

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 (cliffines, 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

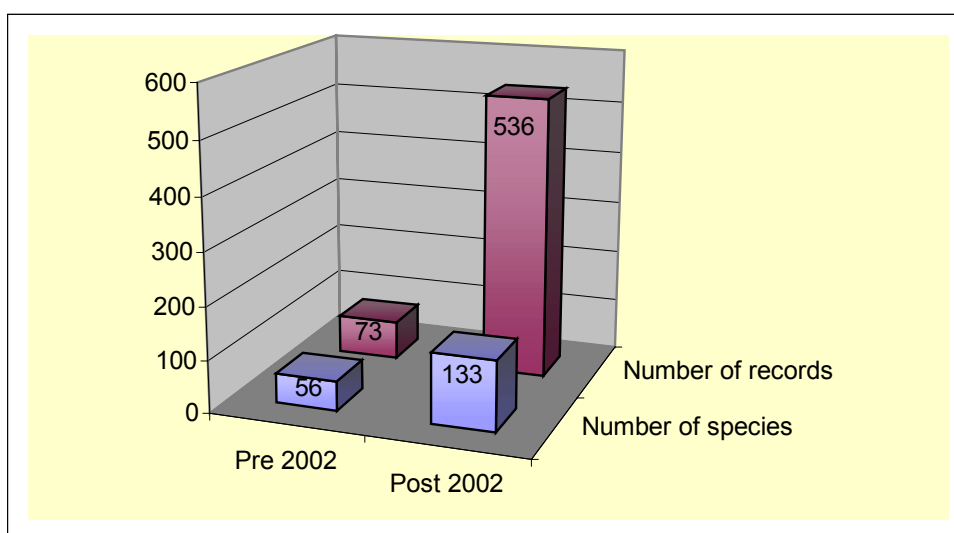
3.1 OVERVIEW

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*).

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.



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

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 spotlighted 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 vulturinus*) 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).

The White-striped Freetail-bat (*Nyctinomus*



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

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
<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe-bat	0	0	1	2#	Definite
<i>Mormopterus planiceps</i>	Little Mastiff-bat	0	0	0	2#	Probable
<i>Mormopterus</i> sp 1	Undescribed Mastiff-bat	0	0	0	3#	Definite
<i>Nyctinomus australis</i>	White-striped Freetail-bat ^o	0	0	2#	3#	Definite
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	0	0	0	3#	Definite
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	0	0	2#	3#	Definite
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	0	7	2#	5#	Definite
<i>Myotis adversus</i>	Large-footed Myotis	0	0	0	1#	Definite
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	2	2	0	0	
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat	2	1	0	0	
<i>Nyctophilus</i> sp.*	Long-eared bat	0	0	1#	2#	Definite
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	0	0	0	1#	Probable
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat	0	0	0	1#	Probable
<i>Vespadelus darlingtoni</i>	Large Forest Bat	0	2	2#	2#	Definite
<i>Vespadelus regulus</i>	Southern Forest Bat	2	2	1#	1	Definite
<i>Vespadelus</i> sp.*	Unidentified Eptesicus	0	0	1#	3#	Definite
<i>Vespadelus vulturinus</i>	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.

^o 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 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 Guineacore 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 than 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 be 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 Wollondilly 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.