but there are few records south of the Australian Capital Territory. Occasional sightings have been made in NPWS estate including Morton and Gardens of Stone National Parks, Copperhannia Nature Reserve and Bungonia State Conservation Area (DEC 2004a).

Compiling records was one of the priorities of the Draft Regent Honeyeater Recovery Plan (Menkhorst *et al*. 1999) and so a number of records are included in the Atlas of NSW Wildlife, though the accuracy of these records is often low. These are shown in Map 4. Two records from the 1970s are from the Wollondilly River upstream of Goodmans Ford, while a third record from 1989 is simply noted as "Wollondilly River, Wombeyan Caves Road." All these records may have been within Wollondilly River Nature Reserve. The most recent records are from the Birds Australia Atlas of up to eight birds present for at least a week at "Riverview" which is situated between the two portions of the reserve on the Wollondilly River. None were recorded during the current surveys. As most of these records are linked with the Wollondilly River and the fact that White Box (*Eucalyptus albens*) is rare this far upstream, the Regent Honeyeater is probably linked to flowering mistletoe (*Amyema cambagei*) within the Tablelands River Oak Forest in the vicinity of Wollondilly River Nature Reserve.

HOODED ROBIN

Species Profile

The Hooded Robin (*Melanodryas cucullata*) is a medium-sized bird that usually occurs in eucalypt woodland or *Acacia* shrubland. The adult male is distinctive and has a black hood and upper body with a white stripe on the shoulder. The adult female is mostly grey with a dark-brown wing. Both sexes have a white wing stripe and underparts and a prominent white side-panel on the tail, which along with their larger size, distinguish this species from the Jacky Winter (*Microeca fascinans*) and female *Petroica* Robins. They utilise dead or fallen timber as perches when foraging, where it feeds mainly on insects. Usually occurs as pairs, though cooperative breeding is also common, with normally two or three eggs laid in a cup-shaped nest placed in a horizontal fork (Higgins and Peter 2002). There are four subspecies covering most of Australia, with the two subspecies in New South Wales being *picata,* which extends from north western NSW through to the Kimberleys in Western Australia, and the nominate (*cucullata*) which is south and east of this subspecies (between Queensland and South Australia) (Schodde and Mason 1999).

Threats

The south-eastern subspecies of the Hooded Robin has been identified as one of a number of birds that have declined significantly in range and population in the sheep-wheat belt of central west NSW due to degradation and fragmentation of woodland habitats (Reid 1999). Populations do not appear to persist even in large fragments of remaining habitat although the precise reason for this is as yet unknown (Garnett and Crowley 2000). Habitat modification and reduction of food availability through grazing by stock and weed invasion may also be a threat (NSW Scientific Committee 2001c). Eggs and young have been known to be predated by native avian predators and possibly by Foxes (*Vulpes vulpes*) (Higgins and Peter 2002).

Local and Regional Conservation Status

The south eastern subspecies of the Hooded Robin is listed as Vulnerable on the NSW TSC Act (1995). It has been recorded in most subcoastal areas of New South Wales, though is rare in the Australian Alps Bioregion. Within the South Eastern Highlands, it has a patchy distribution in the north, east and around the Australian Capital Territory, appearing to avoid the higher areas around Oberon and west of Kosciuszko National Park. Very few of the records from the South Eastern Highlands are within DEC reserves, although there is a record from Copperhannia Nature Reserve (DEC 2004a).

Within Wollondilly River Nature Reserve the Hooded Robin was only recorded around “Bowmans Hill” Hut where an adult male was first seen in June 2003. In January 2004, a pair and at least one juvenile were seen at the same location, utilising the exotic trees within the garden for feeding and roosting. There were also records from the Birds Australia Atlas at Bullio and from a property near the junction of Wollondilly River and Guineacor Creek (Murphys Flat) that had been recorded prior to the DEC surveys. These locations are shown on Map 4. This species was more regularly recorded further down the Wollondilly in the Jooriland area of Warragamba Special Area (DEC in prep.). It is likely to be found in small numbers throughout the Devonian Red Gum-Box Woodlands of the area, particularly in areas with dead trees adjoining cleared lands.

DIAMOND FIRETAIL

Species Profile

The Diamond Firetail (*Stagonopleura guttata*) is an attractive finch, which is distinguished by its bold black breastband and white-spotted black flanks. The eye, beak and rump are red, with the latter contrasting strongly with the black tail in flight (Pizzey and Knight 1997). It is most frequently encountered in Eucalypt dominated communities that have a grassy understorey, where it feeds mainly on grass seeds (Garnett and Crowley 2000). Usually encountered as pairs, though sometimes forms small flocks in autumn and winter. They nest in trees or sometimes mistletoe, building bottle-shaped nests and usually produce four to six eggs (Pizzey and Knight 1997). It is endemic to south-eastern Australia, with records extending from Rockhampton (Queensland) to the Eyre Peninsula and Kangaroo Island (South Australia) (Pizzey and Knight 1997).

Threats

The Diamond Firetail has been historically recorded in all types of timbered country (Smith *et al*. 1995) but much of its habitat has been cleared and it is therefore numbered in the suite of woodland birds that have declined in south-eastern Australia (Reid 1999). They appear to be unable to survive in areas with no remnants larger than 200 hectares (NSW Scientific Committee 2001d). Clearing and habitat degradation by over-grazing and the spread of exotic grasses may also result in the loss of key food plants and possibly competition from flock-foraging Red-browed Finches (*Neochmia temporalis*) (Garnett and Crowley 2000). Predation by foxes and cats may be another threat (Smith *et al.* 1995).

Local and Regional Conservation Status

The Diamond Firetail is listed as Vulnerable on the NSW TSC Act (1995). It is widely recorded in the eastern two thirds of the state, with scattered records in the far west, although it is less widely recorded in the three coastal Bioregions and in the high country of the Australian Alps. It is also broadly recorded in the South Eastern Highlands Bioregion, though it is sparse or absent in the higher areas around Oberon and south of the Australian Capital Territory. Records within conservation reserves within this Bioregion, however, are sparse, with sightings in Copperhannia and Winburndale Nature Reserves (DEC 2004a).

This species has been recorded widely in and around Wollondilly River Nature Reserve. It was recorded on two different occasions around the Bowman's Hill Hut and on the Horse Flat access trail within the reserve. The latter site included juvenile birds indicating that breeding is likely to be occurring within the reserve. It was also recorded near the Wollondilly River near Five Hundred Acre Flat during current surveys. Birds Australia had records from a property near the junction of the Wollondilly River and Guineacor Creek (Murphys Flat) and the Bullio area which are also shown in Map 4. This is another species recorded more widely downstream in the Jooriland area of Warragamba Special Area (DEC in prep.). The Diamond Firetail is also likely to be found in patches of Devonian Red Gum-Box Woodlands in the drier areas of the Warragamba Special Area.

KOALA

Species Profile

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The Koala (*Phascolarctos cinereus*) is a distinctive, iconic arboreal mammal of eucalypt forest and woodland. It feeds on a wide range of eucalypt and other tree species, though in a local area a few species will be preferred almost exclusively. Individuals spend most of the day resting in the forks of trees, and are most active following sunset (NPWS 1999a). They generally move about a home range, the size of which varies depending on density of food trees and population size, though individuals, particularly dispersing juveniles, are known to travel up to 50 kilometres (Martin & Handasyde 1995, NPWS 1999a). Three subspecies occur between north Queensland and the Eyre Peninsula in South Australia, however, the distribution is now fragmented and introductions, such as to Phillip Island, have possibly reduced the genetic diversity of many of the populations (Martin & Handasyde 1995).

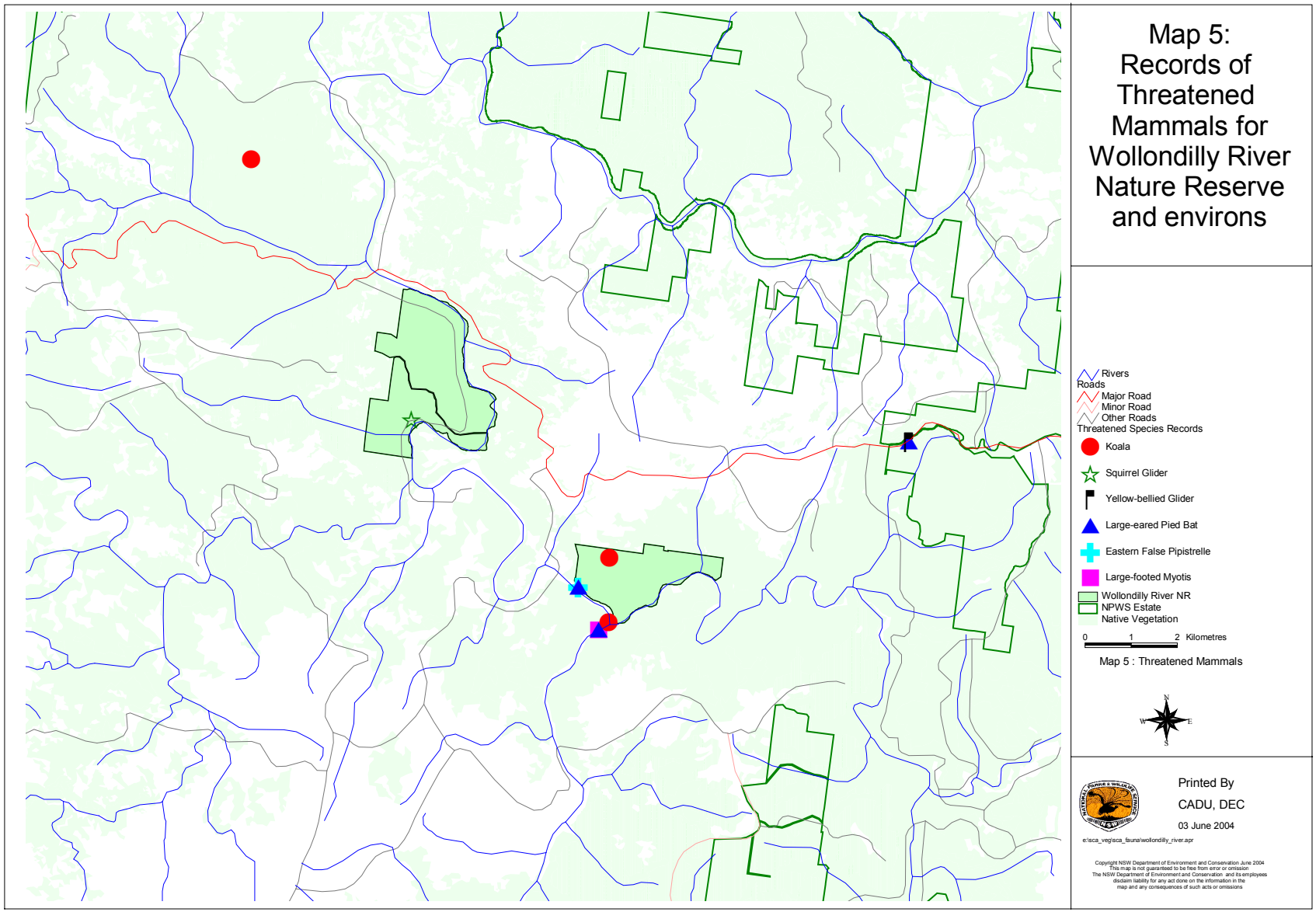
Threats

NPWS (2003d) summarises the threats to the Koala as follows: destruction of habitat by clearing for urban development, agriculture and mining; degradation of habitat through fragmentation and disturbance such as fire or weed invasion; direct mortality from dogs and motor vehicles; death and injury and the reduction of feeding habitat caused by fire, and infection by *Chlamydia* which causes keratoconjunctivitis (an infection of the eyes) and infertility. The latter appears to occur naturally in Koalas in NSW, and symptoms are displayed when animals are stressed (NPWS 2003d). In Victoria, populations that have been transferred from Phillip Island appear to have lost their immunity and rates can be high, but it does not appear to be a major threat (Menkhorst 1995). Throughout its entire range, loss, fragmentation and degradation of habitat is its greatest threat (NPWS 2003d). Reed *et al*. (1990) reported on a survey in 1986-87 that found that the Koala had disappeared from 50 to 75 percent of its known range in NSW and populations had been lost from many localities, particularly on the southern and western edges of their distribution.

Local and Regional Conservation Status

The Koala is listed as Vulnerable on the NSW TSC Act (1995). Numerous records occur in the north east quarter of the state and also along the southern coast and ranges. Further west, the records appear more sporadic. Records appear throughout the South Eastern Highlands Bioregion, with greater densities in the east. There are a number of records within Bungonia State Conservation Area and Morton National Park within the Bioregion, and other scattered reserves including South East Forest National Park and Freemantle Nature Reserve (DEC 2004a). The recent discovery of a colony in Nattai National Park (DEC 2004b) shows the value of systematic survey in detecting this species, and suggests that other populations may remain undiscovered in the area.

Individual Koalas were recorded on two consecutive nights during surveys of the eastern portion. The first was spotlit near the northern boundary, while the second was heard near the junction of the Wollondilly and Wingecarribee Rivers. It is extremely unlikely that these sightings were of the same individual due to the large distance (approximately 1.5 kilometres) one individual would have had to move in one night. Another had been heard calling near Lord's Mountains (to the north west of the reserve) during vegetation surveys. These records are included in Map 5. These records confirm the anecdotal records from landholders within the Burragorang Valley and Tallygang Mountain areas. Koalas probably occur at low abundance throughout the Southern Highlands particularly in areas where favoured food trees like Forest Red Gum (*Eucalyptus tereticornis*) and Grey Gum (*E. punctata*) are present.


Map 5:
Records of Threatened Mammals for Wollondilly River Nature Reserve and environs
Rivers
Roads
Major Road
Minor Road
Other Roads
Threatened Species Records
Koala
Squirrel Glider
Yellow-bellied Glider
Large-eared Pied Bat
Eastern False Pipistrelle
Large-footed Myotis
Wollondilly River NR
NPWS Estate
Native Vegetation
0 1 2 Kilometres
Map 5 : Threatened Mammals
N
W
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CADU, DEC
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SQUIRREL GLIDER

Species Profile


©DEC

The Squirrel Glider (*Petaurus norfolcensis*) is a nocturnal mammal that inhabits dry sclerophyll forests and woodlands and builds leaf-lined nests in tree hollows. It is very similar in appearance to the smaller and more common Sugar Glider (*Petaurus breviceps*). However, the Squirrel Glider has a longer more pointed face, longer and narrower ears and a bushier tail and also lacks the persistent yapping call of the smaller species. It has a varied diet, including insects, nectar, pollen, seeds, *Acacia* gum and sap from Eucalypts (Suckling 1995). Usually occurs in family groups of up to ten, consisting of one male, one or more females and their dependant young. Home ranges are thought to vary between 0.65 and 8.55 hectares, depending on habitat quality, and individuals have been known to move up to 500 metres in one night. It is sparsely distributed along the east coast and inland slopes of between north Queensland and Victoria (NPWS 1999b).

Threats

NPWS (1999b) lists the following threats to the Squirrel Glider. They are known to be greatly affected by the loss of nesting resources when the availability of hollow bearing trees are lost through clearing, fragmentation or timber extraction. Predation by cats and foxes are also thought to contribute to the species vulnerability. Impacts of fire regimes are poorly understood although the availability of food resources may be reduced or lost after fire.

Local and Regional Conservation Status

The Squirrel Glider is listed as a vulnerable species on the NSW TSC Act (1995). The records within the Atlas of NSW Wildlife are scattered along the coast and west of the Divide, with the greatest concentration of records in the Sydney Basin and NSW North Coast Bioregions. Within the South Eastern Highlands it is restricted mainly to the extreme north east and the far south west near the Victorian border. Records are also from a few reserves scattered throughout the Bioregion, including Turon and Woomargama National Parks and Winburndale Nature Reserve (DEC 2004a).

In Wollondilly River Nature Reserve one individual has been spotted to the west of “Bowmans Hill” Hut in 2002. This record is shown on Map 5. No other records exist for the surrounding areas. None were recorded during these surveys and even Sugar Gliders were found to be at low densities in the area. Even within the Warragamba Special Area the Squirrel Glider has been found at only a few isolated locations (DEC 2004b). As this species prefers grassy woodlands, it is possible that the Squirrel Glider occurs at extremely low densities in the Devonian Red Gum-Box Woodlands of the Wollondilly River area, particularly where *Acacia* species are at suitable densities to provide gum when nectar is unavailable.

BRUSH-TAILED ROCK-WALLABY

Species Profile

©E. Holland/DEC

The Brush-tailed Rock-wallaby (*Petrogale penicillata*) is a medium sized macropod, characterised by its distinctive facial markings, black paws and high levels of agility (NSW Scientific Committee 2003). The tail is often used to aid identification, being long and thickly furred with a distinctive brush-like appearance near its tip (NPWS 2002). Habitats occupied by this species tend to take one of three forms: loose piles of large boulders containing a maze of subterranean holes and passageways; cliffs (usually over fifteen metres high with many mid level ledges covered by overhangs; or isolated rock stacks, usually sheer sided and often girdled with fallen boulders (NPWS 2002). Vegetation forms a vital component of the habitat, especially as refugia near major rock outcrops. The species typically exhibits low migration rates between colonies, impeding persistence and recovery of populations affected by threatening processes. Its range formerly extended between south east Queensland to the Victoria, but is was thought to be extinct in the latter state until small populations were rediscovered in the Grampians and near the Snowy River (Eldridge and Close 1995)

Threats

Historical decline of the Brush-tailed Rock-wallaby is attributed to three factors: hunting for bounty and fur; predation by introduced predators; and competition with introduced herbivores (feral Goat (*Capra hircus*), Rabbit (*Oryctolagus cuniculus*) and stock) (NSW Scientific Committee 2003). The major threats continuing to impact on the species include ongoing predation and competition with feral species such as Fox (*Vulpes vulpes*) and wild Dogs (*Canis lupus familiaris*), habitat modification by fire, vegetation clearing, disease transmission (toxoplasmosis and hydatosis) by feral carnivores (NSW Scientific Committee 2003) and inbreeding (Environment ACT 1999).

Local and Regional Conservation Status

Brush-tailed Rock-wallabies are listed as endangered on the NSW TSC Act (1995) and as Vulnerable on the Commonwealth EPBC Act (1999). The Rock-wallabies were probably once widespread in the South Eastern Highlands, but are now restricted to the north eastern boundary. Known locations within the South Eastern Highlands and Sydney Basin Bioregions include Kangaroo Valley, Broke in the Hunter Valley and Morton National Park with an introduced population at Jenolan Caves (DEC 2004a). Recently, during DEC fauna surveys, a colony of Brush-tailed Rock-wallabies was discovered further downstream along the Wollondilly River within Nattai National Park, contributing significantly to the conservation and management of the species (DEC 2004b). These locations fall within the most fragile metapopulation of Brush-tailed Rock-wallabies in NSW, and consequently are all of very high conservation significance (NSW Scientific Committee 2003c).

The Brush-tailed Rock-wallaby has not been recorded within the study area. This endangered species was formerly known from around Wombeyan Caves, though the last known individual from this population was captured and taken to Jenolan Caves in 1995 (R. Humphries pers. comm.). Anecdotal records from this area persist in the vicinity of Guineacor Creek and Top of the World, though these have not been confirmed (D. Ashton pers. comm.). Recent searches on the steep slopes above Russell and Rac-a-rock Glens on the Wombeyan Caves Road have discovered old scats and suitable habitat, but no animals were sighted (R. Pedroza pers. comm).

The discovery of the Nattai population indicates that this species can often be difficult to detect and may still remain in areas of suitable habitat. Targeted surveys, particularly along the steep slopes below Tallygang Mountain, are required to determine whether Brush-tailed Rock-wallabies do still occur within the study area. Reduction in goat numbers may also increase the chances of any populations of increasing, by reducing competition for food. Given the conservation significance of this species, any sites discovered should have management and monitoring undertaken in close consultation with the Statewide recovery plan for the species.

LARGE-EARED PIED BAT

Species Profile

©Narawan Williams

The Large-eared Pied Bat (*Chalinolobus dwyeri*) is readily recognisable from other members of its genus by the combination of large ears and overall black colour, with bands of white fur along the sides of the body, that join to form a V-shape (Parnaby 1992b, Churchill 1998). The call is an alternate pattern made at a low frequency, which is readily distinguishable from all other species (Reinhold *et al.* 2001). Originally described from Copeton in 1966, it has been recorded from a number of scattered locations on either side of the Great Dividing Range between Rockhampton (Queensland) and Bungonia (New South Wales) (Hoye and Dwyer 1995). It has been found in a wide range of habitats, including wet and dry eucalypt forest, Cypress (*Callitris*) forest and sub-alpine woodland (Duncan *et al.* 1999). It is a cave-roosting species, though it has also been detected roosting in disused mine shafts, overhangs and once in an abandoned Fairy Martin (*Petrochelidon ariel*) nest (Churchill 1998). It seems to prefer the 'twilight' areas of caves, and may be dependent on sandstone outcrops (Duncan *et al.* 1999, Hoye and Dwyer 1995).

Threats

The only confirmed threat to this species is the destruction or interference of roost sites. Other potential threats include mining induced subsidence (particularly coal-mining in sandstone areas) which may destroy roost sites, habitat destruction for agriculture and urban development, and predation by feral animals (Duncan *et al.* 1999).

Local and Regional Conservation Status

The Large-eared Pied Bat is listed as Vulnerable on the NSW TSC Act (1995) and also as Vulnerable on the Commonwealth EPBC Act (1999). The Sydney Basin appears to support a significant proportion of the Large-eared Pied Bat population in NSW, with scattered records occurring in the Bioregions to the north and west. Within the South Eastern Highlands Bioregion, the species is restricted to the north and east, with Jenolan Karst Conservation Reserve and Kanangra-Boyd National Park forming the western boundary of the species' known distribution. Most records from NPWS estate in this Bioregion are from reserves that straddle the boundary with Sydney Basin, including Blue Mountains, Gardens of Stone and Morton National Parks (DEC 2004a).

The Large-eared Pied Bat has been recorded at three locations surrounding Wollondilly River Nature Reserve all derived from Anabat call analysis (Map 5). It appears, based on existing records, that Wollondilly River Nature Reserve is at the western limit of the species' distribution. Definite calls were identified south of the Wollondilly River and at Joadja Nature Reserve (Mills 2002), while another call was recorded at another location south of the eastern portion of the reserve, though the identification was only to the level of probable. It was more widely recorded in the Warragamba Special Area, which has many more typical sandstone habitats (DEC in prep.). Roosting may occur within the vicinity of the reserve as it is unknown how far this species travels while foraging. Rock overhangs in the area may be worth investigating, and undertaking further bat survey may gather further knowledge on the distribution of this species.

EASTERN FALSE PIPISTRELLE

Species Profile

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) is a relatively large (up to 70 millimetres) bat that is similar to the Greater Broad-nosed Bat (*Scoteanax rueppellii*), though it has two pairs of upper incisors, a gap between the incisors and the canines, and larger ears (Parnaby 1992b, Churchill 1998). Its calls can be confused with various species of *Scotorepens* and the Greater Broad-nosed Bat, though good quality calls can be separated using ultrasound analysis (Reinhold *et al.* 2001). It is found in small numbers throughout its range in south eastern Australia, between south east Queensland and western Victoria, and Tasmania. It seems to prefer wet habitats, particularly riparian or high rainfall areas, with large trees (greater than 20 metres) (Menkhorst and Lumsden 1995). It may be more common at high elevations (Phillips 1995), though it has been recorded between sea level and 1500 metres in Victoria (Menkhorst and Lumsden 1995). It usually roosts in hollows in *Eucalyptus*, though it has been recorded in caves (Churchill 1998). It may hibernate over winter and has been known to travel at least twelve kilometres from its roost site (Churchill 1998).

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Threats

The main threat would appear to be destruction of roosting sites, through land clearance and logging (Gilmore and Parnaby 1994).

Local and Regional Conservation Status

The Eastern False Pipistrelle is listed as Vulnerable on the NSW TSC Act (1995). Records for the species are scattered across both the Sydney Basin and South East Highlands Bioregion. Within the latter Bioregion it is known from quite a few reserves including Gardens of Stone, Blue Mountains, Abercrombie River, Tallaganda and Woomargama National Parks (DEC 2004a).

This species was only identified from call analysis, using Anabat at a site to the south of the eastern portion of Wollondilly River Nature Reserve. This location is indicated on Map 5. Unfortunately, it could only be identified to the level of probable. However, given its wide distribution within the South Eastern Highlands Bioregion it is highly likely that further survey work, particularly in the moister habitats, would detect this species as occurring within the reserve.

LARGE-FOOTED MYOTIS

Species Profile

©Ray Williams

The Large-footed Myotis (*Myotis adversus*) is another bat species for which the taxonomy is currently undergoing review. The Australian specimens are now considered to consist of two or three species. The southern species (*M. macropus*) is recorded coastally and along the Murray River from south eastern South Australia to south east Queensland. However, the northern limit of this species and the area of overlap with *M. moluccarum* are poorly known (Duncan *et al.* 1999, Churchill 1998). Even though it can be recorded from up to 20 metres using Anabat, it can be difficult to identify from *Nyctophilus* species (Reinhold *et al.* 2001). It is easily distinguished from other species by its disproportionately large feet, which it uses to rake its prey of insects and small fish from the surface of water (Churchill 1998). It occurs in a wide variety of habitats as long as water is nearby. It normally roosts in caves, though will also use tree hollows, vegetation, and man-made structures, such as bridges and mines (Churchill 1998).

Threats

The threats to this species are poorly known, but it is probably most sensitive to changes in water quality. These may be sedimentation (from vegetation clearing and logging), eutrophication (sewage and fertiliser run-off), pollution and altered flow regimes (Duncan *et al.* 1999). Roosting sites may be susceptible to disturbance by such activities as recreational caving or roadworks (Duncan *et al.* 1999, Gilmore and Parnaby 1994).

Local and Regional Conservation Status

The Large-footed Myotis is listed as Vulnerable on the NSW TSC Act (1995). This species is most likely to be recorded within the three coastal Bioregions within NSW, though there are scattered records on and west of the Divide. Within the South Eastern Highlands Bioregion it has only been recorded at a few locations. This may indicate that this species is difficult to detect, because at some known roosting sites within the Bioregion, such as the caves at Wee Jasper, it appears to be reasonably common. Reserves with records are also few, but they include Blue Mountains and Tarlo River National Parks and Wee Jasper Nature Reserve (DEC 2004a).

This species was detected using Anabat at one location, to the south of the eastern portion of Wollondilly River Nature Reserve (Map 5). This record was confirmed as a definite recording of this species. As this species is usually only caught in traps placed immediately over water this species can be difficult to catch in harp traps (N. Williams pers. comm.). Further survey work would probably show that this species utilises the Wollondilly River as a feeding site quite regularly, though it would be difficult to confirm whether any roosting sites are in the reserve.

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APPENDIX A

Systematic Site Details Wollondilly River Nature Reserve and environs

The first table lists the Site Number, Description, AMGs for each site within Wollondilly River NR used in this report ([J] Indicates the site is within Joadja NR, and [N] indicates Nattai NP). The Vegetation Community is from NPWS (2003c). The final columns indicate the number of census of each technique that were undertaken at the site.

Site Number	Location Description	Zone	Easting	Northing	Vegetation Community	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Elliott trapping
BRR08O [N]	Wanganderry - bottom of scarp approx 1km west of Burragorang lookout(WRG-23)	56	241476	6193614	Devonian Red Gum-Yellow Box Woodland	1	1	1		1		
BRR23O	Wollondilly – approx 10m north of marked walking trail. Approx. 100m from end of road (HFP07)	56	235085	6192584	Tablelands River Oak Forest	1	1	1			1	
BRR25W	Wollondilly – on track to Horses Flat approx. 1.5km N of Horses Flat Hut. At gully crossing (HFP09)	56	232076	6197796	Cleared-Modified Land	1	1	1			1	
BRR28W	Wollondilly – on track running west from Horse Flat. At border of SCA land (HFP12)	56	230970	6195746	Devonian Red Gum-Yellow Box Woodland	1					1	
BRR29W	Wollondilly – on track approx 500m W of Horse Flat hut at bend in track where gully crosses (HFP13)	56	231706	6196547	Devonian Red Gum-Yellow Box Woodland	1	1	2				
BRR34W	Wollondilly NR- on east side of gully approximately 700m south-east of end of road on Tea House land (WNR01)	56	235299	6193515	Highlands Slopes Grey Gum-Stringybark Forest	1	1	1		1	1	
BRR35W	Wollondilly NR- on northern slope of gully line approximately 800m north-east of junction of Wollondilly and Wingecarribee rivers (WNR02)	56	236127	6193611	Highlands Slopes Grey Gum-Stringybark Forest	1	1					
BRR40W	Wollondilly NR- junction with Wollondilly river and Nature reserve (NBA16)	56	235330	6192561	Devonian Red Gum-Yellow Box Woodland					1		
BRR66O	Wollondilly River NR- On Wollondilly river approximately 1km south-east of Goodman Ford (BRRPE01)	56	231617	6199074	Tablelands River Oak Forest	1	1	1				
BRR67O	Wollondilly River NR- west area on midslope south of Mt Hickson summit approximately 800m (Hickson 2)	56	231047	6197469	Devonian Red Gum-Yellow Box Woodland		1					
BRR68W	Wollondilly River NR west- approximately 500m north-west of summit of Mt Hickson (Hickson1)	56	230567	6198377	Devonian Red Gum-Yellow Box Woodland		1					
BRR69O	Wollondilly River NR- steep gully 1.2km east of camp ground (Hell Gully)	56	236646	6193526	Devonian Red Gum-Yellow Box Woodland	1						
BRR96O	Barrallier- Past Horse Flat along Bowmans Hill firetrail southwest end of reserve across dry creekline (BarrHT4)	56	230823	6196230	Devonian Red Gum-Yellow Box Woodland				1			
BRR97W	Wollondilly River NR- South end of Horse Flat Bowmans Hill (BarrHT5)	56	232584	6196289	Devonian Red Gum-Yellow Box Woodland				1			

Site Number	Location Description	Zone	Easting	Northing	Vegetation Community	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Elliott trapping
HNW01O	Wollondilly River NR- Wingecaribee river 800m upstream from junction with Wollondilly river (WNR04)	56	236096	6192496	Tablelands River Oak Forest	1						
KMDJ03 [J]	Joadja NR- just south off Wombeyan Caves road west of Burragorang Lookout	56	241766	6196025	Highlands Gorge River Peppermint Forest	2	1	1		1	2	1

The second table lists the Site Number for sites on private land surrounding Wollondilly River NR used in this report (Other details are confidential). The Vegetation Community is from NPWS (2003c). * indicates that the site is outside the mapped vegetation, but the vegetation at the site was equivalent to this community. The final columns indicate the number of census of each technique that were undertaken at the site.

Site Number	Vegetation Community	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Elliott trap
BRR17W	Tablelands River Oak Forest						1	
BRR18W	Cleared-Modified Land						1	
BRR19W	Tablelands River Oak Forest			1				
BRR20O	Devonian Red Gum-Grey Box Woodland	1					1	
BRR21W	Devonian Red Gum-Yellow Box Woodland							
BRR22W	Devonian Red Gum-Yellow Box Woodland	1		1				
BRR24W	Cleared-Modified Land						1	
BRR39O	Water Bodies					1		
BRR45W	Cleared-Modified Land	1		1				
BRR48W	Cleared-Modified Land	1	1	1		1		
BRR60W	Cleared-Modified Land				1			
BRR63O	Sheltered Porphyry Forest	1						
BRR65W	Devonian Red Gum-Grey Box Woodland	1						
BRR70G	Cleared-Modified Land	1						
BRR71O	Highlands Slopes Grey Gum-Stringybark Forest	1	1					
BRR72O	Montane Exposed Silvertop Ash	1	1	1				
BRR73W	Devonian Red Gum-Yellow Box Woodland	1	1					
BRR74W	Devonian Red Gum-Yellow Box Woodland	1						
BRR75O	Highlands Slopes Grey Gum-Stringybark Forest	1	1	1				
BRR76O	Sheltered Porphyry Forest	1	1	1	1			
BRR77O	Sheltered Porphyry Forest	1	1	1				
BRR78W	Devonian Red Gum-Yellow Box Woodland	1	1					
BRR80W	Cleared-Modified Land				1			
BRR81W	Highlands Slopes Grey Gum-Stringybark Forest				1			
BRR82W	Montane Exposed Silvertop Ash				1			
BRR89W	Devonian Red Gum-Yellow Box Woodland		1	1				
BRR90W	Devonian Red Gum-Yellow Box Woodland		1	1				
HNW02W	Tablelands River Oak Forest*					1		
KMJD03	Highlands Gorge River Peppermint Forest	2	1	1		1	2	1

APPENDIX B

Fauna Species of Wollondilly River Nature Reserve and environs

The following is a complete species list for Wollondilly River Nature Reserve and for the area up to five kilometres from its boundary. Separate fields show data derived from the current survey data and that from other sources that include the DEC Atlas of NSW Wildlife and data licensed from Birds Australia. Introduced species are indicated by an asterisk*.

Family Name	Scientific Name	Common Name	Conservation Status	Within Nature Reserve		Outside, but within 5 km, of Nature Reserve	
				Current Survey	Other Sources	Current Survey	Other Sources
Frogs							
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P	2	0	4	0
Myobatrachidae	*Limnodynastes dumerilii*	Bullfrog	P	1	0	2	0
Myobatrachidae	*Limnodynastes tasmaniensis*	Spotted Marsh Frog	P	0	0	1	0
Hylidae	*Litoria dentata*	Keferstein's Tree Frog	P	0	0	2	0
Hylidae	*Litoria lesueuri*	Lesueur's Frog	P	3	0	2	2
Hylidae	*Litoria peronii*	Peron's Tree Frog	P	2	0	3	0
Reptiles							
Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle	P	2	0	4	0
Agamidae	*Amphibolurus muricatus*	Jacky Lashtail	P	1	0	20	0
Agamidae	*Physignathus lesueurii*	Eastern Water Dragon	P	2	0	6	0
Varanidae	*Varanus varius*	Lace Monitor	P	2	0	6	0
Scincidae	*Bassiana platynota*	Red-throated Cool-skink	P	0	0	2	0
Scincidae	*Cryptoblepharus virgatus*	Cream-striped Shinning-skink	P	2	0	4	0
Scincidae	*Ctenotus robustus*	Robust Ctenotus	P	1	0	2	0
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Ctenotus	P	1	0	4	0
Scincidae	*Egernia cunninghami*	Cunningham's Spiny-tailed Skink	P	0	0	1	0
Scincidae	*Eulamprus quoyii*	Eastern Water-skink	P	11	0	3	0
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P	7	0	4	1
Scincidae	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink	P	0	0	0	1
Scincidae	*Lygisaurus foliorum*	Tree-base Litter-skink	P	0	0	4	0
Scincidae	*Saproscincus mustelinus*	Weasel Shadeskink	P	0	0	1	0
Scincidae	*Tiliqua scincoides*	Common Bluetongue	P	0	0	1	0
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	P	3	0	0	0
Birds							
Phasianidae	*Coturnix ypsilophora*	Brown Quail	P	0	0	1	0
Anatidae	*Anas superciliosa*	Pacific Black Duck	P	3	1	3	3
Anatidae	*Chenonetta jubata*	Australian Wood Duck	P	4	1	5	1
Anatidae	*Cygnus atratus*	Black Swan	P	4	0	3	3
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe	P	0	0	0	1
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	P	0	0	1	0
Anhingidae	*Anhinga melanogaster*	Darter	P	0	0	0	2
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	P	1	0	0	1
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant	P	2	0	1	2
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant	P	0	1	0	4
Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant	P	0	1	0	1

Family Name	Scientific Name	Common Name	Conservation Status	Within Nature Reserve		Outside, but within 5 km, of Nature Reserve	
				Current Survey	Other Sources	Current Survey	Other Sources
Ardeidae	*Ardea pacifica*	White-necked Heron	P	0	0	1	0
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P	0	1	2	4
Ardeidae	*Nycticorax caledonicus*	Nankeen Night Heron	P	0	0	1	0
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	P	1	0	0	1
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	P	2	0	0	0
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	P	2	1	3	3
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-eagle	P	1	0	0	2
Falconidae	*Falco berigora*	Brown Falcon	P	0	0	0	1
Falconidae	*Falco cenchroides*	Nankeen Kestrel	P	0	0	2	0
Falconidae	*Falco peregrinus*	Peregrine Falcon	P	0	0	1	0
Rallidae	*Fulica atra*	Eurasian Coot	P	0	0	2	2
Rallidae	*Gallinula tenebrosa*	Dusky Moorhen	P	2	1	2	2
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	P	1	1	1	0
Charadriidae	*Vanellus miles*	Masked Lapwing	P	0	0	4	0
Columbidae	*Geopelia placida*	Peaceful Dove	P	3	0	1	5
Columbidae	*Leucosarcia melanoleuca*	Wonga Pigeon	P	6	0	10	1
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	P	1	0	2	2
Columbidae	*Phaps chalcoptera*	Common Bronzewing	P	2	0	2	1
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	P	0	0	3	5
Cacatuidae	*Callocephalon fimbriatum*	Gang-gang Cockatoo	P	2	0	2	5
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-cockatoo	V	9	0	13	4
Cacatuidae	*Eolophus roseicapillus*	Galah	P	0	0	0	4
Psittacidae	*Alisterus scapularis*	Australian King-parrot	P	1	1	6	5
Psittacidae	*Neophema pulchella*	Turquoise Parrot	V	0	0	0	1
Psittacidae	*Platycercus adscitus eximius*	Eastern Rosella	P	4	1	1	8
Psittacidae	*Platycercus elegans*	Crimson Rosella	P	7	2	16	16
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P	4	1	2	10
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	P	0	0	2	1
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-cuckoo	P	0	0	0	1
Cuculidae	*Chalcites lucidus*	Shining Bronze-cuckoo	P	0	0	3	0
Cuculidae	*Cuculus pallidus*	Pallid Cuckoo	P	0	1	0	0
Cuculidae	*Eudynamys orientalis*	Pacific Koel	P	0	0	0	1
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo	P	2	0	0	1
Strigidae	*Ninox boobook*	Southern Boobook	P	3	0	2	0
Strigidae	*Ninox strenua*	Powerful Owl	V	0	0	1	0
Tytonidae	*Tyto novaehollandiae*	Masked Owl	V	0	0	1	0
Podargidae	*Podargus strigoides*	Tawny Frogmouth	P	2	1	4	0
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	P	1	0	1	0
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	P	8	0	6	0
Alcedinidae	*Alcedo azurea*	Azure Kingfisher	P	0	0	1	1
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	P	5	4	11	10
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	P	2	0	2	3
Meropidae	*Merops ornatus*	Rainbow Bee-eater	P	2	1	1	4
Coraciidae	*Eurystomus orientalis*	Dollarbird	P	6	0	0	4
Menuridae	*Menura novaehollandiae*	Superb Lyrebird	P	2	0	16	0
Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subsp.)	V	1	0	0	3
Climacteridae	*Cormobates leucophaeus*	White-throated Treecreeper	P	14	1	16	2
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P	11	2	11	8

Family Name	Scientific Name	Common Name	Conservation Status	Within Nature Reserve		Outside, but within 5 km, of Nature Reserve	
				Current Survey	Other Sources	Current Survey	Other Sources
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P	4	1	11	2
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	P	0	1	1	1
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill	P	2	0	2	10
Acanthizidae	*Acanthiza lineata*	Striated Thornbill	P	5	0	10	2
Acanthizidae	*Acanthiza nana*	Yellow Thornbill	P	4	0	4	2
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P	10	2	9	4
Acanthizidae	*Acanthiza reguloides*	Buff-rumped Thornbill	P	7	0	6	0
Acanthizidae	*Aphelocephala leucopsis*	Southern Whiteface	P	0	1	0	0
Acanthizidae	*Calamanthus pyrrhopygius*	Chestnut-rumped Heathwren	P	0	0	1	0
Acanthizidae	*Gerygone mouki*	Brown Gerygone	P	1	0	2	2
Acanthizidae	*Gerygone olivacea*	White-throated Gerygone	P	2	0	0	3
Acanthizidae	*Origma solitaria*	Rockwarbler	P	1	0	2	0
Acanthizidae	*Pyrrholaemus sagittatus*	Speckled Warbler	V	0	0	1	1
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P	6	2	7	5
Acanthizidae	*Smicrornis brevirostris*	Weebill	P	2	0	0	1
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P	6	2	6	8
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P	4	1	9	2
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P	10	2	15	12
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater	P	0	0	6	2
Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater	P	0	1	0	3
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P	5	0	0	0
Meliphagidae	*Manorina melanophrys*	Bell Miner	P	0	0	0	1
Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater	P	1	0	3	1
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	P	3	0	1	2
Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater	P	0	0	0	1
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	P	20	2	16	9
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P	1	1	1	7
Meliphagidae	*Xanthomyza phrygia*	Regent Honeyeater	E1	0	0	0	5
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P	6	3	5	5
Petroicidae	*Melanodryas cucullata cucullata*	Hooded Robin (south-eastern subsp.)	V	2	0	0	3
Petroicidae	*Microeca fascinans*	Jacky Winter	P	3	0	1	3
Petroicidae	*Petroica boodang*	Scarlet Robin	P	0	0	2	7
Eupetidae	*Cinclosoma punctatum*	Spotted Quail-thrush	P	0	0	7	0
Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	P	0	0	4	2
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	P	3	1	3	1
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P	13	2	17	7
Pachycephalidae	*Falcunculus frontatus*	Eastern Shrike-tit	P	0	0	2	0
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P	4	0	9	3
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P	10	2	8	8
Dicruridae	*Dicrurus bracteatus*	Spangled Drongo	P	0	1	0	0
Dicruridae	*Grallina cyanoleuca*	Magpie-lark	P	0	1	1	8
Dicruridae	*Myiagra inquieta*	Restless Flycatcher	P	2	0	0	7
Dicruridae	*Myiagra rubecula*	Leaden Flycatcher	P	4	0	5	0
Dicruridae	*Rhipidura albiscapa*	Grey Fantail	P	8	2	13	9
Dicruridae	*Rhipidura leucophrys*	Willie Wagtail	P	2	1	3	12
Dicruridae	*Rhipidura rufifrons*	Rufous Fantail	P	0	0	0	1
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P	5	1	2	8
Campephagidae	*Coracina tenuirostris*	Cicadabird	P	4	0	5	0

Family Name	Scientific Name	Common Name	Conservation Status	Within Nature Reserve		Outside, but within 5 km, of Nature Reserve	
				Current Survey	Other Sources	Current Survey	Other Sources
Campephagidae	*Lalage tricolor*	White-winged Triller	P	1	0	0	1
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	P	5	1	3	4
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	P	3	1	3	7
Artamidae	*Artamus superciliosus*	White-browed Woodswallow	P	0	0	1	0
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P	4	1	10	3
Artamidae	*Gymnorhina tibicen*	Australian Magpie	P	6	0	14	10
Artamidae	*Strepera graculina*	Pied Currawong	P	8	1	10	7
Artamidae	*Strepera versicolor*	Grey Currawong	P	0	0	1	0
Corvidae	*Corvus coronoides*	Australian Raven	P	6	2	5	5
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough	P	4	0	5	2
Ptilonorhynchidae	*Ptilonorhynchus violaceus*	Satin Bowerbird	P	3	1	1	6
Motacillidae	*Anthus australis*	Australian Pipit	P	4	1	1	3
Passeridae	*Passer domesticus*	House Sparrow*	U	0	0	0	2
Fringillidae	*Carduelis carduelis*	European Goldfinch*	U	0	0	0	3
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P	7	1	7	3
Estrildidae	*Stagonopleura bella*	Beautiful Firetail	P	0	0	0	1
Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V	3	0	1	4
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	P	8	2	4	5
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P	3	1	0	18
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	P	0	0	0	3
Sylviidae	*Acrocephalus australis*	Australian Reed-warbler	P	0	0	1	1
Sylviidae	*Cincloramphus cruralis*	Brown Songlark	P	0	0	1	2
Sylviidae	*Cincloramphus mathewsi*	Rufous Songlark	P	0	0	2	2
Zosteropidae	*Zosterops lateralis*	Silvereye	P	5	2	6	5
Muscicapidae	*Turdus merula*	Eurasian Blackbird*	U	0	0	0	1
Sturnidae	*Acridotheres tristis*	Common Myna*	U	0	0	1	4
Sturnidae	*Sturnus vulgaris*	Common Starling*	U	1	0	3	10
Mammals							
Ornithorhynchidae	*Ornithorhynchus anatinus*	Platypus	P	1	0	1	0
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P	1	0	2	0
Dasyuridae	*Antechinus* sp.	Unidentified Antechinus	P	0	0	3	0
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	1	0	2	0
Vombatidae	*Vombatus ursinus*	Common Wombat	P	11	0	11	0
Petauridae	*Petaurus australis*	Yellow-bellied Glider	V	0	0	3	0
Petauridae	*Petaurus breviceps*	Sugar Glider	P	0	0	1	0
Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V	0	1	0	0
Pseudocheiridae	*Petauroides volans*	Greater Glider	P	0	0	2	0
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P	0	0	3	0
Phalangeridae	*Trichosurus* sp.	brushtail possum	P	0	0	1	0
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	P	4	0	4	0
Macropodidae	Macropod sp.	unidentified macropod	P	1	0	6	0
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	P	21	1	11	0
Macropodidae	*Macropus robustus*	Common Wallaroo	P	11	0	8	0
Macropodidae	*Macropus rufogriseus*	Red-necked Wallaby	P	0	0	2	0
Macropodidae	*Wallabia bicolor*	Swamp Wallaby	P	9	1	8	0
Rhinolophidae	*Rhinolophus megaphyllus*	Eastern Horseshoe-bat	P	1	0	2	0
Molossidae	*Mormopterus planiceps*	Little Mastiff-bat	P	0	0	2	0

Family Name	Scientific Name	Common Name	Conservation Status	Within Nature Reserve		Outside, but within 5 km, of Nature Reserve	
				Current Survey	Other Sources	Current Survey	Other Sources
Molossidae	*Mormopterus* sp 1	undescribed mastiff-bat	P	0	0	3	0
Molossidae	*Nyctinomus australis*	White-striped Freetail-bat	P	5	0	11	0
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	0	0	3	0
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	P	2	0	3	0
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	P	2	0	12	0
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V	0	0	1	0
Vespertilionidae	*Myotis adversus*	Large-footed Myotis	V	0	0	1	0
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	P	2	0	2	0
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat	P	2	0	1	0
Vespertilionidae	*Nyctophilus* sp.	long-eared bat	P	1	0	2	0
Vespertilionidae	*Scotorepens orion*	Eastern Broad-nosed Bat	P	0	0	1	0
Vespertilionidae	*Vespadelus darlingtoni*	Large Forest Bat	P	2	0	4	0
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	P	3	0	3	0
Vespertilionidae	*Vespadelus* sp.	Unidentified Eptesicus	P	1	0	3	0
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	P	18	0	16	0
Muridae	*Mus musculus*	House Mouse*	U	0	0	1	0
Leporidae	*Oryctolagus cuniculus*	Rabbit*	U	6	0	5	0
Canidae	*Canis lupus*	Dingo, domestic dog	U	1	0	0	0
Canidae	*Vulpes vulpes*	Fox*	U	5	1	4	0
Felidae	*Felis catus*	Cat*	U	1	0	0	0
Equidae	*Equus caballus*	Horse*	U	0	0	1	0
Suidae	*Sus scrofa*	Pig*	U	9	1	3	0
Bovidae	*Bos taurus*	European cattle*	U	2	0	0	0
Bovidae	*Capra hircus*	Goat*	U	21	1	28	0




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