The Vertebrate Fauna of North-eastern Wollemi National Park

Project funded under the Central Branch Parks and Wildlife Division
Biodiversity Survey Priorities Program

Information and Assessment Section
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Cover Photos

Front cover
Feature Photo (Narawan Williams)
Mormopterus sp. 3 (Narawan Williams)
Spotted Gum (Elizabeth Magarey)
Nobbi Lashtail (Narawan Williams)
Grey Gum (Daniel Connolly)
Squirrel Glider (Narawan Williams)
Back cover
Red-crowned Toadlet (Dave Hunter)
Woodland in Yengo National Park (Narawan Williams)
Tawny Frogmouth (Narawan Williams)
Escarpment Slopes Woodland in North-east Wollemi National Park (Elizabeth Magarey)

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OVERVIEW

North-eastern Wollemi National Park (the study area) comprises 128 000 hectares of land within the catchment of the Hunter River, representing just under 30 per cent of Wollemi National Park. The area encompasses a section of the southern escarpment of the Hunter Valley, characterised by alluvial flats, steep talus slopes and escarpments with frequent outcropping of sandstone. The Great Dividing Range in the vicinity of the Hunter catchment is of very low relief, facilitating interchange between coastal and western environments. Vegetation ranges from dry woodlands characteristic of the central western slopes in the north, sclerophyllous forests and woodlands typical of hinterland sandstone environments in the south and east, to moist gully systems with north coast botanical influences in the north-east. This diverse range of environments provides a rich assemblage of habitats for fauna.

This report compiles and reviews Atlas of NSW Wildlife data on terrestrial vertebrate fauna and documents the extensive systematic surveys undertaken by the Department of Environment and Conservation during 1997 and during the spring, summer and autumn of 2004-05. A total of 230 systematic survey sites have sampled the birds, frogs, bats, reptiles and arboreal mammals. Terrestrial mammals have been sampled opportunistically, while fish have not been included in this study. The 2004-05 surveys were undertaken to provide a more accurate inventory of fauna across the range of habitats present and enable a more reliable assessment of the importance of the reserve to the protection of threatened species at a local, regional and state level. The report finds that:

- Two-hundred and seventy-eight (277) species of native terrestrial vertebrate fauna are known to inhabit the study area. This is made up of 152 diurnal bird species, nine species of nocturnal birds, ten arboreal mammal species, 22 bats, 14 ground mammals, 49 reptiles and 21 frog species respectively.
- The composition and distribution of fauna species is strongly affected by the convergence of environments and influences within the park. It includes: species endemic to the Sydney Basin such as Rockwarbler and Red-crowned Toadlet; species typical of coastal hinterland environments, such as the Lewin's Honeyeater and Bell Miner; species tied to drier habitats like those found in central western NSW, including the Painted Burrowing Frog, Tree-crevice Skink and Inland Broad-nosed Bat; and species more common on the north coast including Red-eyed Green Tree Frog and Robust Velvet Gecko. A number of animals lie towards the limit of their known range and ecological tolerance within the park.
- North-eastern Wollemi National Park supports habitat for at least 33 fauna species listed as threatened on the NSW Threatened Species Conservation Act (1995). Five of these are widespread and were detected in relatively high numbers: the Glossy Black-cockatoo, Gang-gang Cockatoo, Yellow-bellied Glider, Large-eared Pied Bat and Eastern Bent-wing Bat. Others are also widespread but more patchily distributed, including the Red-crowned Toadlet, Giant Burrowing Frog, Powerful Owl, Masked Owl, Brush-tailed Rock-wallaby, Koala, Grey-headed Flying-fox, Eastern False Pipistrelle, Greater Broad-nosed Bat and Eastern Cave Bat. Three species are rare due to restricted habitat availability: Rosenberg's Goanna, Sooty Owl and East-coast Freetail-bat; while the Eastern Pygmy Possum and Spotted-tailed Quoll were each recorded on very few occasions, probably due to their highly cryptic nature.
- A suite of threatened species are restricted to the fertile, dry grassy Box woodlands on the northern escarpment slopes and valleys, rarely penetrating far into the reserve, including the Black-chinned Honeyeater, Grey-crowned Babbler, Diamond Firetail, Speckled Warbler, Brown Treecreeper, Regent Honeyeater, Hooded Robin, Barking Owl, Squirrel Glider and Greater Long-eared Bat. These environments, located either side of the reserve boundary, also provide foraging habitat for the Swift Parrot and Painted Honeyeater, though these birds have not been recorded within the study area to date.
- Feral animals including Rabbits, Foxes and Wild Dogs are present, with highest densities recorded near the boundaries of the reserve. Foxes and Wild Dogs pose threats to native wildlife through predation.

The report highlights vegetation types found in the vicinity of the northern perimeter of the reserve as being of particular conservation interest, due to the number of threatened species that are concentrated within these environments. This information has important implications for fire management, land acquisition and feral animal and weed control. The report also recognises that management of fauna in the reserve is limited by poor information on the patterns in fire intensity, accuracy of vegetation mapping and the delineation of fauna habitats for threatened species.

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1 INTRODUCTION

1.1 PROJECT AIMS

The Central Branch Parks and Wildlife Division (PWD) of the NSW Department of Environment and Conservation (DEC, formerly NSW National Parks and Wildlife Service (NPWS)) has established a biodiversity survey priorities (BSP) program for DEC managed estate within the Branch. This program recognises that information that documents the range of biodiversity values held within reserves is fundamental to successful reserve management and to generating an improved understanding of the contribution reserves make to the protection of vegetation communities, plant and animal populations and their habitats. Currently there is only sparse and incomplete information that describes the role reserves play in ensuring the viability of fauna species across large regions and local areas.

Typically the largest reserves, which potentially offer a significant contribution to biodiversity conservation, are the most poorly understood and the most deficient in data quality and quantity. The BSP program goes some way towards addressing this information shortfall by surveying the most poorly known reserves first and combining this with larger regional conservation assessment projects.

Currently the Hunter region is the focus of considerable biodiversity assessment and environmental planning investigation. In terms of human population it represents one of the fastest growing regions in the state and extreme pressures are being placed on many of the habitats of the Central Coast and Lower Hunter as a result of urban expansion. Knowledge of the values of the large sandstone reserves that fringe the southern Hunter Valley is fundamental to understanding the conservation priorities for many species in the region. The Hunter Range Area of Wollemi National Park is characterised by low levels of information on its fauna values (NPWS 2003b). Consequently the north-eastern portion of this large reserve was identified as a survey priority. The specific objectives of this project are to:

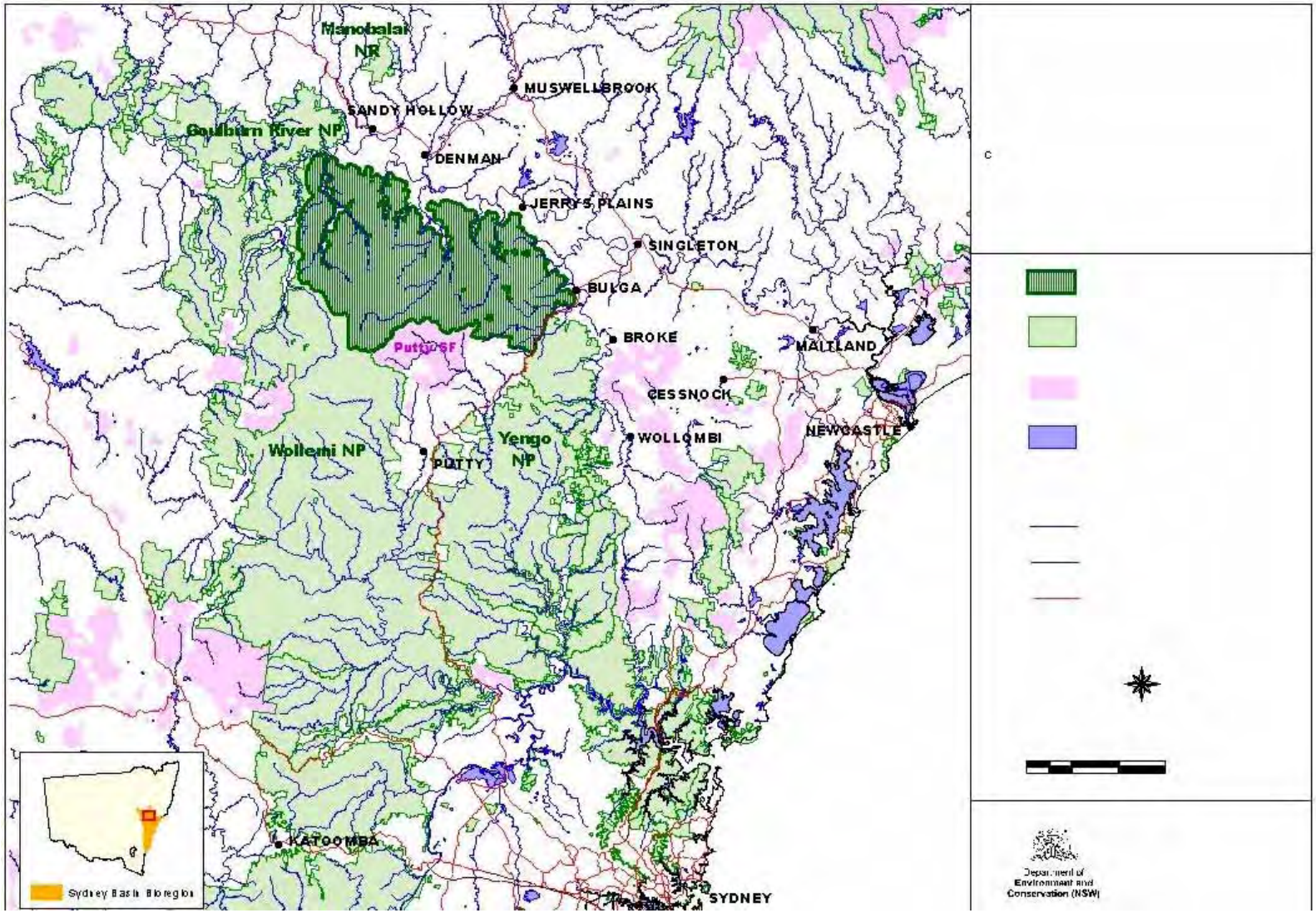
1. Document, review and collate existing terrestrial vertebrate fauna data.
2. Carry out systematic field sampling of all terrestrial vertebrate fauna groups to establish baseline data for future conservation assessment and monitoring works.
3. Identify and profile threatened fauna species and other regionally significant fauna that are known or likely to occur.
4. Identify broad-scale patterns in fauna occurrence and habitat use across the study area and identify habitats of particular conservation significance.

1.2 BACKGROUND

Wollemi National Park comprises an area of approximately 488 620 hectares, making it the second largest national park in New South Wales (NSW) (NPWS 2001d). The area examined herein (the study area) is confined to the far north-east of the park, defined as the land within the park that is east of the Hunter Range Area boundary and north of the Hunter Main Trail (Map 1). The study area encompasses approximately 128 000 hectares of land, which represents just under 30 per cent of Wollemi National Park. This area is located approximately 25 kilometres west of Singleton and 140 kilometres north-west of the Sydney metropolitan area (Map 1).

The study area incorporates the catchments of Hungerford, Baerami and Kings Creeks (which feed into the Goulburn and then the Hunter River), as well as Martindale, Doyles and Appletree Creeks (which feed directly into the Hunter Rivers). The northern boundary loosely follows the meandering line of the southern escarpment of the Hunter Valley. Private lands on the Hunter Valley floor, which are largely cleared for agriculture, bound the north and north-east. Goulburn River National Park abuts the far north-western corner of the study area while Yengo National Park neighbours the south-eastern boundary. The southern boundary separates Wollemi National Park from the Putty State Forest, while to the west and south-west lies the remainder of Wollemi National Park.

Wollemi National Park forms part of the Greater Blue Mountains World Heritage Area, which was inscribed on the World Heritage List in November 2000. Sections of the park also form part of the Wollemi Wilderness Area, which was declared in March 1999. The western half of the study area, west of the Martindale Trail, is an identified Wilderness Area. Areas of the National Park that are declared as wilderness are managed in accordance with the Wilderness Act 1987, which involves the closure and rehabilitation of vehicular access routes, and cessation of maintenance of walking tracks and routes.



Map 1: Location of north-eastern Wollemi National Park and surrounding conservation areas

1.3 HISTORY OF LAND USE

Aboriginal people occupied the area now known as Wollemi National Park for at least 12000 years prior to European settlement (NPWS 2001d). Approximately 120 Aboriginal sites have been recorded within the entire park, though the actual number is expected to be far greater (NPWS 2001d). Early European attitudes to the park were based on their perception of the area as an unproductive, remote and undesirable landscape (NPWS 2001d). The rugged features, low nutrient soils and dry climate have prevented the use of the Wollemi area for settlement or primary industry (NPWS 2001d). As a result large areas of the reserve have been excluded from European modification. The area was designated as Vacant Crown Land until 1984, during which time the perimeters and creeklines would have been used for small scale agriculture-related activities such as Cattle grazing, logging and firewood collection. There was limited use of the area for oil shale mining and in more recent times for defence force exercises. The Baerami Valley was mined for oil shale in the first half of this century, the site of which has been extensively studied due to its historic significance. Low intensity Cattle grazing continues to occur in small sections of the National Park, adjacent to cleared lands along the northern perimeter.

The Wollemi National Park environment stands in stark contrast to the Hunter Valley floor, which has been extensively cleared for agriculture, settlements and mining. The floors of the Baerami, Hungerford, Martindale and Doyles Creek valleys were first cleared for small scale dairy farming and the production of cream and butter (B. Flannery pers. comm.) and currently support a mix of agricultural activities including Cattle grazing, olive farming, pecan nut farming and horse studs.

1.4 ENVIRONMENT

1.4.1 Biogeography

The study area lies near the north-western edge of a distinct environmental region known as the Sydney Basin Bioregion (Thackway and Cresswell 1995). This Bioregion extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee (Map 1). The Bioregion is characterised by a temperate climate with warm summers and no dry season (NPWS 2003c). The study area lies at the junction between two distinct sub-regions known as the Wollemi subregion and the Hunter subregion (NPWS 2003b). The former is characterised by sandstone plateau with benched rock outcrops covered in sclerophyllous forests and woodlands with a diverse shrub storey, and with tall mesic forest and rainforest in gullies (NPWS 2003c). The latter is characterised by a complex of Permian shales, sandstone, conglomerates and coal measures with more grassy open forests and woodlands (NPWS 2003c).

Being near the north-western edge of the Sydney Basin, the study area receives influences from adjacent Bioregions, including the NSW North Coast, the Brigalow Belt South and the NSW South Western Slopes. These influences lead to a rather unique mix of environments. Wollemi National Park lies between Goulburn River, Gardens of Stone, Yengo and Blue Mountains National Parks, a system of reserves which preserves the sandstone based links between the Sydney, Hunter and Central West regions of New South Wales.

1.4.2 Geology and geomorphology

Wollemi National Park is based on four strata of sedimentary rock listed here from oldest to youngest: the Permian coal measures, the Narrabeen and Hawkesbury sandstones and shales and the Wianamatta shales (NPWS 1997b). Erosion activity has weathered away most of the Wianamatta and Hawkesbury series, exposing the Narrabeen group (NPWS 1997b). Weathering of the sandstones and claystones of this group has given the park its characteristic dissected landscape, dominated by many deep valleys, cliffs and narrow gorges. The majority of land within the study area contains rugged hills with rounded summits, irregularly benched slopes often littered with boulders and frequent sandstone outcrops, and narrow valleys (Story *et al.* 1963). Sandstone cliffs also occur within the study area, usually overlooking steep shaly slopes littered with boulders (Story *et al.* 1963). Soils formed from the Narrabeen and Hawkesbury Sandstones are generally very shallow, characterised by low nutrient levels, particularly of phosphorous (NPWS 1997b). Sandy alluvium occurs along wider valley floors in the north of the study area.

The Permian Coal Measures outcrop as steep talus slopes along the northern perimeter of the study area. This area is characterised by steep hills and escarpments with frequent outcrops of sandstone and conglomerate, surface rubble, and closely spaced ravines on shales often partly choked with

sandstone rubble. This stratum weathers to form moderately fertile clay loams (NPWS 1997b), with fragments of sandstone or shale (Story *et al.* 1963).

1.4.3 Elevation

Mount Monundilla is the highest point within the study area, reaching an elevation of 1108 metres above sea level (asl). Between this mountain and the headwaters of the Baerami, Gungalwa, Reedy, Martindale and Putty Creeks, elevation ranges from 1100 metres to 600 metres asl. The remainder of the study area ranges from 600 metres on the ridges down to 200 metres along the lower gully lines, with a small portion of Doyles Creek reaching down to 120 metres asl just before flowing into private lands to the north. The northern boundary is defined by steep escarpments that rise sharply to 300 metres asl from the wide valley flats located at approximately 150 metres asl.

1.4.4 Climate

Long term climate patterns across the study area are directly related to topography. Generally the areas that lie above 1000 metres asl have a mean annual temperature of 13 to14 degrees Celsius and a temperature range of one to 28 degrees. Lower elevations in the north and east of the study area have a mean annual temperature of 15 to16 degrees, with a maximum of 30 degrees and a minimum of two degrees Celsius. However, temperatures regularly exceed this average maximum, as experienced during October 2004 when it climbed over 40 degrees Celsius in the Hungerford Valley.

The annual rainfall data follows a similar pattern, related to elevation. The escarpment and talus slopes in the north-western corner are relatively dry, sometimes described as arid, receiving on average between 600 and 700 millimetres of rain per year. The average annual precipitation rises with elevation, ranging between 700 and 900 millimetres in the east and south of the study area, depending on the position in the landscape. Average annual rainfall reaches a maximum of 950 millimetres in the vicinity of Mount Monundilla.

1.5 VEGETATION

North-eastern Wollemi National Park supports a diverse and complex array of vegetation communities. While much of the vegetation is characterised by sclerophyllous eucalypt forests and woodlands, a number of savannah woodland, rainforest, heath and native cypress pine communities are also found in small and disjunct patches. The species composition of the vegetation communities varies in response to regional climatic influences and geology. Three broad botanical divisions occur within the study area, as follows. Vegetation characteristic of the Central West Slopes of NSW is found on the northern half of the study area in dry, warm environments. NSW North Coast influences extend a little way into the north east of the reserve, just west of Howes Valley. Influences of the coastal hinterland that dominate the Central Coast botanical division are found in areas of higher rainfall near Putty State Forest and Three Ways. The influences of each of these botanical divisions are discussed below.

The valley floors of Baerami, Hungerford, Martindale, Doyles and Appletree Creeks contain Permian clays that form fertile soils. The valley floors support vegetation that is typical of the grassy woodlands of the Goulburn Valley and the central and upper Hunter Valley. Forest Red Gum (*Eucalyptus tereticornis*), Yellow Box (*E. melliodora*) and Grey Box (*E. molucanna)* dominate the canopy (Plate 1). However, most of the alluvial valley floors and terraces have been cleared for agriculture with only isolated trees and small remnants remaining. The valley floors are dissected by large streams and creeks, beside which a cover of River Oak (*Casuarina cunninghamiana* subsp. *cunninghamiana*) and narrow ribbons of Rough-barked Apple (*Angophora floribunda*) persist.

Plate 1: Valley Floor Grassy Woodlands
© Narawan Williams/DEC

Plate 2: Northern Sandstone Exposed Woodland on Baerami Range © DEC

The valleys are surrounded by steep escarpment slopes that rise up to sheer sandstone cliffs. These slopes comprise a combination of Permian sediments and sandstone talus from the eroding cliff lines. Lower slopes and foothills feature tall Dawson's Box (*E. dawsonii*), Grey Box and Grey Gum (*E. punctata*). Mid slopes contain a mix of species, while Red Ironbark (*E. fibrosa*) and Grey Gum along with Black Cypress Pine (*Callitris endlicheri*) occur on the more exposed upper escarpment slopes that are dominated by colluvial sandstone. The understorey here is generally shrubby with ground cover interspersed by sandstone boulders. The combination of plant species found in these forests and woodlands are typical of the Permian Escarpments that lie beneath sandstone tablelands from Nattai in the Southern Blue Mountains to the Hunter Valley.

The Narrabeen sandstone plateau of the northern escarpment between the Baerami to the Martindale ranges is an area of low to moderate elevation and very low rainfall. Dry sclerophyllous woodlands dominate here, with mesic influenced eucalypt forest restricted to the most sheltered slopes and gullies. A number of closely related vegetation communities occupy the dry stony slopes and ridges of the sandstone plateau. A wide variety of ironbarks are known to occur although Red Ironbark is most commonly encountered (Plate 2). Other species such as Grey Gum, Narrow-leaved Stringybark (*E. sparsifolia*), Brown Bloodwood (*Corymbia trachyphloia* subsp. *amphistomatica*) and Dwyers Redgum (*E. dwyeri)* are also present. These latter two species are indicative of western influences, each being more commonly found across Goulburn River National Park and into the western slopes at Pilliga and Nombinnie Nature Reserves. The shrub layer is rarely dense, and the ground cover sparsely vegetated and notably rocky. The eastern edge of the Martindale Range and Doyles Range have slightly higher rainfall and exhibit a greater coastal influence. Smooth-barked Apple (*Angophora costata*) occurs on some ridges here, together with stringybarks and Grey Gum and with Cycads (*Macrozamia* spp.) in the understorey.

Plate 3: Rocky Heath © Narawan Williams/DEC

Plate 4: Dry Rainforest on Spring Creek © DEC

Massive sandstone outcropping and benching is a common landscape feature of the narrow northern ridges and exposed slopes (Plate 3). Low growing *Acacia* woodlands occupy these sites with Currawang (*Acacia doratoxylon*) prevalent. Black Cypress Pine and mallee forms of Dwyer's Red Gum are also common amongst sprawling thickets of Spur-wing Wattle (*Acacia triptera*) and Fringed Heath Myrtle (*Micromyrtus sessilis*). Red Gum – Box grassy woodlands are still present on the rich soils that are associated with basalt caps on the Baerami and Doyles Range, such as on the top of Mount Nielson.

Narrow gullies incise the northern sandstone plateau, flowing northward toward the Hunter River. Flowing water is rare in these gullies and it is not until the larger streams associated with open valley flats that water flow becomes permanent. Taller Grey Gums occupy the sheltered aspects although the understorey remains sclerophyllous rather than mesic, reflecting the relatively low soil moisture, rainfall and the frequency of fire. Small trees of Forest Oak (*Allocasuarina torulosa*) are sometimes present. Shrubs are common and ground cover is usually a sparse cover of hardy ferns, herbs and grasses. In the most incised gullies and gorges a simple dry rainforest community develops, dominated by Grey Myrtle (*Backhousia myrtifolia*) (Plate 4). Rusty Fig (*Ficus rubiginosa*) also commonly grows amongst cracks in the sandstone strata.

Vegetation found along the Hunter Range near the southern boundary exhibits a more coastal influence than the rest of the study area. A moderately tall woodland and forest complex is found on the ridges and exposed slopes (Plate 5). Sydney Peppermint (*E. piperata*), Narrow-leaved Stringybark and Red Bloodwood (*Corymbia gummifera*) are prominent and the shrub layer is generally dense if fire has been absent, with a high diversity of flowering species such as Hairpin Banksia (*Banksia spinulosa*) and Prickly Shaggy-pea (*Podolobium ilicifolium*). Slopes and open gullies are typical of other hinterland sandstone reserves with Sydney Peppermint and Smooth-barked Apple being the dominant tree species. Some more mesic sandstone shrubs, herbs and vines are also common.

Plate 5: Eastern Sandstone Woodland on Commission Road © DEC

Tall moist eucalypt forest also occurs in the headwaters and upper stretches of Martindale Creek. Tall Blue Gums (*E. saligna* and *E. deani*) grow alongside Turpentine (*Syncarpia glomulifera*), Sydney Peppermint and Rough-barked Apple. Mesic shrubs and ferns are common. This tall moist eucalypt forest grades into a warm temperate rainforest in narrow gorges (Plate 6). This rainforest is more diverse than the dry rainforest of the northern escarpment. It supports a tall canopy of Coachwood *(Cerapetalum apetalum*), Sassafras (*Doryphora sassafras*) and Lilly Pilly (*Acmena smithii*).

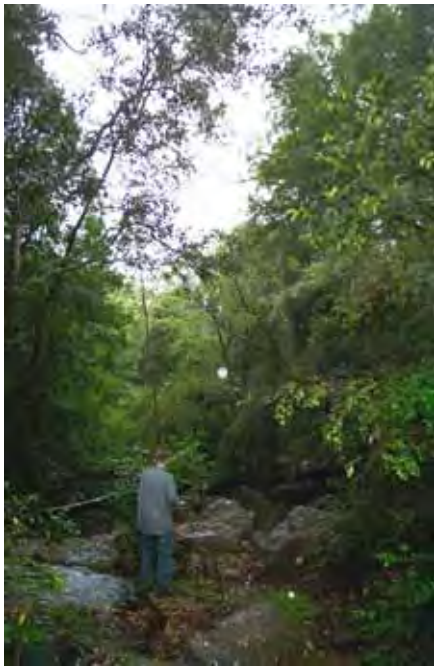


Plate 6: Moist Gully Forest off California Trail © DEC

The basalt cap of Mount Monundilla supports a complex of rainforest and moist forest, despite its exposure. At around 1100 metres in elevation, the rainforest has distinct cool temperate influences aligning to other high elevation rainforest communities found at Mount Coricudgy and Mount Wilson.

The North Coast botanical region reaches its southern limit in the north-eastern corner of the study area around the headwaters of the Milbrodale and Parsons Creeks. These influences are subtle and are generally only observed in the lower elevations of the sheltered and moist gully systems. These systems do not support unique species in themselves but rather combinations of pioneering rainforest species such as Whalebone Tree (*Streblus brunonianus*), Orange Thorn (*Citriobatus pauciflorus*), Mutton Wood (*Rapanea variabilis*), *Sigesbeckia orientalis* subsp. *orientalis* and Wombat Berry (*Eustrephus latifolius*) that are not common elsewhere in the study area. They are more abundant at similar elevations on the northern side the Hunter River and to the east in the northern ranges of the Yengo and Watagan land systems. Small tongues of Spotted Gum (*Corymbia maculata*) also occur behind Bulga in the north-eastern area on residual shale derived soils. This vegetation is similar to the Spotted Gum communities that occur on the Hunter Valley floor and coastal foothills to the east.

The vegetation patterns along the south-eastern corner of the study area, along Doyles and Milbrodale Ranges, share much in common with those of northern Yengo National Park. A mosaic of dry shrubby woodlands and forests on ridges and exposed slopes include Grey Gum, Narrow-leaved Stringybark and Ironbarks (*E. fibrosa, E. crebra*). Smooth-barked Apple is also a regular component of the canopy on slopes and ridges. The understorey is sparse to moderately shrubby with Prickly Shaggy-pea and Geebungs *(Persoonia spp.)* common. Taller forests develop on deeper soils and on more protected aspects, with Grey Gum and Smooth-barked Apple becoming more prevalent in the canopy. In these environments Forest Oak is prominent in the small tree layer. Tall forests of Mountain Blue Gum (*E. deanei*) and Turpentine occupy the most sheltered aspects and gullies. Creeks are mostly dry with lower slopes adjoining providing a moderate cover of mesic shrubs. There is only just enough rainfall to provide enough soil moisture to retain some hardy dry rainforest species on the forest floor. These moister environments represent the southern limit of the north coast botanical division.

1.6 FIRE

Little is known about traditional Aboriginal burning practices in the study area, or the fire regime prior to the 1940s. Fire is a natural component of the Wollemi National Park ecosystem and the area is characterised by a highly flammable mix of fire adapted flora, except in the most sheltered gullies. The most recent wildfire burnt through the majority of the eastern half of the study area, east of Gungalwa Creek, in the summer of 2001/2002. The majority of the park to the east of Commission Road had also burnt in January 1994. The eastern region of the study area between Martindale Trail and Commission Road is burnt by wildfire most regularly, as lightening strikes and arsonists often light fires along the Martindale Trail and the Hunter Main Trail that then burn to the north and east towards Bulga. The frequent fire regime in this area inhibits the development of a mesic understorey, despite the moderate rainfall.

The central parts of the study area burnt most recently over the summer of 1997-98, and have a moderate frequency of fires. Wild-fire has largely been excluded from the north-western corner surrounding the private lands in the Baerami, Hungerford, Kings and Wilpen Creek valleys, though small prescribed burns are often undertaken here. The south-western corner has a complex history of small fires, the most recent of which occurred in the late 1980s and late 1990s.

2 METHODS

2.1 EXISTING FAUNA DATA

Prior to the current study, knowledge of the terrestrial vertebrate fauna of north-eastern Wollemi National Park was very limited. Some of this knowledge had been stored in the Atlas of NSW Wildlife, the state's major fauna database. This database was the primary resource used to access existing data on the fauna of the study area. The majority of records within the Atlas prior to the summer of 2004-05 derived from the licensed data sets of Birds Australia. These records were collected in two stages. The first period was prior to 1984 (primarily 1977-1981) when a large number of records were gathered as part of the Bird Atlas published by the Royal Australasian Ornithologists Union (RAOU) (Blakers *et al.* 1984). The method used by Birds Australia at this time involved designating a ten-minute spatial grid, based on easting and northing lines, and attributing all sightings within that grid to coordinates at the centre of the grid. Seven such grid centres lie within the study area. This data is spatially inaccurate and there is no guarantee that all or even any of these sightings actually occurred at the given location. Consequently there is a large amount of bird data that presents a misleading picture of the species composition of Wollemi National Park.

The second period of Birds Australia data collection occurred between 1998 and 2002 for the second Bird Atlas (Barrett *et al.* 2003). Many of these records collected during this period have a higher degree of spatial accuracy and are more useful for the purposes of this project. Observations arising from this data were sourced from major fire trails, particularly California Trail, Commission Road and the Hunter Main Trail.

The second largest number of records within the Atlas of NSW Wildlife prior to 2004 derive from systematic surveys undertaken as part of the NSW Comprehensive Regional Assessment (CRA) process, which sought to provide a broad overview of the conservation value of public lands in eastern NSW. Work was undertaken in 1997 and 1998 and centred on major roads including the Hunter Main Trail, Martindale Trail and Glen Gallic Trail, with limited work in the east along Putty Road and California Trail. These surveys were undertaken by NPWS using the systematic techniques described below (NPWS 1997a).

A relatively small number of records derive from the specimen register of the Australian Museum. Remaining records within the Atlas derive from observations made by park rangers and field officers, state forest staff, bushwalkers and naturalists, scientific researchers working in the area, and other visitors to the park. These records have various levels of reliability depending on the type of observation, as well as the certainty and experience of the observer.

2.2 SURVEY STRATIFICATION AND SITE SELECTION

The aim of the survey stratification and site selection process was to proportionately sample the range of habitat types contained within north-eastern Wollemi National Park. Prior to the commencement of this project 65 systematic fauna survey sites had been established within the study area as part of the CRA program. The CRA sites were concentrated along the easily accessible major trails, leaving immense portions of the study area unsurveyed. In addition, not all survey techniques were undertaken at each site. The site selection process undertaken for the 2004-05 survey season ensured that the data collected would complement, rather than replicate, work that had previously been undertaken within the study area.

The initial step undertaken was a gap analysis to identify the previous systematic fauna survey effort undertaken within each modelled vegetation community across the whole of Wollemi National Park. Vegetation communities that had not previously been sampled or had been under-sampled (where the amount of previous survey effort was less than that predicted by the proportional size of the community), and were present within the study area, were prioritised for sampling. Secondly, an assessment was undertaken to identify significant gaps in the spatial distribution of systematic fauna survey sites within the study area. Thirdly, for logistical reasons survey points were also required to be on or within five kilometres of a road. These three factors were used to select priority regions of the study area to be targeted for survey in the spring/summer season of 2004-05. Once the priority regions were selected, the primary strata used for site selection were vegetation type and air photo interpretation (Bell 1998) and landsystem (Story *et al*. 1963). Vegetation type alone could not be relied upon for site stratification as field inspection revealed significant errors in the modelling in the north and west of the study area. In addition, an effort was made to sample the full topographic

variation within the priority regions (i.e. to sample the range of aspects and positions in the landscape from ridgeline to gully).

In the field, the proposed site locations were ground-truthed to ensure that they were representative of the intended stratum, had been minimally effected by recent burning or other habitat modification, and comprised a single vegetation community. If these criteria were not met, an alternative location was found. Systematic survey sites were 100 by 200 metres in area, and where possible were spaced a minimum of one kilometre from each other (two kilometres for nocturnal call playback surveys). In some cases during hikes, due to the terrain and the time taken to walk between sites, survey sites were placed closer than one kilometre. In this case, care was taken to ensure that adjacent sites sampled different habitats and that animals were never double counted.

The location of access trails and the large amount of travelling time between areas (especially when walking in difficult terrain) limited selection of survey sites. Consequently, considerable difficulties were met in locating survey sites that proportionately sampled the full range of strata, maintained sufficient distance between sites to ensure they were independent from one another, and could be accessed with a reasonable degree of efficiency. For these reasons, vegetation types that were located far from roads (such as Eastern Sandstone Exposed Woodlands) were under-sampled whereas vegetation types that were easily accessible (including slopes and plains Box woodlands) were slightly over-sampled. Due to time and budgetary constraints and the fact that fauna survey is very labour intensive, not all spatial gaps in sampling could be filled. The most notable shortfall was the failure to access the central sandstone plateau, north-east of Mount Monundilla, which would have required a helicopter.

Table 1 presents the area of vegetation types categorised into broad classes and the corresponding survey effort for each fauna survey technique. Appendix A provides the specific AMG, broad vegetation class and survey techniques undertaken at each survey site. The tables include all systematic surveys undertaken within the study area by DEC between 1997 and 2005 (i.e. during both CRA and BSP programs).

2.3 SURVEY METHODS

The systematic fauna survey methods used were based on those developed by the NPWS Biodiversity Survey Coordination Unit (NPWS 1997a). The techniques were used to sample the following vertebrate fauna groups: diurnal and nocturnal birds, diurnal and nocturnal reptiles, bats, arboreal mammals, amphibians, and terrestrial mammals. Consistency in the use of these techniques allows comparison between fauna species detected across different vegetation types and environments within the study area. Furthermore, it will allow comparisons with future consistent surveys of the park and of environments elsewhere.

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 into the DEC Biodiversity 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.

2.3.1 Systematic site-based methods

Site attributes

A site attribute form, aiming to characterise fauna habitat, was filled out at every systematic site where survey techniques were conducted. A 20 by 20 metre quadrat typical of the overall 100 by 200 metre site was used for the assessment. The site attribute locates and describes the site in a format that is comparable to other sites. Data relating to physio-geographic, disturbance, structural and floristic, microhabitat and stream categories were recorded for the site. Standard codes provided by the Australian Soil and Land Survey Handbook (McDonald *et al*. 1990), particularly for vegetation (i.e. Walker and Hopkins 1990) were used wherever possible.

Diurnal bird survey

Diurnal bird censuses comprised a twenty-minute observation and listening search within a two hectare (100 by 200 metre) area, conducted by an experienced bird surveyor. Censuses were conducted only during periods of relatively high bird activity (in the early morning) and reasonable detectability (e.g. low wind and cicada activity). All surveys were undertaken in spring and summer. All bird species and abundance of individuals seen or heard were recorded. Individuals were scored

as on-site if they were detected within the one hectare plot. Individuals recorded outside the plot, in adjacent vegetation types or flying overhead were recorded as off-site.

Diurnal herpetofauna search

A standard half hectare area (50 by 100 metres) was searched for one person-hour at each site (standardised regardless of the number of persons searching). Censuses were restricted to spring and summer during 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 or in extreme heat.

This census technique entailed active searching of potential reptile and frog microhabitats within the half hectare area. 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 shelter sites. Incidental observations of other fauna were also recorded.

Mapped broad vegetation class	Area of vegetation class (hectares)	Proportion of study area occupied by vegetation class (%)	No. of diurnal bird surveys	No. of diurnal reptile surveys	No. of site spotlight surveys	No. of harp trapping bat sites	No. of ultrasonic bat detector sites	No. of nocturnal streamside searches for frogs	No. of owl call broadcast sites	No. of Elliott trap sites	No. of hairtube sites
Northern Sandstone Exposed Woodlands	43537	34.07	22	30	6	9	7	2	9	1	0
Eastern Sheltered Sandstone Forests	24366	19.07	15	15	5	2	5	2	9	3	2
Northern Sandstone Sheltered Forests	18586	14.54	13	15	7	4	2	1	5	0	1
Narrabeen Wollemi Woodland Complex	12993	10.17	14	17	1	8	17	2	14	0	0
Eastern Sandstone Exposed Woodlands	11915	9.32	8	6	0	2	4	2	7	0	1
Escarpment Slopes Box-Ironbark Woodlands	6989	5.47	20	10	14	5	6	3	8	3	3
Residual Spotted Gum Forest	1690	1.32	5	6	4	4	1	1	1	1	1
Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1662	1.30	17	12	13	13	4	1	8	0	0
Tall Moist Gully Forests	1590	1.24	2	1	1	1	2	1	1	0	0
Grassy Box Woodlands	1065	0.83	0	4	0	0	0	0	0	0	0
Heath	928	0.73	1	1	0	0	0	0	0	0	0
Dry Rainforest	855	0.67	2	2	0	0	0	0	0	0	0
Cleared	835	0.65	2	0	0	3	0	0	3	1	0
Tall Open Shale Forest	509	0.40	2	2	1	1	1	0	1	0	2
Warm Temperate Rainforest	245	0.19	0	0	0	0	0	0	0	0	0
Alluvial Woodlands	17	0.01	0	0	0	0	0	0	0	0	0
Creekline Forests	12	0.01	1	1	1	1	1	1	1	0	0
Total*	127792	100	124	122	53	53	50	16	67	9	10

* area based on GIS data layers does not equal gazetted area of reserve. Note also that mapped vegetation unit as presented here does not always equal vegetation community in the field. Undersampled communities such as Rainforest were sampled as part of this project.
Transect spotlight surveys are not included in this table as these traverse a variety of vegetation types. Nine such censuses were undertaken during CRA surveys.

Table 1: Area of each broad vegetation class within north-eastern Wollemi National Park and corresponding allocation of systematic survey sites. Includes sites established during Comprehensive Regional Assessment and Biodiversity Survey Priorities surveys.

Nocturnal site spotlighting survey

This census comprised searching for arboreal mammals along a 200 metre transect within a site for half a person hour. Fifty-watt spotlights were used to scan the vegetation for animals and enable detection of reflected eye shine. Surveyors also listened intently for fauna calls during the survey period. All fauna observed or heard within the census period were recorded, noting whether they were on or off site.

Harp trapping

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, in spring and summer. Sites were selected for their perceived potential to interrupt bats along their flight paths, and were usually positioned on tracks or creeklines or in gaps between trees where adjacent vegetation may 'funnel' flying bats.

Traps were checked each morning. Captured bats were identified by external morphology, forearm measurement and body weight, and keyed out where necessary using Parnaby (1992a) and Churchill (1998). Animals were released on the following night at the point of capture.

Bat ultrasonic ('Anabat') call recording

Ultrasonic recorders (Corben 1989) are particularly useful for detection of high-flying species, which often comprise more than one third of an area's bat species (Parnaby 1992b), yet are under sampled by harp trapping (Richards 1992). Additionally, ultrasonic detectors also record low-flying species. The method requires the recording and identification of high frequency, echo-location "calls" made by bats, which, except for one or two species, are ultrasonic, that is, inaudible to humans. All recordings were made during spring and summer, when bat activity is highest.

CRA

The recording equipment for the surveys consisted of an Anabat II® detector and a tape recorder. Census duration was 30 minutes. Censuses were conducted between dusk and up to two hours after dusk, a peak activity period for microchiropteran bats. A 40-kilohertz calibration tone was recorded for a few seconds at the start and end of each recording session and sometimes at intervals during the recording period.

BSP

The recording equipment for the surveys consisted of an Anabat II® detector and digital flash card recorder, housed within a tupperware box for weather protection. The box was set up in locations where bats were expected to fly, such as over water bodies, at cave entrances and along tracks. The Anabat was set to commence detection at dusk and turn off at dawn. During the night, a delay switch operated to turn on the recording device when bat activity was detected and then de-activate the device while no bat activity was occurring. The equipment was left in each location for one night only, then moved elsewhere. A 40-kilohertz calibration tone was recorded for a few seconds at the start and end of each recording session.

Anabat recordings were transferred onto computer and analysed by Narawan Williams, a recognised expert in this field. Identification was designated as definite, probable or possible, following the methodology of Parnaby (1992b) and Pennay *et al.* (2004). Reference calls were collected for a number of species (see Appendix E) in order to document local call patterns and to assist with the identification and verification of non-reference calls.

Nocturnal streamside search

Streamside searches for frogs were undertaken for half a person hour in one of two ways: in stream or gully habitats a 200 metre stretch was searched; at standing water bodies a half hectare (50 by 100 metre) area was surveyed. The searches were only conducted on warm, dark, humid and wet nights or nights within two days of rain. All frogs, and other animals, identified visually or by call within the time period were recorded, together with the weather conditions at the time of the survey.

Nocturnal call playback

Nocturnal birds and mammals are often detected only when they vocalise for territory or social contact, behaviour which can be elicited by broadcasting specific calls. 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 a site. Prior to call broadcasts, on arrival at the site, the surrounding area was searched by

spotlight for five minutes to detect any fauna in the immediate vicinity and then a ten minute period of listening was undertaken.

A pre-recorded compact disc of each species' call series was played, amplified through a 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, date and time that response occurred, and weather details such as amount of cloud cover was recorded. Very windy and rainy periods were avoided where possible. Censuses conducted in poor weather were noted. Censuses were undertaken in autumn and winter.

Elliott trapping

This technique involved setting ten Elliott A traps at approximately twenty metre intervals along a 200 metre transect through a site. Traps were baited with a mixture of peanut butter, oats and honey. Traps were left in place for four nights, checked and emptied every morning soon after dawn. Any animals captured within the traps were identified, sexed if possible, and released.

Hair tube sampling

During CRA, twenty large hair-sampling tubes (nine centimetre diameter, after Scotts and Craig 1988) were placed at 100 metres intervals along a two kilometre transect. During Biodiversity Survey Priorities ten large hair-sampling tubes were placed at approximately twenty metre intervals along a 200 metre transect. In both cases alternative tubes were baited with meat or a mixture of peanut butter, honey and rolled oats. Each tube was fitted with adhesive paper to collect hairs of small and medium sized mammals that were attracted to the bait. Tubes were left on site for a minimum of ten nights. Hair samples were identified using the techniques described by Brunner and Coman (1974) by an expert in the field, Barbara Triggs. Identifications were classified into three levels of reliability: definite, probable and possible.

2.3.2 Transect based methods

Transect spotlighting survey

The method employed varied on a site by site basis, and was only undertaken during the CRA surveys. A team of two surveyors walked or drove along a transect, varying between 300 metres and eight kilometres in length, searching for arboreal mammals with 50 watt spotlights. An AMG was calculated for each sighting along the transect and entered into the data sheet.

2.3.3 Opportunistic methods

Predator and herbivore scat and pellet collection

The presence of hairs, and occasionally skeletal remains, in predator scats and owl pellets can result in the identification of prey species at a high level of confidence and is hence an efficient sampling technique for prey animals. In addition, the recording of predator or non-predator scats constitutes records for the species that deposits the scat, providing locality records for species such as the Spotted-tailed Quoll (*Dasyurus maculatus*), Fox (*Vulpes vulpes*), Dingo (*Canis lupus dingo*), Dog (*C. lupus familiaris*) and Pig (*Sus scrofa*). Due to the unmeasurable time delay between prey ingestion and defecation, the location in which the prey animals lived cannot be accurately known, so this technique is useful only for detecting the species presence within a general area. However, it has been shown previously that predators defecate an average of two kilometres from the point of prey ingestion (Lunney *et al.* 2002).

Predator scats were collected, placed in paper envelopes, labelled and sent to specialist Barbara Triggs for analysis. Hair samples were identified using the techniques described by Brunner and Coman (1974). Identifications were classified into three levels of reliability: definite, probable and possible.

The location of herbivore scats was also noted on an opportunistic basis to indicate the presence of an animal. If there was any doubt in herbivore scat identification in the field, samples were brought back for identification by an expert.

Searches of caves and overhangs

When come across, caves and overhangs were thoroughly searched with a headtorch for animals such as cave-roosting bats, geckos and nesting birds.

Incidental records

Surveyors driving or walking through the study area recorded the location of interesting fauna when it was seen or heard. Particular animals targeted by this technique were those undersampled by systematic surveys, including large ground mammals, non-vocalising birds, and secretive, shy and/or rare animals. The date, time, map grid location (usually obtained from a GPS) and microhabitat of the animal were recorded on a data sheet.

2.4 SURVEY TIMING

As summarised above, systematic field surveys have been undertaken within north-eastern Wollemi National Park over a number of years. Table 2 summarises the timing of these surveys and the techniques that were undertaken in each period.

Survey program	Timing	Techniques employed
Comprehensive Regional Assessment (CRA)	January to November 1997	Diurnal bird census, reptile search, transect spotlighting, site spotlighting, 30 minute bat call detection, harp trapping, nocturnal call playback, nocturnal streamside search, hair tubes, elliott trapping, opportunistic methods
	March 1998	Diurnal bird census
Biodiversity Survey Priorities (BSP)	August 2004	Nocturnal call playback, site spotlighting, opportunistic methods
	September 2004 – February 2005	Diurnal bird census, reptile search, site spotlighting, harp trapping, all night bat call detection, nocturnal streamside search, elliott trapping, opportunistic methods
	April – May 2005	Nocturnal call playback, hair tubes, opportunistic methods

Table 2: Timing of DEC systematic fauna surveys within north-eastern Wollemi National Park

3 RESULTS AND DISCUSSION

3.1 OVERVIEW

DEC has established and surveyed a total of 230 systematic fauna survey sites within north-eastern Wollemi National Park, of which 162 were surveyed in 2004-05 as part of the Biodiversity Survey Priorities fauna survey program. These sites cover the dominant habitats and landscapes present within the study area, and were surveyed during spring, summer and autumn. In addition to these surveys, members of Birds Australia have contributed significantly to the number of fauna records for the study area, as have numerous DEC staff, scientific researchers, and dedicated members of the public.

Two hundred and seventy eight (277) species of vertebrate fauna are known to occur in north-eastern Wollemi National Park, of which 242 (86%) were recorded during the 2004-05 surveys. This total includes 31 species listed as threatened on the NSW Threatened Species Conservation Act (TSC Act) (1995), of which seven are also listed under the Commonwealth Environmental Protection and Biodiversity Conservation Act (EPBC Act) (1999). Fifteen introduced fauna species have been recorded within the study area to date, including ten ground mammals and five birds. An additional forty-one native and three introduced species have been recorded on the Atlas of NSW Wildlife for which there is some doubt regarding their occurrence in the park proper, as will be discussed below. A complete species list for all terrestrial vertebrate fauna groups is provided in Appendix B.

In addition to the above fauna, 48 species have been recorded within a five kilometre radius of the study area boundary (see Appendix C). This includes six additional threatened species, of which two, the Swift Parrot and Painted Honeyeater, are considered to have the potential to also occur within the park.

The value of systematic fauna survey is apparent in the contribution it has made to the knowledge of fauna within the study area and the building of a species inventory. The Comprehensive Regional Assessment (CRA) surveys, undertaken in 1997-98, added 72 species to the list of known fauna within north-eastern Wollemi National Park, and the Biodiversity Survey Priorities (BSP) program, undertaken in 2004-05, added a further 30 species to the study area database. Figure 1 indicates the increase in the known number of fauna species within the study area over time, primarily as a result of dedicated systematic fauna survey. Furthermore, the BSP surveys increased the number of fauna records within the park more than two fold, from 4422 to 10349. Changes in the density of fauna records as a result of surveys associated with this project, and the location of survey sites, are shown in Map 2.

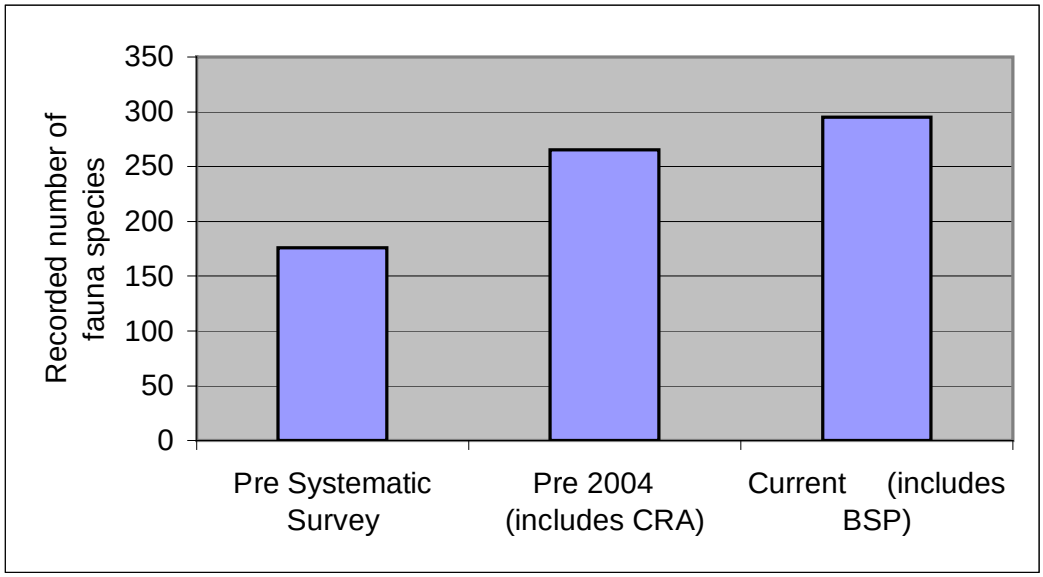
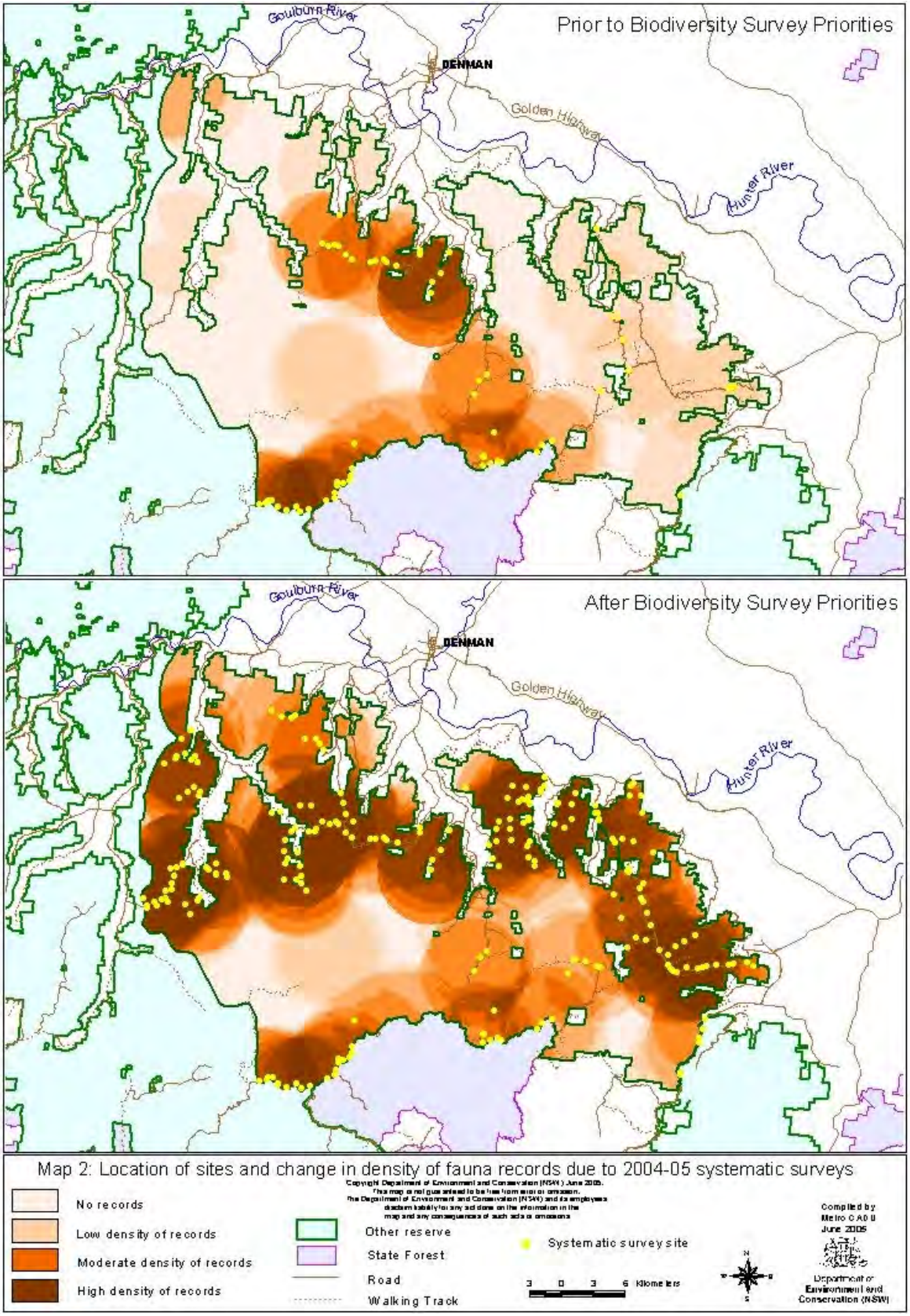


Figure 1: Number of species recorded within north-eastern Wollemi National Park following systematic fauna survey.



Map 2: Location of sites and change in density of fauna records due to 2004-05 systematic surveys in north-eastern Wollemi National Park

3.2 NATIVE DIURNAL BIRDS

A total of 190 native diurnal bird species are now recorded on the Atlas of NSW Wildlife as occurring within north-eastern Wollemi National Park, including eleven species listed as threatened under the TSC Act (1995). One species, the Regent Honeyeater is also listed as Endangered under the EPBC Act (1999). In addition, two threatened species, the Swift Parrot and the Painted Honeyeater, have been recorded within two kilometres of the study area and though they have not been recorded within it, potential habitat is present and it is considered likely that the species utilise the park, at least on occasion. Seven of these threatened species are dependent upon the dry woodlands that occupy the northern perimeters, while others are more widespread through the study area. These threatened species will be discussed further in Section 5. Scientific names for bird species described in the following discussion are presented in Appendix B.

3.2.1 Results of DEC surveys

The DEC surveys undertaken during 1997-98 and 2004-05 confirmed the presence of 145 species of native diurnal bird, including seven species not previously known to occur. One hundred and thirty-two of these species were observed during the 122 systematic diurnal bird surveys, with the remaining thirteen species only recorded by opportunistic sightings. Based on the systematic bird survey results, the most common bird species in the park in spring and summer is the Noisy Friarbird, which was recorded at 93 (76% of) sites. This is a sizeable gregarious bird that feeds preferentially on nectar and moves between areas to seek out tree flowering events throughout the year (Saunders and Burgin 2001). The large number of flowering eucalypts present at numerous sites during the time of systematic survey is likely to account for the high abundance of this species. Also frequently recorded during diurnal bird surveys were the White-throated Treecreeper (71%), Pied Currawong (67%), Brown Thornbill (66% of sites) and Spotted Pardalote (66% of sites). These birds are all common in dry sandstone forests and woodlands throughout the region.

Of conservation significance is the presence of a number of species that are thought to be in decline, though they have not yet been listed on either the TSC or EPBC Acts. A recent review of bird records across the nation identified numerous species that appear to have declined in numbers in recent years (Barrett *et al.* 2003). Of the species identified, the following occur within north-eastern Wollemi National Park (followed by the total number of times they have been recorded in the study area on the Atlas of NSW Wildlife to date): Rockwarbler (97); White-winged Chough (68); Spotted Quail-thrush (31); Red-browed Treecreeper (27) and Flame Robin (2). In addition, a number of species that have been located within the study area are thought to have declined within the Sydney Basin Bioregion in recent years (Barrett *et al.* 2003). These include the Jacky Winter (93), Wedge-tailed Eagle (44), Nankeen Kestrel (40), Dusky Woodswallow (35), Brown Falcon (20), Australian Pipit (19), Scarlet Robin (14), White-winged Triller (13) and White-throated Needletail (6). The presence of these species suggests that Wollemi National Park, together with the neighbouring national parks of the Blue Mountains and Hunter Range, play an important role in the ongoing regional conservation of their habitats.

The high richness of honeyeater species within the study area is an example of the diversity of bird species within the park. Twenty species are regularly observed, including Yellow-faced Honeyeater (a total of 216 records in the Atlas of NSW Wildlife), Noisy Friarbird (209), Bell Miner (142), Eastern Spinebill (130), Lewin's Honeyeater (104), Yellow-tufted Honeyeater (93), White-eared Honeyeater (92), White-naped Honeyeater (81), Scarlet Honeyeater (63), Noisy Miner (61), White-plumed Honeyeater (51), Brown-headed Honeyeater (47), Striped Honeyeater (36), New Holland Honeyeater (28), Black-chinned Honeyeater (21), Red Wattlebird (16), Fuscous Honeyeater (12), Little Friarbird (11), White-cheeked Honeyeater (9) and Crescent Honeyeater (7). The Yellow-faced Honeyeater is widespread and abundant in the park during spring and summer due to its propensity to inhabit a large range of environments, from dry woodlands of the northern escarpment to tall mesic forest and rainforest along Hayes Creek, and to the fact that it is not restricted to flowering eucalypts (M. Schulz pers. comm.). The occurrence of this species would be markedly different in the winter, however, as large numbers migrate from the study area. Yellow-faced Honeyeaters were seen on passage moving out of the Hungerford Valley in April 2005. A further five species have been recorded on less than five occasions, including Regent Honeyeater (3), Blue-faced Honeyeater (3), Brown Honeyeater (1), Singing Honeyeater (1) and Yellow-plumed Honeyeater (1). The occurrences of the latter three species in the study area are uncertain, however, as the sightings are likely to have been either of vagrant or mis-identified birds, or are spatially inaccurate. Honeyeaters are a diverse group of birds across the Hunter Range Area, with 21 species recorded in northern Yengo National Park (DEC

2005c), seventeen in Goulburn River National Park (NPWS 2001a) and twelve in Manobalai Nature Reserve (DEC 2005b).

Birds of prey are another well represented group, with twelve species known to inhabit the park. The most commonly observed is the Wedge-tailed Eagle (recorded 44 times), a large majestic bird that is often seen soaring over the steep hills and escarpments at the northern boundaries of the park. The Nankeen Kestrel is also common (recorded on 40 occasions), and again has been most frequently observed at the interface between cleared lands and wooded. The Brown Falcon and Black-shouldered Kite are both frequently observed within the study area (21 and 16 times respectively) which is an important finding as both species have been reported by Birds Australia to have declined in numbers in the Sydney Basin Bioregion since the 1980s (Barrett *et al.* 2003). The Brown Falcon, Black-shouldered Kite and Nankeen Kestrel utilise cleared lands adjacent to the park for foraging, where they hunt reptiles, rodents and insects (N. Williams pers. comm.). In contrast, the Brown Goshawk, Grey Goshawk, Collared Sparrowhawk and Pacific Baza forage largely within forests and woodlands, and are therefore likely to be more widespread throughout the study area. The Peregrine Falcon is also likely to be more common towards the northern perimeter of the park, as it would nest and roost in caves and cliff edges along the northern sandstone escarpments, foraging for smaller birds within both cleared and forested lands.

3.2.2 Revision of diurnal bird species list

A large proportion of the bird records in the Atlas of NSW Wildlife are derived from Birds Australia datasets. As mentioned above, records collected for Birds Australia prior to 1998 have a very low degree of spatial accuracy and there is no guarantee that any of the sightings attributed to a certain point actually occurred at that location. Indeed, 21 species recorded by Birds Australia have not been detected within the study area by any other method, and a further twelve species have only since been recorded on the very edge or immediately outside the boundary of the park. Table 3 presents a summary of these species and comments regarding whether the bird is actually likely to occur within the park. It is likely that many of the waterbird species recorded were actually sited in the Upper Hunter Valley proper, along the Hunter River and its plains. The bird list for the study area is artificially elevated by the inclusion of the first 27 species in Table 3, which is misleading as to the fauna values held within Wollemi National Park. Therefore, these 27 species will not be included within the species totals presented in this report. The last six species listed in the table are known to utilise habitats present within the park proper, but are likely to be most abundant at the interface between cleared and wooded lands.

Species common name	Last recorded	Comment
Australasian Shoveler	1978	May fly over the park. Unlikely to utilise habitats in the park proper.
Black Swan	1978	May fly over the park. Unlikely to utilise habitats in the park proper.
Great Crested Grebe	1978	May occur on boundary of the park in large dams on private lands. Unlikely to utilise habitats in the park proper.
Great Cormorant	1981	May fly over the park. Unlikely to utilise habitats in the park proper.
Little Black Cormorant	1978	May fly over the park. Unlikely to utilise habitats in the park proper.
Australian Pelican	1980	May fly over the park. Unlikely to utilise habitats in the park proper.
Great Egret	1981	May fly over the park. Unlikely to utilise habitats in the park proper.
White-necked Heron	1981	May occur on boundary of park in dams and paddocks; may fly over the park. Unlikely to utilise habitats in the park proper.
Yellow-billed Spoonbill	1980	May fly over the park or utilise dams and pasture on private lands. Unlikely to utilise habitats in the park proper.
Royal Spoonbill	1980	May fly over the park. Unlikely to utilise habitats in the

Species common name	Last recorded	Comment
		park proper.
Australian White Ibis	1980	May occur on boundary of park in dams and paddocks; may fly over the park. Unlikely to utilise habitats in the park proper.
White-bellied Sea-Eagle	1980	May fly over the park. Unlikely to utilise habitats in the park proper.
Whistling Kite	1978	May fly over the park. Unlikely to utilise habitats in the park proper.
Eurasian Coot	1980	May occur on boundary of the park in large dams on private lands. Unlikely to utilise habitats in the park proper.
Black-fronted Dotterel	1981	May occur at sandy waterholes and creeklines near boundary of the park or in dams on private lands. Unlikely to utilise habitats in the park proper.
Cockatiel	1977	This individual was probably an escapee or vagrant bird.
Little Raven	1979	Unlikely to occur in park. Possible misidentification.
Australian Reed-Warbler	1978	Unlikely to occur within the park as it prefers permanent water bodies with reed beds.
Golden-headed Cisticola	1978	Unlikely to occur within park as it prefers rank grasslands.
Little Pied Cormorant	2000 by BA (Birds Australia) on boundary of NP at Appletree Flat	May occur on boundary of the park in dams on private lands and may fly over park. Unlikely to utilise habitats in the park proper.
White-faced Heron	2004 by DEC on dam at edge of park in Baerami Valley	Occurs on boundary of park in dams and paddocks; may fly over the park. Unlikely to utilise habitats in the park proper.
Straw-necked Ibis	1999 by BA on boundary of park in Martindale Valley	Known to occur in cleared lands in the Baerami and Hungerford Valley but is unlikely to utilise habitats in the park proper.
Dusky Moorhen	2000 by BA on boundary of NP at Appletree Flat	May occur on boundary of the park in dams on private lands. Unlikely to utilise habitats in the park proper.
Purple Swamphen	2000 by BA on boundary of NP at Appletree Flat	May occur on boundary of the park in dams on private lands. Unlikely to utilise habitats in the park proper.
Emerald Dove	2002 by BA on boundary of NP at Appletree Flat	Unlikely to occur within park as it is an inhabitant of rainforest and wet eucalypt forest. Possibly an escapee or mis-identified bird.
Horsfield's Bushlark	2001 by BA on boundary of park in Doyles Creek Valley	Known to prefer grasslands and crop lands and is unlikely to inhabit the park proper.
Zebra Finch	2001 by BA on boundary of park in Appletree Creek Valley	These observations were probably of escapees or vagrant birds.
White-backed Swallow	1980	May occur in sandy areas along major watercourses in the park, or forage in woodlands at the edge of the park.
Azure Kingfisher	1978	May occur along larger creeks and watercourses in the park that have permanent or semi-permanent water.
Pacific Black Duck	2001 by BA at edges of the park in	Known to occur in cleared lands in the northern valley floors. Likely to utilise ephemeral creeklines within the

Species common name	Last recorded	Comment
	Appletree Creek, Doyles Creek and Little Horseshoe Creek Valleys	park proper, and to fly over it.
Little Eagle	2001 by BA on boundary of park in Doyles Creek Valley	Likely to utilise a variety of habitats in the park, particularly open woodlands on watercourses and slopes.
Red-rumped Parrot	2004 by DEC near boundary of NP along Wilpin and Baerami Creeks	Known to prefer pastoral country but may utilise the open grassy woodlands along the perimeter of the park.
Plum-headed Finch	1982 by casual observer on boundary of park west of Martindale Valley	Prefers grasslands, wetlands, lightly timbered grassy flats and open pastoral country. More likely to occur on cleared private lands but may utilise open woodlands along the perimeter of the park.

Table 3: Native bird species recorded only by Birds Australia or only on the perimeter of north-eastern Wollemi National Park

A thirteenth threatened species, the Olive Whistler (*Pachycephala olivacea*), listed as Vulnerable under the TSC Act (1995), has been recorded just once within the park on the Glenn Gallic trail 600 metres south of where the National Park borders the west of Martindale Valley. The nearest confirmed location of the species lies approximately 70 kilometres to the north-east of the study area near Barrington Tops. The bird has also been recorded once in the Watagans (approximately 70 kilometres to the south-east of the study area), but is not considered a resident anywhere south of the study area until the ACT (D. Hobcroft pers. comm.). The Olive Whistler is usually found in wet forests, watercourses or coastal heaths (Pizzey and Knight 1999). This species may be mis-identified by its call, which resembles that of female or young male Golden Whistler (D. Hobcroft pers. comm.). As there is uncertainty about the reliability of this record, a profile has not been generated for the species and it will not be discussed further in this report.

The close examination of diurnal bird records in the Atlas of NSW Wildlife undertaken for this report has led to a revision of the number of species known to occur within north-eastern Wollemi National Park. With the removal of spatially inaccurate records and possible mis-identifications (see Appendix B), 152 species are now known to occur.

3.2.3 Patterns in diurnal bird species distribution

The composition and richness of bird species within north-eastern Wollemi National Park is a reflection of the diversity of habitat types present within the park. An example of this is the fact that all the species of scrub-wrens and treecreepers that occur within the central east of NSW have been recorded. The White-browed Scrubwren occurs in a wide variety of habitats in the eastern third of NSW from the coast to the ranges and some areas on the western slopes (DEC 2005a), a distribution reflected in its occurrence throughout the study area. In contrast, the Yellow-throated Scrubwren (Plate 8) and Large-billed Scrubwren are largely restricted to moist coastal forests and rainforests (Higgins and Peter 2002) and hence within the study area only occur within gully lines in the east and south. These latter species approach the western edge of their range within the study area. The White-throated Treecreeper is also a habitat generalist and has been recorded across the study area in dry woodlands, heaths, tall forest and rainforest. In contrast the Red-browed Treecreeper is restricted to tall forests and gullies (Pizzey and Knight 1999) and has only been recorded in the east and south of the study area in habitats that are suitable to accommodate them. The Brown Treecreeper (south-eastern subspecies) is different again, preferring drier forests and woodlands (Pizzey and Knight 1999). Consequently it is confined to the northern half of the study area within the Box-Red Gum Woodlands.

Plate 8:Yellow-throated Scrubwren nest
© Narawan Williams/DEC

A number of bird species approach the edge of their known range within north-eastern Wollemi National Park. This includes birds at their northern limit (including Gang-gang Cockatoo, Rockwarbler and Pilotbird), birds more typical of moist coastal environments (including Lewin's Honeyeater, Black-faced Monarch, Australian Brush-turkey, Bell Miner, White-cheeked Honeyeater and many more), and birds more common in dry woodlands west of the Great Dividing Range (such as Grey-crowned Babbler, White-browed Babbler, Western Gerygone, Southern Whiteface, Striped Honeyeater and Black-chinned Honeyeater). The fact that all of these birds, each with divergent habitat requirements, are accommodated is a testament to the area's microhabitat and landscape diversity.

3.3 NOCTURNAL BIRDS

Nine species of nocturnal bird have been recorded within the study area to date. This includes all six owls that are expected to occur in the Hunter Range Area: Southern Boobook (*Ninox boobook*, 55 locations), Barn Owl (*Tyto alba*, 8), Masked Owl (*Tyto novahollandeae,* 6), Powerful Owl (*Ninox strenua*, 5), Barking Owl (*Ninox connivens*, 4) and Sooty Owl (*Tyto tenebricosa*, 1). All but two of these owls (Southern Boobook and Masked Owl) were not known to occur until systematic surveys were undertaken, largely because of their cryptic nature during daylight hours. The latter four species are listed as Vulnerable under the TSC Act (1995) and will be discussed further in Section 5 of this report. Almost 70 systematic playback sites have been completed within the study area. Response rates were low with the Masked and Powerful Owl each found at 5% of sites and the Barking Owl at 6% of sites. The Sooty Owl was not recorded from systematic survey effort. The density of these threatened owls is markedly different from that recorded in the southern Sydney region where systematic surveys have recently been undertaken by DEC. In southern Sydney, Powerful Owls were located at over 20% of owl censuses, Sooty Owls (9%), Masked Owls (3%) and Barking Owls less than 1% (DEC 2005d).

The Southern Boobook and Barn Owl are widespread and abundant within the Sydney Basin Bioregion, and indeed across the eastern half of the state. However reporting rates of the Southern Boobook have declined within the Bioregion in recent years (Barrett *et al.* 2003), making its abundance in large reserves, such as Wollemi National Park, important. The Southern Boobook is rare in the north-western corner of the study area, where despite the numerous hours spent undertaking systematic nocturnal surveys only eight individuals have been seen or heard calling. The species is abundant within surveyed habitats in the remainder of the area, however, particularly along the Hunter Main Trail as well as the California Trail and Commission Road. Barn Owls (Plate 9) are widespread but comparatively sparse, having been observed only during systematic surveys: once to the west of Commission Road in the east of the study area; and five times in the Hungerford and Baerami Creek catchments. These birds are less likely to occur within denser forested areas, as they depend on open country for foraging, such as grassy woodlands or grasslands. In addition to these records, Barn Owls are known to occur within the cleared lands that fringe the north-western boundary of the park. An interesting interaction was had between a pair of Barn Owls and a pair of wildlife surveyors while the surveyors were returning to camp after spotlighting in the Baerami Valley in September 2004. The birds were first seen foraging in the paddocks, including hovering and swooping on suspected prey. On spotting the car, the owls flew towards it, proceeding to hover within ten metres of the windscreen for a few minutes. When the surveyors slowly drove on, the owls followed the car, continuing to hover and swoop for another five minutes, as if curious about the object. Eventually the birds retreated and were last seen perching in a paddock tree and a fence post. The Barn Owls located within open farmland are likely to utilise buildings for roosting, including sheds and old homesteads, while those within the park itself are likely to utilise tree hollows and caves or overhangs.

Plate 9: Barn Owl © Narawan Williams/DEC

The small Australian Owlet-nightjar (*Aegotheles cristatus)* is widespread and abundant within the study area, its variety of calls having been heard on 100 occasions while individuals have been spotted additionally at eight locations. These observations are scattered throughout the areas of the park that were targeted for systematic survey, with particularly

high numbers recorded around the Baerami, Hungerford, Doyles and Appletree Creek catchments, as well as along the Glenn Gallic and California Trails. The White-throated Nightjar (*Eurostopodus mystacalis)* is also common, though less frequently detected than the Australian Owlet-nightjar. This species has been recorded on 27 occasions (26 during systematic survey), the majority of which are located in the drier habitats in the north-western corner of the study area, around the Baerami and Hungerford Valleys, the Glen Gallic Trail and the Yarrawa area. Six records exist for the far east of the study area, on the California Trail and the north of the Commission Trail. The Australian Owlet-Nightjar usually forages for insects at the mid-storey to ground level, while the White-throated Nightjar usually forages at canopy height, particularly within larger gaps in the canopy, taking insects on the wing (N. Williams pers. comm.). The tendency of the latter species to utilise more open vegetation types may explain its higher degree of abundance within the woodlands in the north-west of the study area.

The Tawny Frogmouth is common throughout forests and woodlands of the greater Blue Mountains and Hunter Range regions, including within the study area. This bird has been frequently observed in all of the areas where surveys have been undertaken. It occurs in a wide variety of habitats, and is therefore common in both the drier woodlands in the west of the study area and the moister forested gullies in the east. This well-camouflaged bird is often spotted along roadways at night, where it perches on overhanging branches waiting to capture insects, frogs, rodents or other small ground-dwelling animals from the road surface (N. Williams pers. comm.).

3.4 ARBOREAL MAMMALS

Ten species of arboreal mammal have been recorded within the study area, including four species listed as Vulnerable under the TSC Act (1995): Yellow-bellied Glider (*Petaurus australis*, 48 locations), Squirrel Glider (*Petaurus norfolcensis*, 10), Koala (*Phascolarctos cinereus*, 9) and Eastern Pygmy-possum (*Cercartetus nanus*, 1). These records continue to provide evidence that the Yellow-bellied Glider is more widespread and abundant through the sandstone reserves of the greater Sydney region than previously thought and conversely that the Squirrel Glider is rare within the reserve system maintaining a stronghold within dry woodlands of the Hunter Valley and Central Coast. An interesting encounter with a Koala was had in October 2004. During a very hot day, when the temperature was over 40 degrees Celsius, an individual was spotted approximately three metres from the ground in a Grey Myrtle (*Backhousia myrtifolia*) shrub in Rose Gully, a tributary of Hungerford Creek. Open woodland dominated by Grey Gums was present on the slopes above the creek and it is likely that the animal had retreated to the gully line to escape the intense heat and seek shelter in the dense shade provided by the Myrtle. These threatened arboreal mammal species will be discussed further in Section 5 of this report.

Fifty-two systematic spotlight sites have been completed across the study area. The most frequently encountered species of arboreal mammal in the study area was the Common Brushtail Possum *(Trichosurus vulpecula)*, recorded at over 100 locations. This large possum was observed during 50 percent (26 of 52) of systematic site spotlight surveys, as well as during nocturnal call playback surveys, nocturnal streamside searches, numerous times opportunistically and even once in a hollow during a diurnal herpetofauna search. Common Brushtail Possums have been recorded in all areas where systematic surveys have been undertaken. However, the species appears to be more abundant along the creeks and valley systems in the west and to a lesser extent the east of the study area, and less abundant along the ridgelines in the east and south, such as along the Commission Road and the Hunter Main Trail. Across NSW, the Common Brushtail Possum has been located more frequently in drier open forests and woodlands (Kavanagh 2004), explaining its greater abundance in the drier western half of the study area.

Sugar Gliders (*Petaurus breviceps*) are also widespread, having been recorded at over 50 locations. This small mammal uses a variety of habitats, but requires suitable trees with hollows for nesting and sufficient foraging material, particularly nectar and pollen, *Acacia* gum, the sap of certain eucalypts and invertebrates (Suckling 1995a). The species has been heard calling within each of the main habitats within the reserve, including gully lines, slopes and ridges in the north-west, east and south. This species smaller body size, lower energy demands, and more diverse diet enable it to occupy many environments not inhabited by the closely related Squirrel Glider (Quin 1995). The Sugar Glider and Squirrel Glider are very difficult to distinguish, and some surveyors continue to have problems, particularly when individuals are young or are partly obscured from view by foliage or mist. Such identification difficulties were experienced along the Hunter Main Trail, and some question remains about the identity of gliders observed here. Four individuals were identified as Squirrel Gliders at this locality during CRA surveys, however the high elevation (above 490 metres asl) and habitat is highly

unusual for this species. It is well established that Squirrel Gliders prefers dry woodlands below 300 metres asl and are not found in tall forests or closed forest (e.g. Goldingay and Jackson 2004). Hence, for the purposes of this report it will be assumed that Squirrel Gliders only occur within the dry woodlands along the northern perimeter of the study area, as will be discussed further in Section 5.

Greater Gliders (*Petauroides volans*) have been recorded on numerous occasions, however these records are restricted to a few locations in the east and the south of the study area. Of the 35 locations at which the species has been observed, 26 occur along the Hunter Main Trail at the boundary between Wollemi National Park and the Putty State Forest. This area is at higher elevation than the remainder of the study area, lying above 500 metres, and is characterised by higher rainfall and a complex of moderately tall woodland and forest. Records of these large gliders also occur along gully lines in the east of the study area, including Parsons Creek (along Putty Road), Hayes Creek (along the California Trail) and Wambo Creek. These gully systems are characterised by tall Blue Gum forests, with a mesic influence in the understorey. In contrast, Greater Gliders were not recorded in the drier woodland habitats in the north-west, despite numerous spotlight surveys being undertaken. Greater Gliders are known to prefer tall forests, particularly in higher elevation areas, so this pattern of occurrence within the reserve is to be expected.

The Feathertail Glider (*Acrobates pygmaeus*) (Plate 10) is also present within the study area, though this small agile marsupial is very difficult to detect. It has been directly observed on 13 occasions, identified once from remains within a Fox scat and one individual was found after being killed during a tree felling exercise. Fifteen individuals of this species were detected during nine spotlighting surveys (less than 15% of surveys), sometimes detected by their faint eyeshine and sometimes by their fast movements up or down trunks or when gliding. One individual was observed when it landed on a Mountain Blue Gum trunk in front of a surveyor and had trouble moving quickly on the smooth bark. The glider records are distributed widely across the study area, however all the records occur either within creekline habitats or in the higher rainfall areas of the park.

Plate 10: Feathertail Glider © Ray Williams

The Common Ringtail Possum prefers habitats with a dense sub-canopy, vine or shrub layer, in which to shelter and build their spherical nests (dreys). Such habitats are somewhat limited within the study area and consequently the abundance of Ringtail Possums is low. The species has been observed on only six occasions, a drey has been found once and a skull has been identified from a seventh location. There is insufficient data to assess patterns of occurrence of the species across the study area, however it appears to be absent from the dry grassy woodland habitats in the far north-west. This result is consistent with findings within similar habitats in Goulburn River National Park (NPWS 2001a). It has been recorded at a wide range of altitudes, from below 200 metres asl just east of Martindale Creek to over 600 metres asl on the Hunter Main Trail in the south-west of the study area.

A single Mountain Brushtail Possum (*Trichosurus caninus*) has been recorded within the study area, located opportunistically on the Hunter Main Trail during the CRA surveys in May 1997. This species is more typical of tall forests at higher elevations, the type of habitat that is very limited within this section of Wollemi National Park. The Possum is therefore likely to only occur in the south and south-west along the Hunter Range and in the vicinity of Mount Monundilla.

3.5 BATS

The Microchiroptera, or microbats, are a sub-order of bats that are generally small, feed on insects and navigate using echolocation (Churchill 1998). Twenty species of microbat are known to occur within the study area, including both tree and cave-roosting species. Only four of these species were known to occur prior to the undertaking of DEC surveys, highlighting just how essential systematic surveys are to gaining an understanding of this fauna group. The systematic surveys have indicated that north-eastern Wollemi National Park contains habitat for seven species that are listed as Vulnerable under the NSW TSC Act (1995): the East-coast Freetail-bat (*Mormopterus norfolkensis*), Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*),

Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*), Greater Long-eared Bat (*Nyctophilus timoriensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Eastern Cave Bat (*Vespadelus troughtoni*). These threatened species will each be discussed further in Section 5. In addition, the Large-footed Myotis (*Myotis adversus*) has been recorded once within the park, its ultrasonic call detected by anabat along the Hunter Main Trail during CRA surveys in May 1997. The species has not been recorded since, however, and there is doubt regarding the reliability of this record, as discussed below.

The study area supports a high diversity of microbat species due to the large range of microhabitats, environments and landscape features present within the park. The extent of this diversity is exemplified by the results collected from a single harp trap erected along Hungerford Creek in October 2004. On the first night, over 100 bats of eight species were captured between dusk and dawn, including the Eastern Bent-wing Bat, Gould's Long-eared Bat (*Nyctophilus gouldi*), Gould's Wattled Bat (*Chalinolobus gouldii*), Eastern Broad-nosed Bat (*Scotorepens orion*), Greater Broad-nosed Bat, Chocolate Wattled Bat (*C. morio*), Little Forest Bat (*Vespadelus vulturnus*) and Large Forest Bat (*V. darlingtoni*). On the second night, the trap was checked at approximately 10 pm and a further 150 bats were present, including an additional four species (Lesser Long-eared Bat (*Nyctophilus geoffroyi*), Eastern Cave Bat, Inland Broad-nosed Bat (*Scotorepens balstoni*) and Inland Freetail-bat (short penis form, *Mormopterus* sp. 3). The trap was closed at 10 pm to risk injury to the bats and to avoid having to hold large numbers of animals the following hot day. Small pools of water were present along the creek near the harp trap at the time of survey and as the surrounding environment was very dry and the temperature very hot at the time it is thought that many of the bats were coming in to drink or forage over the water. The creek was acting as a fly-way (or bat highway), thus supporting commuting bats that would roost in a variety of different microhabitats and environments.

A total of 53 harp trapping sites and 50 ultrasound call detection sites have been completed in the study area. The microbat species most frequently encountered during the systematic surveys was the Little Forest Bat. In total 449 individuals were captured at 37 locations, representing 73 per cent of harp trap sites. The species was detected an additional 27 times by its ultrasonic call. This species was followed by the Gould's Long-eared Bat (57 per cent of traps) and Chocolate Wattled Bat (43 per cent of traps and 28 times by call). These three small microbats are tree-roosting species that each occupy a wide range of habitats across their range, from dry woodland and mallee to wet sclerophyll forest (Churchill 1998). Within the study area they have been recorded within all of the main habitat types. Records are concentrated around the perimeter of the park and along major access trails, however this is an artefact of sampling as harp trapping has not been undertaken in the more remote sections of the park. These species are likely to also be abundant across the central Narrabeen sandstone plateau.

Plate 11: *Mormopterus norfolkenis* (left) and *Mormopterus* species 2 © Elizabeth Magarey/DEC

Fourteen tree-roosting microbat species have been recorded in harp traps at lower frequencies, either because they are less abundant or because their habit of flying higher than the traps can be set prevents them from being captured. Of particular interest is the large number of species that approach the edge of their known distribution within the study area, resulting in the presence of a number of species from within genera that do not usually occur together. The mix of Freetail-bats illustrates this inter-regional diversity. Four species occur: East-coast Freetail-bat (*Mormopterus norfolkensis*) (recorded 2 times), Eastern Freetail-bat (*Mormopterus* sp. 2) (recorded 11 times), Inland Freetail-bat (short penis form, *Mormopterus* sp. 3) (recorded once) and Southern Freetail-bat (long penis form, *Mormopterus* sp. 4) (recorded 3 times). The first two species (Plate 11) are typically eastern Australia animals, occurring along and to the east of the Great Dividing Range (Churchill 1998). The latter two species, however, are more common in western NSW, typically inhabiting dry or semi-arid areas inland of the Great Dividing Range (Churchill 1998). The pattern of occurrence of this group of bat species within the study area broadly follows these trends. Though the number of captures are too low to draw firm conclusions, the Eastern Freetail-bat and East-coast Freetail-bat have been recorded at more locations in the east of the study area, while the two remaining *Mormopterus* species have been recorded more often in the drier western environments. Similarly both inland and coastal species of Broad-nosed Bat are found within the study area: the Inland Broad-

nosed Bat (*Scotorepens balstoni*, 7 locations) and the Eastern Broad-nosed Bat (*Scotorepens orion*, 19 occasions). Furthermore, these two species were twice captured in the same trap, indicating that their ranges actually overlap within the park. Other examples of the mix between eastern and western species include the Greater Long-eared Bat which is more typical of semi-arid environments in western NSW, and Large Forest Bat which prefers areas that receive more than 500 mm of rainfall along the east coast (Churchill 1998).

The Long-eared Bats (*Nyctophilus* sp.) have only been detected by harp trapping, as the species of this genus cannot be reliably distinguished by their ultrasonic call using standard parameters (Pennay *et al.* 2004). These bats can orientate and forage without using echolocation (Churchill 1998), such that very short quite calls are often all that is recorded by ultrasound recording devices. Their abundance and distribution is therefore underestimated across the study area in comparison to bat species that can be detected using both techniques. Long-eared Bats have been recorded using ultrasonic detection at least 16 locations in the study area. It is apparent from harp-trapping results, however, that Gould's Long-eared Bat is the most abundant species of this genus, followed by the Lesser Long-eared Bat. As will be discussed in Section 5, the Greater Long-eared Bat appears to be present only at low abundance, although this could be underestimated by sampling techniques.

The White-striped Freetail-bat (*Nyctomus australis*) is common and widespread within north-eastern Wollemi National Park, having been detected in all sampled environments with the exception of the Martindale Trail. This is one of only two species of bat that occurs in central NSW that emit navigation calls that are audible to humans. Consequently it has been detected aurally during a range of survey techniques including at 30 spotlighting sites, nine nocturnal call playback sites, one nocturnal stream-side search and eighteen times opportunistically. The White-striped Freetail-bat is a fast-flying species that does not manoeuvre very well and tends to forage in open areas or above the tree canopy usually 50 metres or more above the ground (Churchill 1998). It is therefore rarely captured in harp traps, and was not detected by this method. It can sometimes be detected using the ultrasonic call detection system, however, and was recorded at 15 locations by this method. This bat is known to utilise a wide range of habitats and is expected to occur throughout the study area.

Five cave-roosting bat species have been recorded within the study area, supported by the abundance and complexity of sandstone caves, as well as the existence of a series of disused oil shale mines within the Baerami Valley. The most frequently encountered of these species was the Eastern Bent-wing Bat; 98 individuals were captured at six harp locations and a further 23 records were collected using the ultrasonic call detection system. This medium-sized microbat has been detected in all areas where bat surveys have been undertaken, though it appears less common in the east of the study area, perhaps because there are fewer roosting sites (caves and mines) there. Of particular interest was the capture of a banded Eastern Bent-wing Bat along Ruebens Creek in September 2004. This bat was originally banded in Castle Hill in June 2002 (G. Hoye pers. comm.). The Eastern Horseshoe-bat (*Rhinolophus megaphyllus)* and Large-eared Pied Bat were also frequently encountered, recorded at 29 and 21 locations respectively. The Eastern Horseshoe-bat has been recorded most frequently in the north of the study area, probably because of the mines and the abundance of caves along the northern escarpment. In contrast records of Large-eared Pied Bat are distributed evenly across all areas where surveys were undertaken, except in the south-east.

The Eastern Cave Bat was first detected in the park in September 2004 when an individual was discovered roosting on the ceiling of a sandstone overhang north-east of Ruebens Knob. This is an exciting find as very little is known about this species and this was the first roost site to be located in the region. The species has since been captured six times in harp traps, in both the north-west and north-east of the study area. The species can be very difficult to distinguish using ultrasonic call, so its abundance and distribution may be underestimated in relation to bats that can be detected by both methods. Never the less, DEC surveys in Yengo National Park (DEC 2005c), Manobalai Nature Reserve and Crown Lands (DEC 2005b) and Goulburn River National Park (NPWS 2001a) have revealed the region to be a stronghold for the species.

The Baerami oil-shale mines have been the subject of a series of surveys between 1987 and 2001, the majority undertaken by Fly By Night Bat Surveys Pty Ltd (Hoye 1995; Hoye 1999; Hoye 2001). These surveys have yielded interesting information about the bats that use the mines and the impacts of shaft collapses and entrance grilling. In summary, numbers of the Eastern Bent-wing Bat have been reported to decline over time, from several hundred in at least two mines in 1987 to approximately 30 in just one mine in 1999 (Hoye 2001). This is thought to be due to the grilling of mine entrances and the collapse of adits. Eastern Horse-shoe Bats appear to have maintained their numbers more consistently over time, and remain present in at least four mines (Hoye 1999). These bats may also have been effected by grilling and adit collapse in the Widden No. 2 mine, however, as

numbers have decreased slightly in this mine. The Large-eared Pied Bat was recorded at the entrance to Neats Mine in 1995 and it was considered likely to be roosting within the mines also (Hoye 1995). During the current surveys in September 2004, all three species of cave-roosting bat, the Eastern Bent-wing Bat, Eastern Horse-shoe Bat and Large-eared Pied Bat were detected by anabat at the entrance to Neats mine, indicating that they are all still present within this mine. In addition, small numbers of Eastern Horseshoe Bat were observed roosting in both Widden No. 2 and Neats adits. No attempt was made at this time, however, to calculate actual abundance of any of the bat species. It is recommended that further monitoring of the mines be undertaken in order to assess whether bat numbers continue to decline, and to inform future management of the mine adits and entrances.

The 2004-05 surveys of the Hunter Range reserves have revealed an interesting pattern in the occurrence of microbat species across the area. The composition of bat species supported within each park is directly related to the habitat types located therein, with a clear change in assemblages from the moist coastal environments to the dry western-influenced environments. The bat fauna of Werakata National Park is dominated by coastal species including Eastern Broad-nosed Bat (*Scotorepens orion*), Large Forest Bat (*Vespadelus darlingtoni*) and Little Bent-wing Bat (*Miniopterus australis*) (DEC 2005k). Northern Yengo National Park primarily supports species that prefer higher rainfall environments, but also contains a single western species, Southern Freetail-bat (*Mormopterus* sp. 4, long penis form) in very low numbers (DEC 2005c). A diverse mix of bats inhabit Wollemi National Park, including species typical of both eastern and western environments. The Eastern Broad-nosed Bat is present in conjunction with the Inland Broad-nosed Bat, while the coastal Eastern Freetail-bat (*Mormopterus* sp. 2), East-coast Freetail-bat and Large Forest Bat exist alongside the western Southern Freetail-bat, Greater Long-eared Bat, and Inland Freetail-bat (*Mormopterus* sp. 3, short penis form). The bat fauna of Manobalai Nature Reserve is less diverse and is characterised by species typical of the western slopes, including the Yellow-bellied Sheath-tail Bat, Greater Long-eared Bat, Southern Freetail-bat and possibly the Inland Freetail-bat (DEC 2005b). The environment is too dry for the coastal species to exist there.

A single record of a Large-footed Myotis (*Myotis macropus*) exists for the study area, identified from an anabat recording made on the Hunter Main Trail during CRA surveys in May 1997. This species is listed as Vulnerable under the NSW TSC Act (1995). This location is not typical for the species, which is usually located within riparian zones or close to permanent water bodies (Churchill 1998). The ultrasonic call of Large-footed Myotis is very difficult to distinguish from those of the Long-eared Bats (*Nyctophilus* species) (Reinhold *et al.* 2001), and it is possible that the call recorded on the anabat was misidentified. There is a chance that the individual recorded on the Hunter Main Trail was a Large-footed Myotis moving between foraging areas, such as between some of the major creeklines or between dams. However, the study area is unlikely to form significant habitat for the species. The nearest confirmed location for the species is approximately ten kilometres to the north of the study area, on Myambat defence lands (Anon 2005). The species is more likely to occur in the vicinity of major rivers in the region, such as along the Hunter River and its permanent tributaries. Due to the uncertainty surrounding this record, the species has not been considered further in this report.

A single record from 1995 of a the Eastern Forest Bat (*Vespadelus pumilus*) exists within the Atlas of NSW Wildlife, however there is uncertainty regarding the accuracy of this record, as the individual may have been confused with the Eastern Cave Bat or another Forest Bat species, or could be spatially inaccurate. The Eastern Forest Bat is generally a more coastal species, though there is a very small chance that the species may occur within the moist forested areas within the study area.

One species of Megachiroptera (commonly known as fruit bats) has been recorded within the park, the Grey-headed Flying-fox (*Pteropus poliocephalus*). A number of these large bats were recorded for the first time within the study area in January 2005, observed feeding in the abundantly flowering Box and Ironbark trees in the east of the study area. These individuals probably derive from the recently formed colony within Burdekin Park in Singleton, just under thirty kilometres to the east of the area. It is possible that Grey-headed Flying-foxes only visit the study area during large flowering events, as will be discussed further in Section 5. Little Red Flying-foxes (*Pteropus scapulatus)* were recorded roosting in Burdekin Park in Singleton in January 2005, together with the Grey-headed Flying-fox colony. Twenty-thousand individuals of Little Red Flying-foxes were present during the height of summer, and the species bred there for the first time on record (A. Williams pers. comm.). Little Red Flying-foxes set up more temporary camps than those of other flying-fox species as they are reliant on flowering blossom that usually only lasts four to six weeks (Churchill 1998). The bats departed Burdekin Park in May 2005. It is possible that Little Reds utilise north-eastern Wollemi National Park on occasion, when eucalypts are in heavy flower or when food resources are limited elsewhere. However they have not been recorded within Wollemi or adjacent Yengo National Park to date.

3.6 NATIVE GROUND MAMMALS

Ground mammals are difficult to sample adequately as they either require a large, labour intensive trapping effort (e.g. dasyurid and *Rattus* species), are large bodied, wide-ranging habitat-generalists (e.g. Wombats, wallabies, kangaroos), or they prefer inaccessible and precarious habitats (e.g. Brush-tailed Rock-wallabies (*Petrogale penicillata*)). Hence, due to time constraints, fewer sites could be sampled for ground mammals than the other fauna groups. The majority of records for large ground mammals, such as wombats and macropods, have come from opportunistic sightings, while a number of small ground mammal records have come from predator scat analyses. A limited amount of Elliott trapping was undertaken, resulting in the capture of three native species.

A total of fourteen species of native ground mammal have been recorded within the study area, including two species listed as threatened under both state and federal legislation. The Spotted-tailed Quoll (*Dasyurus maculatus*), listed as Vulnerable, has been recorded at four locations, twice by direct observation and twice by the identification of scats left by the predator. This species is among the most cryptic of ground mammals and has not been detected during recent systematic surveys in either north-eastern Wollemi, Yengo or Goulburn River National Parks, Manobalai Nature Reserve, or in the southern Sydney region (DEC 2005d). The Brush-tailed Rock-wallaby, listed as Endangered under the TSC Act (1995) and Vulnerable under the EPBC Act (1999), has been recorded on a number of occasions within the study area, with the majority of recent sightings concentrated between Martindale and Appletree Creeks. These species will each be discussed further in Section 5 of this report.

The most commonly recorded ground mammal within the study area is the Common Wombat (*Vombatus ursinus*), detected by direct observation, burrow entrances, and their characteristic, often prominently placed, scats. These large marsupials are widespread and have been recorded in all major habitats including the drier grassy Box woodlands to the north of the study area, the dry sclerophyll woodlands and forests on the sandstone plateau, and the moister forests in the south and east.

Plate 12: Red-necked Wallaby © Narawan Williams/DEC

In addition to the Brush-tailed Rock-wallaby, four species of macropod occur within the park. The most abundant of which is the Swamp Wallaby (*Wallabia bicolor*), recorded at over 80 locations either by direct observation or by remains identified from predator scats (see Section 3.10). The majority of records are concentrated along roads and walking trails, as this is where the species is most visible and where the majority of predator scats have been collected. However, the wallaby is likely to be widespread, occurring wherever a thick layer of undergrowth provides suitable cover and foraging habitat.

The Common Wallaroo (*Macropus robustus)* and the Red-necked Wallaby (*Macropus rufogriseus)* (Plate 12) are also common, recorded at 38 and 36 locations respectively. The Red-necked Wallaby has been observed more frequently in the east of the park, recorded at only six locations to the west of Martindale Creek. This distribution pattern is to be expected, as this wallaby is essentially a coastal species occurring in the hinterland forests of south-eastern Australia (Calaby 1995). The Common Wallaroo on the other hand is more common in the northern half of the reserve, where it has regularly been observed amongst or adjacent to the steep talus slopes, rocky escarpments and sandstone outcrops and overhangs that abound in this area. This large robust mammal is well adapted to drier environments and inhabits a wide range of habitat types across NSW, though steep escarpments and rocky hills are a constant feature of their preferred environment (Poole 1995). The Eastern Grey Kangaroo (*Macropus giganteus*) is less common, recorded at fourteen locations mostly in the northern half of the area. On eight of these occasions this large kangaroo was observed near the park boundary in cleared or agricultural areas, demonstrating its preference for open grassy habitats for foraging that are adjacent to woodlands for shelter.

One species of monotreme occurs within the study area, the Short-beaked Echidna (*Tachyglossus aculeatus*). This distinctive animal has been directly observed on only two occasions: once on the northern Commission Road near Appletree Creek and once as road-kill on the Putty Road. However, the species often leaves distinctive traces where it has been, such as diggings in the side of ant nests and termite mounds, or their long, smooth, cylindrical-shaped scats. Such traces of the Echidna have

been found frequently, indicating that the species is in fact widespread, though cryptic and possibly only present in low numbers. The records are concentrated in the north and north-west of the study area, though as the species is known to occur within a very wide range of habitats, it is likely that this pattern is simply an artefact of sampling effort.

Five species of small native ground mammal have been recorded within the park, each in relatively low numbers. These low numbers probably reflect the difficulty of detecting such species, however, rather than being a true indication of abundance or distribution. The two most frequently recorded species are rodents: the Bush Rat (*Rattus fuscipes*, observed at 15 locations) and the New Holland Mouse (*Pseudomys novaehollandiae*, 8). The records for each of these species are widely dispersed across the study area, including in the north-western corner, the central sandstone plateau and the far east. The Bush Rat is likely to be widespread and relatively common across the study area where suitable habitats containing dense undergrowth of shrubs or ferns occur. The New Holland Mouse reaches the western limit of its distribution in central NSW near the study area, with records also collected in Goulburn River National Park. Its occurrence within the park is therefore important to the ongoing conservation of this species across its range. Three small dasyurid marsupials also occur: Yellow-footed Antechinus (*Antechinus flavipes*, recorded at 8 locations), Brown Antechinus (*Antechinus stuartii*, 7) and Common Dunnart (*Sminthopsis murina*, 1). Records of the two Antechinus species are reasonably disjunct with the Yellow-footed Antechinus recorded in the north in the vicinity of Doyles Creek, Martindale and Baerami while the Brown Antechinus has been recorded further south, on the Glenn Gallic Trail, the central sandstone plateau and the Hunter Main Trail. These species have elsewhere been reported to partition habitat, with Yellow-footed Antechinus occurring in more open forests while Brown Antechinus occurs in wetter denser forests (Braithwaite 1995). However, whether the separation within the study area reflects true habitat preferences, or is an artefact of the low sample size, would only be ascertained with further research. The Common Dunnart was captured in 1994 in the north-west corner of the study area, near Dingo Creek at the boundary of the forest and a grassy patch. This species is elsewhere known to occur within a wide variety of habitats, though it is notoriously difficult to capture in Elliott traps. It may therefore be more common within the study area than records currently indicate.

The Long-nosed Bandicoot (*Perameles nasuta*) was observed once in 1997 on the Hunter Main Trail approximately five kilometres east of Mount Monundilla. In addition, the species was recently observed by a land-holder in the Baerami Valley, when an adult female and her young were injured on the farm (S. Hartup pers. comm.). Bandicoots often leave evidence of their presence in the form of conical-shaped diggings (Triggs 1996). Such diggings have been recorded more extensively, including in the north-western corner in the vicinity of Kings Creek and also possibly in the east of the reserve. The systematic survey techniques did not target bandicoots, and cage trapping or extensive hair tube surveys would be required to assess the species occurrence and distribution.

There is no direct evidence currently available regarding the extent to which Dogs within the study area have Dingo heritage. Currently, all of the Wild Dogs recorded have been entered into the Atlas of NSW Wildlife under the name 'Dingo/domestic Dog' (*Canis lupis*) as it is not possible to ascertain the ancestry of individuals without DNA testing. However, all of the individuals that were directly observed during the 2004-05 surveys exhibited marked domestic Dog morphological characteristics and are probably at least partially derived from farm Dogs. It must be noted, however, that these Dogs were all observed near the perimeter of the park, where the opportunity to hybridise with domestic breeds is greatest. Recent research undertaken within Yengo National Park has indicated that hybrid Dogs are most concentrated around the perimeter of the park while dogs in the core of the park have a very high degree of Dingo heritage, exhibited in their DNA, appearance and behaviour (T. Horwood pers. comm.). A similar pattern is likely to occur within Wollemi National Park and it is recommended that the research program being undertaken in Yengo National Park be expanded to cover the whole Hunter Range region. This research should aim to: ascertain patterns in the heritage of Dogs/Dingoes across the region; identify key areas of Dingo purity and Wild Dog invasion; provide an understanding of the dynamics of social, territorial and foraging behaviour; provide an understanding of the interaction between Dingo/Dog packs and other predators; and hence provide the bases for informed management strategies. At the very lease, genetic material should be collected from any dead dogs, and sent for analysis to determine its heritage. Ideally, such research should be undertaken before broad-scale Dog control programs are implemented or continued.

A single record of the Vulnerable Parma Wallaby exists within five kilometres of north-eastern Wollemi National Park. The species was identified from a hair sample collected at Little Darkey Creek in northern Yengo National Park in 2002. It is unlikely that the wallaby occurs within the study area, however, due to the scarcity of suitable habitat. It prefers grassy clearings within tall wet layered wet forest, primarily north from the Watagan Mountains (Menkhorst and Knight 2001).

3.7 REPTILES

The diversity of environments within the study area supports an outstanding mix of reptile species. DEC surveys have confirmed the presence of 45 species of reptile, including five geckos, three legless lizards, four dragons, two monitors, 23 skinks and eight snakes. Eighteen of these species were not known to occur prior to systematic surveys. In addition to this, three species have been recorded within 300 metres of the boundary of the park: the Eastern Snake-necked Turtle (*Chelodina longicollis*), Tussock Rainbow-skink (*Carlia vivax*) and Eastern Bandy-bandy (*Vermicella annulata*). The latter two of these have each been recorded within Yengo National Park on the opposite side of the Putty Road from Wollemi National Park and are highly likely to also occur within the study area. The Eastern Snake-necked Turtle has been observed within numerous dams on private property immediately adjacent to the national park boundary. The species is likely to be rare within the park itself, however, due to the absence of suitable habitat. It may occur within some of the fire dams that exist within the park boundary, but the drainage systems are unlikely to hold standing water frequently enough to sustain the species. Two additional species have been recorded on a single occasion by casual observers. One of these, the Rosenberg's Goanna (*Varanus rosenbergi*), is listed as Vulnerable under the TSC Act (1995) and is considered likely to occur at low abundance throughout the higher rainfall areas of the park, as will be discussed further in Section 5. In total, 49 species of reptile are found within north-eastern Wollemi National Park.

A total of 122 systematic reptile searches were completed across the study area. Lesueur's Velvet Gecko (*Oedura lesueurii*) is the most widespread and commonly encountered reptile species, having been recorded during 36 percent of diurnal herpetofauna searches. It is most frequently detected underneath exfoliating rock, as well as in crevices and under bark, and has been recorded on slopes and ridges across the study area, particularly around rock outcrops. The Broad-tailed Gecko (*Phyllurus platurus*, also known as Southern Leaf-tail Gecko) and Thick-tailed Gecko (*Underwoodisaurus milii*) are also widespread, recorded at 33 and 32 locations respectively. The Thick-tailed Gecko has most commonly been observed between Hungerford and Doyles Creeks, while the Broad-tailed Gecko appears common wherever cracks and crevices in rock provide shelter sites for the species. The Stone Gecko (*Diplodactylus vittatus*) is less common but still widespread, recorded most frequently on slopes and ridges between Doyles Creek and the Widden Valley. The Robust Velvet Gecko (*Oedura robusta*) was recorded for the first time within the study area during systematic surveys in February 2005, when it was located in an Ironbark tree on the ridge just east of Appletree Creek. This species has the north coast at the centre of its distribution, where it inhabits dry sclerophyll forests and woodlands, particularly around rock outcrops. It has not been recorded further south than the Watagan State Forest, situated approximately 20 kilometres south of the study area. The discovery of the gecko within Wollemi National Park, the fifth most southerly location for the species on the Atlas of NSW Wildlife, contributes important information about the species at the southern limit of its known range.

Plate 13: Leaden Delma © Alex Dudley/DEC

The Leaden Delma (*Delma plebeia*) (Plate 13), an attractive legless lizard with rusty-brown markings and dark bars on the side of its lips, was recorded for the first time in Wollemi National Park during the systematic surveys in 2004, within the Baerami, Doyles Creek and Martindale Valleys. The species has only been recorded on three occasions further south, within Yengo National Park (DEC 2005c) and Pokolbin State Forest. This legless lizard indicates, once again, that the study area lies at the convergence of the known distribution of species more typical of both the northern and more southern areas of NSW. The Southern Scaly-foot (*Pygopus lepidopus*, recorded at four locations) and Burton's Snake-lizard (*Lialis burtonis*, recorded at three locations) are known to occur in a wide range of habitats to both the north and south of the study area and are likely to be widespread within the region, though their cryptic nature means that they are rarely encountered.

The four species of dragon recorded have each been encountered on a similar number of occasions, yet have a different pattern of distribution across the study area. The Eastern Bearded Dragon (*Pogona barbata*) has been recorded at 18 locations in the vicinity of the Baerami, Hungerford, Martindale and Doyles Creeks, as well as the Glenn Gallic and Yarrawa Trail. In contrast, the Jacky

Lashtail (*Amphibolurus muricatus*) is largely restricted to the east, with all records except one occurring on or to the east of the Martindale Trail. The distribution of these species reflect their broader ranges and habitat preferences, as the Jacky Lashtail is primarily a coastal species, while the Eastern Bearded Dragon ranges from the coast to the semi-arid regions of NSW. The Eastern Water Dragon is a semi-aquatic species (Cogger 1996) and is usually located within the vicinity of permanent water bodies, often basking on rocks or vegetation by the water's edge. It is therefore restricted to the major creeklines where pooled water is held, including Hungerford, Gungalwa, Doyles and Hayes Creeks. The Mountain Heath Dragon (*Tympanocryptis diemensis*) is more widely distributed, but is most commonly located on upper slopes and ridgelines above 400 metres in altitude.

The Lace Monitor (*Varanus varius*) is common and widespread, recorded in a wide range of habitats from the dry Red Gum – Box Woodlands in the north to the mesic Blue Gum Forests in the east. The Sand Monitor (*Varanus gouldii*), however, is restricted to the drier north-western corner of the study area, where on average less than 650 mm of rain falls per annum. This species was regularly encountered along the eastern half of the Glen Gallic Trail during surveys undertaken in October 2004, a time when males may be more readily encountered as they search for a mate. In contrast the extremely cryptic Rosenberg's Goanna has been recorded only once at higher elevation and is likely to occur only within areas that receive more than 650 mm of rain on average per annum.

North-eastern Wollemi National Park supports a rich mix of skink species, including species that are typical of the central east coast and hinterland, the central western slopes and plains, and the north coast. The Dark-flecked Garden Sunskink (*Lampropholis delicata*), Pale-flecked Garden Sunskink (*L. guichenoti*), Red-throated Cool-skink (*Bassiana platynota*), Weasel Shadeskink (*Saproscincus mustelinus*) and Yellow-bellied Three-toed Skink (*Saiphos equalis*) are part of a suite of species that have only been located on and/or to the east or south-east of the Martindale Trail and along the Hunter Main Trail, and appear to be absent from the drier northern and north-western environments. This pattern of occurrence is a direct result of the species habitat preferences and tolerances, as they each prefer more moist habitats with a coastal climate influence. The Barred-sided Skink (*Eulamprus tenuis*), though also a largely coastal species, is capable of inhabiting drier forest and open woodland habitats (Swan *et al.* 2004) and hence has been recorded across the study area, though at low density. This is a largely arboreal lizard that would be expected to occur anywhere in the study area where suitable trees or rock outcrops provide shelter (e.g. hollows or crevices), basking sites and foraging areas.

The Tree-base Litter-skink (*Lygisaurus foliorum*) is the most abundant skink in the dry northern woodlands, recorded at a total of 43 locations and during 41 per cent of diurnal herpetofauna surveys in the north. In contrast, the species has only been recorded at two locations in the south-east and has never been detected in the south along the Martindale Trail or the Hunter Main Trail. Similarly, the Eastern Ranges Rock-skink (*Egernia modesta*) has only been recorded in the far north of the study area, once along the perimeter trail east of Appletree Creek and once in the vicinity of Kings Creek. Together with records from Wambo Coal Mine, adjacent to the eastern boundary of the park, these locations comprise the southern-most records for the Eastern Ranges Rock-skink on the Atlas of NSW Wildlife. The Two-clawed Worm-skink (*Anomalopus leuckartii*) has been recorded at four locations, once by the Australian Museum in 1998 and three times during the current systematic surveys. Each location lies in the dry environments in the north-west of the park, along the major creeks and flats within the Baerami and Hungerford Valleys. The records collected during the current surveys constitute a small southerly range extension for the species. These results illustrate again that the study area encompasses a range of environments that form the crossover for a number of species at the edge of their distribution.

Plate 14: Pink-tongued Skink © Elizabeth Magarey/DEC

The South-eastern Slider (*Lerista bougainvillii*) has been recorded thirteen times during systematic diurnal herpetofauna searches and twice when rocks were turned on an opportunistic basis, primarily located on ridges and slopes. The South-eastern Morethia Skink (*Morethia boulengeri*) has been recorded at eight locations. A distributional pattern is apparent for both of these species as they have only been recorded in the north-western region between Mount Nielson and the western boundary of the study area. The Tree-crevice Skink (*Egernia striolata*) and the Southern Rainbow-skink (*Carlia tetradactyla*) typically occur on and to the west of the Great Dividing Range, extending towards the coast only where drier

environments occur, such as in the Hunter Valley (DEC 2005a). The former species is widespread in the north of the park, occurring in a wide range of habitats here from creek flats to rocky ridges. In contrast, it has not been recorded in moister environments along the Hunter Main Trail and only occasionally in the east of the park. The latter species, typical of dry sclerophyll forests and eucalypt/Cypress woodlands (Cogger 1996) is also more common in the north where such habitats occur, including on the escarpment slopes of the Hungerford, Baerami, Kings, Doyles and Appletree Creek Valleys. All four of these species approach the eastern edge of their range in central NSW within Wollemi and Yengo National Parks, occurring here because of the western-influenced environments that exist within the Hunter Valley.

There are a number of reptile species that do not exhibit any obvious alliances to particular regions of the study area, but are instead more widespread, occurring where the particular landscape features and microhabitat parameters are appropriate for them. For example, the Eastern Water Skink (*Eulamprus quoyii*) occurs along all the major creeks as well as at the headwaters of smaller creeks near the Martindale Trail and the Hunter Main Trail. Records of the Punctate Worm-skink (*Anomalopus swansoni*) are scattered across the area, but are most common on slopes, spurs and small creeks and appear to be absent from higher rainfall habitats such as along the Hunter Main Trail, the California Trail or their major creeklines. This species is particularly abundant on the Martindale Range; during one diurnal herpetofauna search on a narrow rocky spurline in the north of the Range a total of twelve individuals were located under rocks. This hour of reptile searching revealed a particularly high number of reptiles of other species also, including thirteen Three-toed Earless Skinks (*Hemiergis decresiensis*), five Cream-striped Shining-skinks (*Cryptoblepharus virgatus*), four Tree-base Litter-skinks, two South-eastern Sliders, two White's Rock-skinks (*Egernia whitii*), two Tree-crevice Skinks (*Egernia striolata*), and one each of Broad-tailed Gecko, Thick-tailed Gecko, Copper-tailed Ctenotus (*Ctenotus taeniolatus*). This site exemplifies the high richness of reptiles within the study area. The Copper-tailed Ctenotus has been recorded at 57 locations (during diurnal herpetofauna searches and opportunistically) which are widely scattered throughout the study area except on the California Trail. This distinctive lizard has most commonly been recorded on ridges, where it is usually located in rocky areas under rock slabs, but has also been observed along some creeklines in the north-west. The Robust Ctenotus (*Ctenotus robustus*), in contrast, has only been recorded on nine occasions, each near the northern boundary of the study area. This lizard was found on creek flats and lower slopes on all but one occasion where it was seen on the summit of Mount Nielson. This species is known to occur in a wide range of environments from the coast to the arid areas of the state (Swan *et al.* 2004), so its occurrence in the drier parts of the study area is not surprising.

Two more species of *Egernia* occur, in addition to the Eastern Ranges Rock-skink and the Tree-crevice Skink mentioned above. The White's Rock-skink (*Egernia whitii*) is the most frequently encountered *Egernia*, usually observed on slopes and ridges, rather than in riparian zones, due to its love of rocky situations where it shelters under rock slabs and in crevices (Cogger 1996). Cunningham's Spiny-tailed Skink (*Egernia cunninghamii*) was recorded for the first time during the current surveys. This large distinctive lizard is closely associated with rock outcrops and was observed either on rock or in rock crevices on every occasion it was seen. Cunningham's Spiny-tailed Skink is a species complex that is subject to considerable variation in colour and pattern across its range (Cogger 1996). The majority of individuals seen during the surveys had an appearance typical of the group that occurs on Sydney Sandstone (*Egernia cunninghamii krefftii*), however some of the animals appeared to exhibit features of the Northern Tablelands group.

The Common Blue-tongue (*Tiliqua scincoides*) has been recorded on only three occasions, located in the Baerami, Hungerford and Doyles Creek Valleys. However, this species is known to occur in a wide variety of habitats, from the coast to semi-arid areas west of the Great Dividing Range (Swan *et al.* 2004) and is therefore expected to be more widespread in the study area than records indicate, particularly in the northern forests and woodlands, though it may only remain at relatively low density. The Pink-tongue Skink (Plate14) in contrast favours moist conditions, occurring in humid environments from the Hawkesbury River to northern Queensland (Swan *et al.* 2004) and was observed three times in the reserve, on the southern Martindale Trail and the Putty Road. This species would be restricted to wet sclerophyll forest and rainforest in higher rainfall areas the south and east of the park.

There is uncertainty regarding the occurrence of an additional skink species within the park, the Southern Forest Cool-skink (*Niveoscincus coventryi*), which has been recorded on a single occasion. The record is regarded as suspect, as this is a species typical of the south-eastern NSW high country, preferring montane sub-alpine environments, and has not been recorded elsewhere within over 100 kilometres of the study area. This species has therefore not been included in species totals within this report.

Only one species of blind-snake, the Blackish Blind-snake (*Ramphotyphlops nigrescens*) has been recorded within the study area, observed at three locations during the CRA surveys and once by State Forests surveyors, each in the south-west along the Hunter Main Trail. Blind-snakes are notoriously difficult to detect and the species is likely to be more widespread than records indicate. In addition, two further species of blind-snake have been recorded within five kilometres of the study area, and have the potential to occur within the reserve: the Brown-snouted Blind-snake (*Ramphotyphlops wiedii*) and Proximus Blind-snake (*Ramphotyphlops proximus*).

The Elapids are the most diverse and abundant group of snakes within the park, with six species recorded. The Red-naped Snake appears to be the most rare of this group, recorded only once in 1984 in the south-eastern corner of the study area. The Southern Death Adder has been recorded in five locations, once on the parks eastern boundary and four times in the Baerami Valley. The species has also been observed on the Baerami Creek Trail outside of the study area boundary, while land holders in the valley often see these snakes in their paddocks (L. Smith pers. comm.). The Baerami and Wilpen Creek Valleys appear to be a stronghold for the Death Adder within the region. Records of the Small-eyed Snake (*Rhinoplocephalus nigriscens*), Yellow-faced Whipsnake (*Demansia psammophis*) and Eastern Brown Snake (*Pseudonaja textilis*) are sparsely scattered across the study area, at six, five and four locations respectively. These species utilise a broad range of habitats and are each likely to occur across the study area where suitable microhabitats occur, though perhaps at low abundance. The Red-bellied Black Snake (*Pseudechis porphyriacus*) has been recorded on five occasions, each either along a creekline or a road. This species is usually associated with streams, swamps and lagoons (Cogger 1996) and so is likely to occur across the study area either within the drainage systems or moving between them. The Spotted Black Snake (*Pseudechis guttatus*) has not been recorded within the park to date, but is regularly observed on the adjoining alluvial flats and has the potential to occur along the major creeklines and flats in drier northern environments.

The Diamond Python (*Morelia spilota spilota*) and Eastern Brown Tree Snake (*Boiga irregularis*) have been recorded infrequently, three times and twice respectively, though both have been recorded on one or two further occasions immediately outside the eastern park boundary on the Putty Road. The Diamond Python favours rainforest and heavily timbered areas (Swan *et al.* 2004) and within the study area is expected to occur only within more moist environments including sheltered gorges in the north of the park and taller forests with mesic understorey in the east and south. The Eastern Brown Tree Snake approaches the south-west of its range in this area, though it has also been recorded in Goulburn River National Park (NPWS 2001a).

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 the 2004-2005 systematic survey period, the weather was dry and warm, providing poor conditions for conducting frog surveys. However, storms and heavy downpours occurred prior to and during a number of the spring and summer surveys, providing a window of opportunity to sample the frog fauna. As the duration of optimum conditions was limited, only a small number of systematic nocturnal streamside searches were undertaken. Frogs were also encountered on an opportunistic basis during these times as they used the wet weather to disperse and were encountered on roads and trails and during other systematic survey techniques such as site spotlighting, diurnal herpetofauna searches and nocturnal call playback.

The systematic surveys between 1997 and 2005 confirmed the presence of 20 species of frog within the study area, of which fourteen were not previously known to occur. An additional species was recorded in Parsons Creek along the Putty Road, but 50 metres from the park boundary, and is considered highly likely to also be present, bringing the total to 21 frog species. This total includes twelve Myobatrachidae (ground frogs), which lack toe discs and rarely climb trees, and nine Hylidae (tree frogs), which have toe discs and frequently climb trees or rocks (Robinson 1993). Of particular conservation significance is the occurrence of Giant Burrowing Frogs and Red-crowned Toadlets in the south and east of the study area, which are both listed as Vulnerable under the TSC Act (1995). Both of these species reach the northern limit of their known range within the study area such that their protection within the reserve is significant to the conservation of the species across their range. These threatened species will each be discussed further in Section 5.

By far the most widespread and abundant species is the Common Eastern Froglet (*Crinia signifera*), which was observed or heard calling in all of the medium and large creeklines that were visited during the surveys, ranging from those within Box woodland and She-oak forest to Blue Gum Forest. This small frog calls consistently throughout the year and so is easily detected by auditory surveys, though it usually remains quite visually inconspicuous. The Bullfrog (*Limnodynastes dumerilii*) is also

common, recorded at 34 locations along creeklines and roadways in the north, east and south of the park. There is uncertainty regarding the distribution and identity of subspecies of this frog, but it appears that both *L. dumerilii greyi* and *L. d. dumerilii* occur. The other ground frogs were each recorded at much lower frequency, and include the Ornate Burrowing Frog (*Limnodynastes ornatus*, 8 locations), Bibron's Toadlet (*Pseudophryne bibronii*, 12 locations) and Spotted Marsh Frog (*Limnodynastes tasmaniensis*, 4 locations), Dusky Toadlet (*Uperoleia fusca*, 2 locations) and Smooth Toadlet (*Uperoleia laevigata*, 2 locations). The Painted Burrowing Frog (*Neobatrachus sudelli*) was recorded for the first time within the study area on the park boundary in the Doyles Creek Valley in November 2004, after a heavy rain and thunderstorm. This burrowing frog remains underground during dry periods, emerging only after heavy summer rains when it breeds in grassy marshes, flooded claypans and temporary pools (Cogger 1996). The discovery of the species within the park was fortunate, and a case of simply being in the right place at the right time. The species is likely to occur across the north-western portion of the study area, particularly on deeper alluvial sands, though this would only be confirmed by undertaking surveys after similar downpours. The Painted Burrowing Frog is essentially a species of western NSW, more common in woodland and shrubland to the west of the Great Dividing Range (Robinson 1993). Within central NSW, the species has only been recorded to the east of the study area on one occasion, spotted on the Putty Road during the CRA surveys.

Fletcher's Frog (*Lechriodus fletcheri*) was recorded for the first time within the study area during the CRA surveys, when five frogs were observed during a spotlighting survey on the Hunter Main Trail approximately one and a half kilometres east of Three Ways. The vegetation here is wet sclerophyll forest with Blue Gums in the canopy and rainforest plants in the understorey. It is unusual for Fletcher's Frog to be recorded so far from the coast, and the species only survive here because of the relatively high rainfall and the coastal-influenced vegetation. Indeed, this is a very significant finding as the population constitutes an outlier for the species, with the closest known populations located at Barrington Tops and Mount Royal (90 kilometres to the north-east) and the Watagans (70 kilometres to the south-east). Further research on the occurrence and distribution of the species in the region is warranted.

The Dusky Toadlet and Smooth Toadlet are difficult to distinguish and identification difficulties were experienced during the DEC surveys. Some question therefore remains about the identity and distribution of these species. The Dusky Toadlet appears to be more common, having been seen and heard at two locations in the park, whereas the Smooth Toadlet is apparently more rare.

Another significant finding during the current systematic surveys was that of the Great Barred Frog (*Mixophyes fasciolatus*), detected in January 2005 along the Putty Road. The individual was calling from Parsons Creek, which runs along the Putty Road separating Wollemi and Yengo National Parks. The frog was within the boundaries of Yengo National Park, however it is considered highly likely that the species also occurs within this eastern section of Wollemi National Park, in the wet sclerophyll forest that occurs here. This is an important record as the species has not previously been reported within the region or as far west in the southern end of its range. It may be that the species also occurs within the mesic gully systems on the Hunter Range, though this would only be confirmed by targeted surveys after rain in late spring or early summer.

A thirteenth species of ground frog, the Striped Marsh Frog (*Limnodynastes peronii*) was observed just under 300 metres from the boundary of the National Park on a tributary of Baerami Creek in May 2005. This species prefers still or slow-moving, permanent waterbodies, such as swamps, dams or ponds (Cogger 1996). Systematic surveys have not detected this species within the reserve, but it may be present near the perimeter where former farming lands now lie in the reserve, or adjacent to pools in the lower reaches of large watercourses.

Plate 15: Red-eyed Green Tree Frog © Narawan Williams/DEC

The current surveys also yielded significant information about the occurrence of tree frog species within the study area. Six of the species were expected to occur within the area given their known distribution and habitat preferences, including (followed by the number of locations at which they have been recorded) Peron's Tree Frog (*Litoria peronii*, 21), Lesueur's Frog (*Litoria lesueuri*, 10),

Broad-palmed Frog (*Litoria latopalmata*, 9), Green Tree Frog (*Litoria caerulea*, 8), Eastern Dwarf Tree Frog (*Litoria fallax*, 3) and Keferstein's Tree Frog (*Litoria dentata*, 3). The discovery of the remaining three species was more surprising. The Green Stream Frog (*Litoria phyllochroa*, 3) has not been confirmed elsewhere within 20 kilometres of the study area (DEC 2005a). The discovery of the Blue Mountains Tree Frog (*Litoria citropa*, 1) by a pool in Wilpen Creek in October 2004 was exciting as this animal was not previously known from the region and constitutes a north-westerly range extension for the species. The only records north of this within the NSW Wildlife Atlas come from Barrington Tops, a remnant area of rainforest and wet sclerophyll forest, with habitats similar to those in which the Blue Mountains Tree Frog was located within the study area. The presence of such a species indicates the refugia properties that are provided by deeper sheltered gullies in Wollemi National Park. Like many plant species, the presence of a frog that prefers moist habitats within such a dry environment suggests a relict population that perhaps was more abundant in the past, when the entire continent was wetter. The discovery of Red-eyed Tree Frogs (Plate 15) within the area is also significant, as the records collected by DEC in 1997 and 2005 constitute a south-westerly range extension for the species. These results indicate, yet again, that the study area encompasses the range limits for a large number of fauna species, and therefore has conservation high significance.

Another threatened species, the Green and Golden Bell Frog (*Litoria aurea*) has been recorded at Mount Owen mine to the north-east of the study area. It is considered highly unlikely that this species also occurs within the study area due to the absence of potential habitat, preferring large permanent swamps and ponds (Robinson 1993).

3.9 INTRODUCED SPECIES

3.9.1 Introduced mammals

The distribution of introduced species records within the study area is presented in Map 3 and Map 4. Seven species of introduced ground mammal are feral within the study area. This includes species that are well established and widespread (such as Fox, Rabbit (*Oryctolagus cuniculus*) and Wild Dog (*Canis lupus*)) and species that have only been reported on a few occasions (including Cat (*Felis catus*), Goat (*Capra hircus*) and Brown Hare (*Lepus capensis*)). An additional two introduced species recorded within the park, Cattle (*Bos taurus*) and Horse (*Equus caballus*) are likely to be escaped domestic animals. Horses have been recorded on only three occasions, not more than 700 metres within the park boundary. Cattle, however have been recorded at sixteen locations, mostly evidenced by their scats, and though the majority have been near the boundary of the park, the species has been recorded up to nine kilometres inside the boundary, having walked in along major creeklines such as Doyles Creek. The specific impact of Cattle grazing along these creeklines is not known, however depending on its intensity it is likely to be affecting the regeneration of some plants, spreading weeds, fouling water holes and causing harm by trampling and compacting the soil. These impacts may have flow-on effects for the native fauna that rely on these creek-line habitats.

Two species of introduced carnivore are abundant within the study area. The Dog (or Dingo/Dog) has been directly observed on six occasions but detected by its scats at 31 locations, while the Fox has been directly observed on eight occasions and identified from its scats at a further 22 locations (Map 3). It is difficult to ascertain from these records the preferred habitats of Dogs or Foxes within the study area, as the scats were mostly collected from roads and trails where they are easily visible. However both species have been recorded in all major environments, ranging from the dry north-western corner to the moist forests around Mount Monundilla. Foxes have been recorded up to seven kilometres inside the park boundary, but records are most concentrated around the perimeter. A third species of introduced carnivore, the Cat, appears less abundant, observed at only four widely spaced locations, each near the boundary of the study area. It is uncertain, however, whether these figures reflect a real low density within the park or whether the species elusive nature simply means it goes largely undetected (for example scats are typically buried and therefore difficult to locate).

The most frequently recorded introduced species within the study area is the Rabbit, observed on 22 occasions and detected by its scats at a further 17 locations. The majority of these records were collected near the perimeter of the study area, where Rabbits abound within the more fertile grassy areas and are highly visible along roads and trails and at the edges of bushland. The species has been recorded up to six kilometres inside of the park boundary, but only near areas that have suffered some disturbance in the past such as on the California Trail at the old 'California' property, along Hungerford Creek and Reubens Creeks and the Long Arm Trail. The species was also detected on some ridgelines, including near the top of Mount Nielson, on the escarpment west of Baerami Creek and along the Hunter Main Trail. Four additional species of introduced herbivores have been located

within the area at a much lower frequency, the House Mouse (*Mus musculus*, recorded at 6 locations), Goat (2 locations), Hare (observed once only) and Black Rat (trapped once only) (Map 3). The low number of records of Goat and Hare are likely to accurately reflect low abundances within the study area, however the House Mouse is likely to be more abundant and widespread than records indicate, particularly at the bush-agriculture interface and in areas that have been disturbed in the past.

The introduced mammal species are likely to be having a significant negative impact on the native terrestrial flora and fauna of the study area. Four of the species are listed as a Key Threatening Process on the TSC Act (1995) and the EPBC Act (1999), 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 of these animals are summarised below. In addition, Wild Dogs pose a threat through predation, and have been declared a pest species throughout NSW under the Rural Lands Protection Act (1998).

- Feral Rabbits impact negatively on indigenous fauna species via competition for resources, alteration of the structure and composition of vegetation, ring-barking of trees and shrubs and digging of burrows, which in turn contribute to soil erosion (NSW Scientific Committee 2002b). They compete for food and/or shelter with some native fauna species, such as the Brush-tailed Rock-wallaby (NSW Scientific Committee 2002b), and are thought to have contributed to the extinction of several small mammal species (DEH 2004b). Feral Rabbits form the major component of the diet of feral Cats and Foxes in many areas and can maintain populations of these predators at high levels. Sharp declines in Rabbit numbers (such as those caused by disease outbreaks) can cause these introduced predators to prey on indigenous fauna species to a greater extent than they would otherwise be able to (Smith and Quin 1996).
- 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. Species of particular concern are the Spotted-tailed Quoll and Brush-tailed Rock-wallaby. Fox predation has been implicated in limiting habitat choice and population size of a number of medium-sized marsupials (NSW Scientific Committee 1998a). The fact that Foxes prey upon native animals within the study area is evident from scat analysis, as summarised in section 3.10 below.
- Feral Cats threaten native fauna by direct predation, being 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 2000a). Current impacts on native fauna are likely to be most severe in modified, fragmented environments and in areas where the abundance of alternative prey (such as Rabbits and House Mice) fluctuates widely (NSW Scientific Committee 2000a).
- Feral Goats have a major impact on native vegetation through soil damage and overgrazing and can cause significant habitat degradation by trampling, deposition of droppings, and the introduction of weeds (NSW Scientific Committee 2004b). They can compete with native animals for food, water and shelter (NSW Scientific Committee 2004b) and have particularly been implicated as a threat to the Endangered Brush-tailed Rock-wallaby through competition (NSW Scientific Committee 2003a).

Clearly the potential for introduced predators and herbivores to significantly impact on native fauna in the study area is of concern. Comprehensive targeted survey of the species, assessment of their impacts and interrelationships with other predator and prey species, both native and introduced, followed by appropriate management actions, should remain a high priority for study area management.

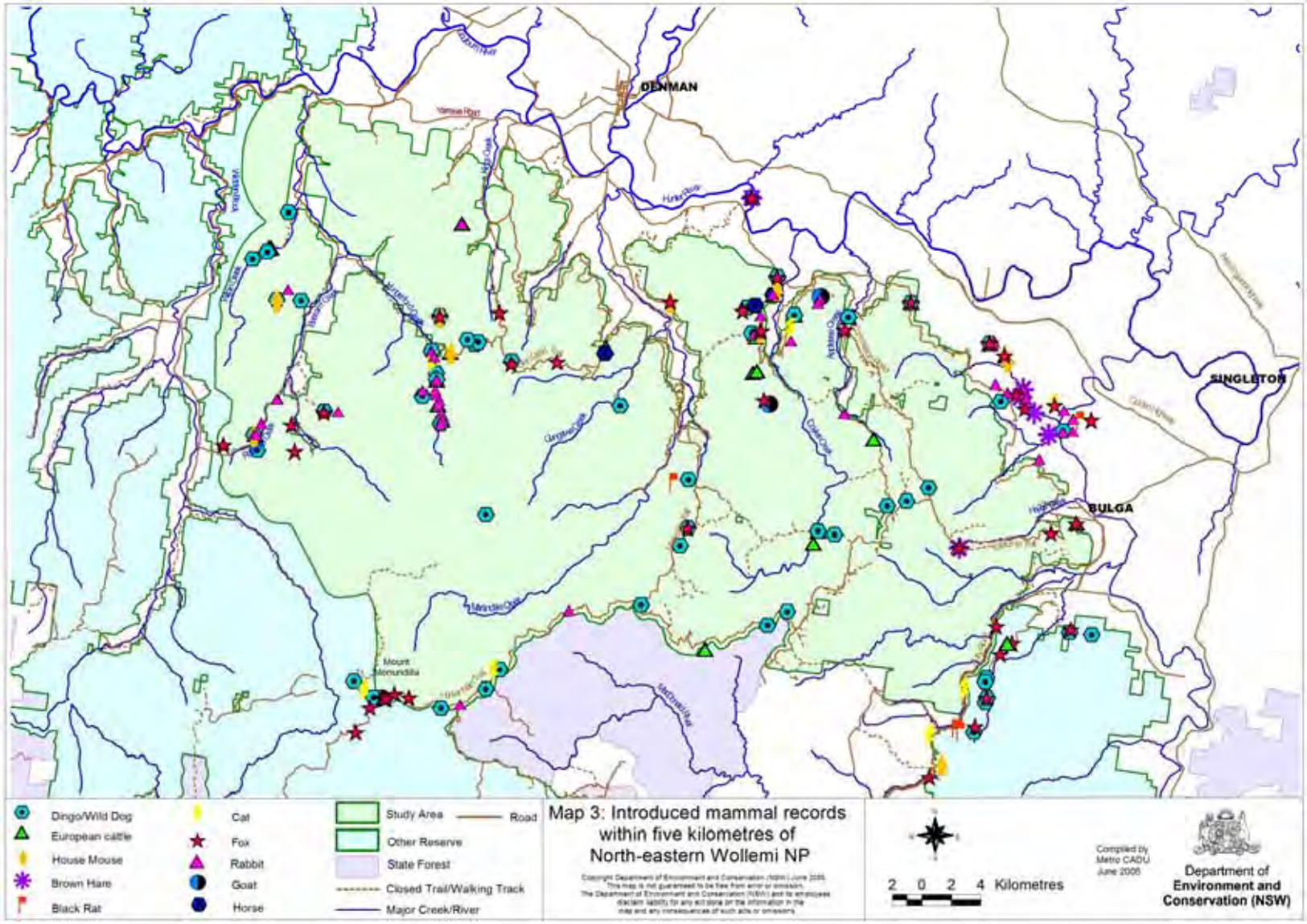
3.9.2 Introduced birds

Eight introduced species of bird are recorded for the study area on the Atlas of NSW Wildlife (Map 4). The most commonly recorded of these is the Common Starling (*Sturnus vulgaris*), which since 1998 has been seen in eight locations on the boundary of the reserve. The Common Myna (*Acridotheres tristis*) has been observed at six locations, which similarly are all on or immediately outside the boundary of the national park. Large numbers of both species are regularly observed in the cleared valleys and plains to the north, yet these birds have not been recorded more than 100 metres inside the national park boundary. This result is typical of Common Starlings, whose preferred habitat in Australia is disturbed lands such as urban areas, pastoral country and gardens (Pizzey and Knight

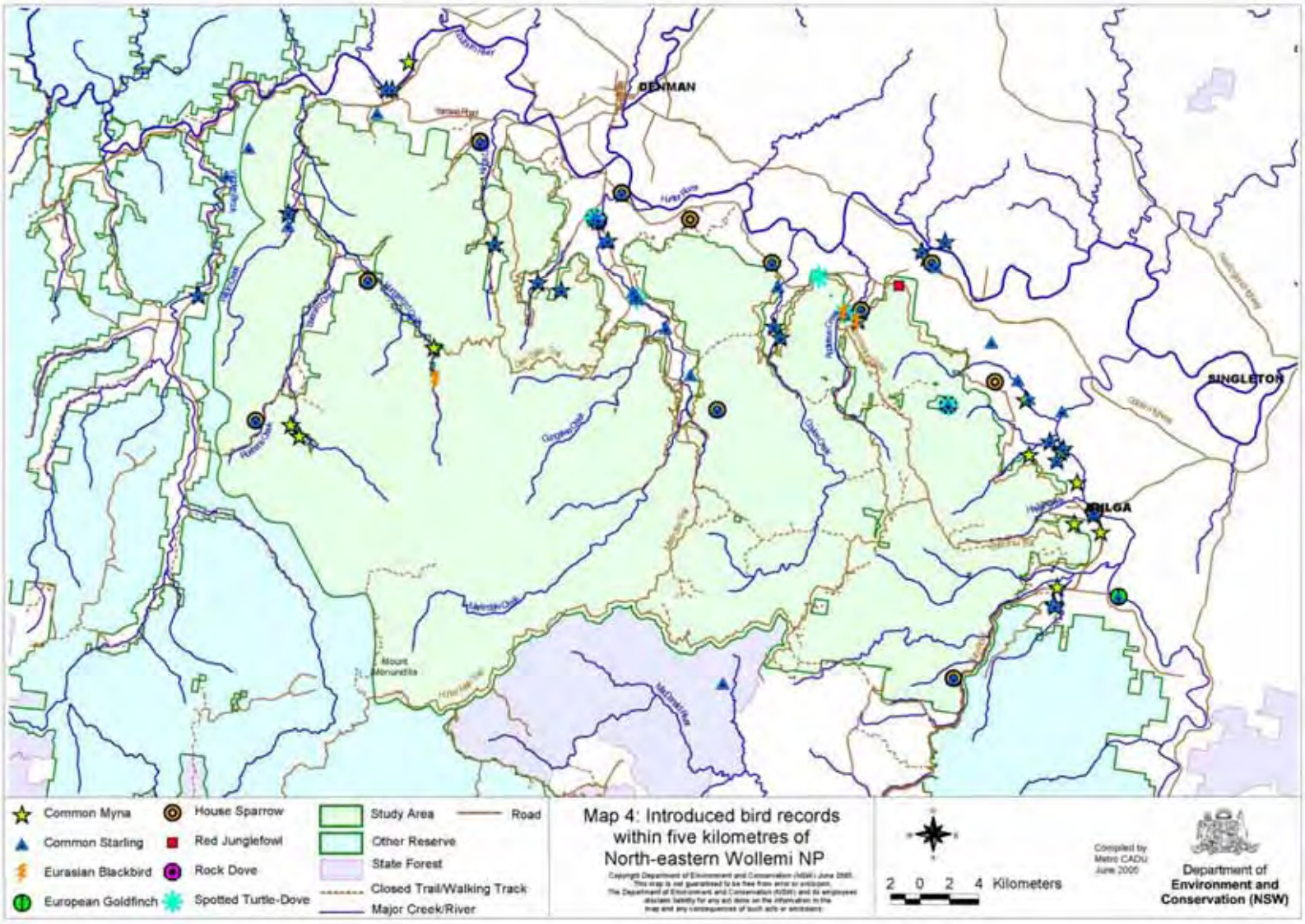
1999). Common Mynas are also usually closely associated with human habitation though they will inhabit open grassy woodlands remnants supporting hollow-bearing trees (Pell and Tidemann 1997).

Common Starlings are known to compete with native birds for nest sites such as tree hollows. Common Mynas are infamous for their aggressive nature, often seen bullying their own and other species for food, nesting sites or territories, particularly in woodland areas. The latter species is known to evict native birds, including parrots, kookaburras, Dollarbirds (*Eurystomus orientalis)* and Australian Magpie-larks (*Grallina cyanoleuca*) from their nests, before dumping out their eggs or chicks (Environment ACT 2004). They are also considered to be a threat to the local survival of mammals that depend on tree hollows, such as Sugar Gliders, particularly in urban habitats (Environment ACT 2004) and have been observed taking over roost sites of White-striped Freetail-bats (M. Schulz pers. comm.). Starlings are well established in rural areas and there is evidence that Common Mynas are spreading out from urban areas into more rural settings, which may increase the impact on native wildlife. Barrett *et al.* (2003) listed the Common Myna as a species that had increased in the frequency of recordings across its distribution between 1984 and 2002. Local residents in the Upper Hunter Area have noticed increasing numbers of this distinctive bird in recent years (J. Barlow pers. comm.). Threatened species that depend on hollows in woodland habitats, such as the Brown Treecreeper and some microbats, are particularly at threat from these introduced species. The distribution of Common Mynas and Common Starlings within the valleys that indent the north of the park should be monitored, and if the species are found to move further into the park, or to increase in number in the Box Woodlands at the edge of the park (on which a number of threatened species depend), action should be taken to control the birds. Any such action must be sure to target the introduced species and not impact on native bird species.

The remaining six species of introduced bird have only been recorded on a small number of occasions within the study area. Three of these, the Rock Dove, House Sparrow and European Goldfinch have only been recorded by Birds Australia in the early 1980s, when the spatial accuracy of records was low. These species have not been observed within 300 metres of the park boundary since spatially accurate data has been collected, and though they possibly occur within the cleared lands adjacent to the park (such as on the floor of the Baerami, Hungerford, Martindale and Doyles Creek Valleys), they are unlikely to occur within the park proper. Two of the species, the Spotted Turtle-Dove and Eurasian Blackbird have each been recorded on three occasions within the study area since the collection of accurate data. Similarly each of these locations is on the interface between the park and cleared lands, the Spotted Turtle-dove around Appletree and Doyles Creeks and the Eurasian Blackbird around Appletree Flat and towards the end of the Hungerford Creek Trail. A Wild Domestic Fowl (*Gallus gallus*) was spotted 300 metres within the park boundary in the far north-eastern corner of the study area in February 2005. This was likely to be an individual that had escaped from neighbouring farmland. With the exception of the Eurasian Blackbird, it is unlikely that any of these species, would intrude far into the bushland within the national park itself and it is therefore unlikely that they pose a significant threat to the ecology of the park.



Map 3: Introduced mammal records within five kilometres of north-eastern Wollemi National Park



Map 4: Introduced bird records within five kilometres of north-eastern Wollemi National Park

3.10 PREDATOR SCAT ANALYSIS

The analysis of Fox and Dog scats yields interesting information about the vertebrate prey composition of the predator's diet. In order to increase sample size and yield greater information about the predators diets, Dog and Fox scats collected from the Hunter Range area of both Wollemi and Yengo National Parks have been pooled and analysed together (Figure 2). Only limited conclusions can be drawn from these results due to the low number of scats analysed and the different length of time it takes to digest different-sized prey animals. Swamp Wallabies, for example, may be over-represented in the sample due to their large size. It is clear, however that a mix of native and introduced ground and arboreal mammals are taken.

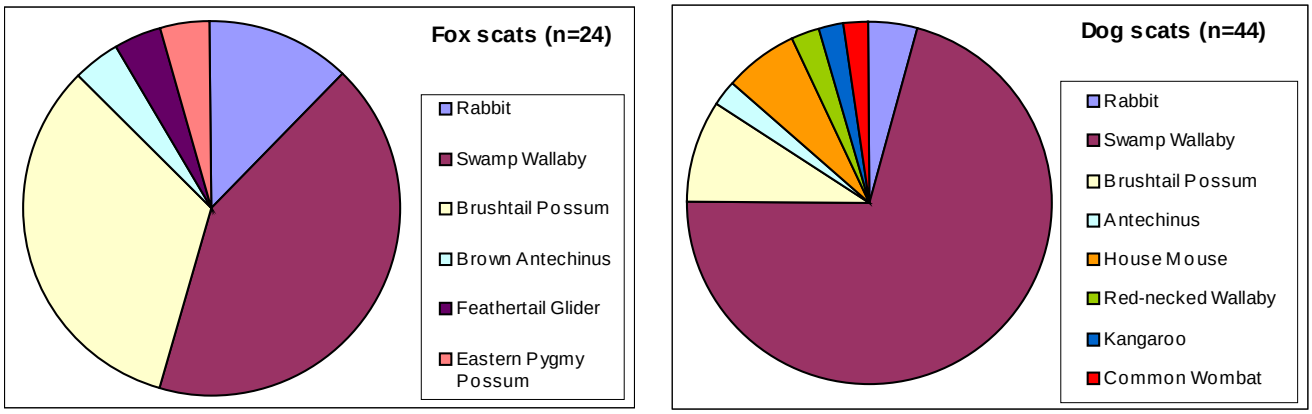


Figure 2: Vertebrate prey items (hair and skeletal remains) identified from predator scats collected in Wollemi and Yengo National Parks (Hunter Range Area)

3.11 LANDSCAPE SCALE PATTERNS IN FAUNA DISTRIBUTION

North-eastern Wollemi National Park lies at the junction of a number of environmental and climatic influences. This is illustrated by the diversity and pattern of vegetation communities, as described in Section 1.5. Vegetation ranges from dry woodlands characteristic of the central western slopes in the north, sclerophyllous forests and woodlands typical of hinterland sandstone environments in the south and east, to moist gully systems with north coast botanical influences in the north-east. The range of landscape features, including alluvial flats, escarpment slopes and cliffs, sandstone benches, outcrops and caves, deeply incised gorges and rolling hills add to the complexity of habitats provided. The composition of fauna species across the study area reflects this diversity of environmental influences and landscape features.

The bird, bat and reptile assemblages in the north of the study area are influenced by the dry environments of the Hunter and Goulburn River Valleys. At the interface of cleared and forested country a suite of threatened bird species known as the declining woodland birds make use of remnant Box-Red Gum-Ironbark Woodlands along lower escarpment slopes and valley floors. Species such as the Speckled Warbler, Black-chinned Honeyeater, Grey-crowned Babbler and Brown Treecreeper are closely tied to these environments and do not extend far into the reserve. A number of skink species are also tied to these drier environments which are more typical of habitats found in central western NSW. These include the South-eastern Slider, South-eastern Morethia Skink, Tree-crevice Skink and Southern Rainbow Skink. Similarly, Inland Freetail-bat (short penis form) and Southern Freetail-bat (Long penis form), Inland Broad-nosed Bat, Greater Long-eared Bat and Painted Burrowing Frog are more typical of semi-arid environments west of the divide. These species do not appear to extend further east into the coastal hinterland environments, as the climate is likely to be too moist for them. Also in this northern environment are species that depend on the system of rock outcrops and caves provided by the northern escarpment. These include the Brush-tailed Rock-wallaby and Eastern Cave Bat.

The central sandstone plateau in the south and east of the park supports species typical of Sydney Sandstone coastal hinterland environments, such as occur across southern Wollemi and the Blue Mountains. The sandstone has eroded to form a complex mosaic of crests, hills, gullies and benches, which each support a particular suite of species. Ridges and slopes support species that are closely tied to the shelter provided by rock outcropping, such as the Copper-tailed Skink and White's Skink. Gullies in this region support species typical of moist coastal environments, such as Lewin's Honeyeater, White-cheeked Honeyeater, Australian Brush-turkey and Bell Miner. The scarcity of well-

developed rainforest habitat means, however, that species such as the Sooty Owl only occur in the most sheltered and extensive incised gullies. Greater Gliders are found only in the tall forests associated with the gully systems and higher elevation areas on the Hunter Range. The occurrence of Fletcher's Frog within wet sclerophyll forest on the Hunter Range typifies the coastal influence here, as this species is rarely found so far inland. Species endemic to the Sydney Basin reach their northern extremity in the region, including the Rockwarbler and Red-crowned Toadlet.

The occurrence of some reptile and frog species illustrates the influence of more northerly environments. The Eastern Ranges Rock Skink and Two-clawed Worm-skink are typical of the northern tablelands and north-western slopes. The Robust Velvet Gecko usually occurs within dry sclerophyll forests and woodlands of the north coast. These three species each reach the southern limit of their distribution within the alluvial environments in the north of the park. The Pink-tongue Skink and Red-eyed Green Tree Frog favour wet sclerophyll forest and rainforest of the north coast, yet occur within the moist gully systems in the east of the reserve.

Similar patterns in fauna species composition are found in Goulburn River and northern Yengo National Parks and Manobalai Nature Reserve and crown lands. These patterns illustrate that the Hunter and Goulburn River Valleys and adjoining tributaries facilitate a connection between eastern and western environments, as well as between southern and northern influences. It may be that the major valley systems are movement pathways between regions both in current habitat occupation and in evolutionary history. The clearance of vegetation on the Hunter and Goulburn River Valley floors has interrupted this important ecological connection and placed a large number of species at risk of regional extinction. This highlights the high conservation significance of the reserve system in the Hunter Range Area, upon which numerous species are likely to depend for their continued survival in the region.

3.11.1 Distribution of threatened species

Fauna habitats vary widely in their spatial extent, with some being widespread, some naturally restricted and others heavily depleted due to clearing. They also vary greatly in their level of modification and number of threatened fauna. These disparities occur largely because threatening processes operate unequally across the landscape, with habitats that occur on more fertile soils experiencing greater disruption than habitats on less fertile, rocky and steep areas. The result of this is that some environments provide habitat for a disproportionately large number of threatened species.

The results of the recent DEC surveys, in combination with other data on the Atlas of NSW Wildlife, indicate that the escarpments and valleys in the north of the study area form a zone that encompasses particularly high numbers of threatened species. Several threatening processes are also concentrated in this area, posing great risk to these species. This 'Northern Perimeter Zone' is herein defined as an area extending one kilometre either side of the northern boundary of the reserve, primarily encompassing Box-Gum-Ironbark Woodlands. There are 15 threatened species that are confined to habitats within this zone. An additional 12 threatened species have also been recorded within the zone, although these are found more extensively elsewhere in the reserve. These 37 species are listed in Table 4.

Threatened species known to occur in the Northern Perimeter Zone	Primary habitat in the Northern Perimeter Zone (✓ =yes) (✗ =no)
Brush-tailed Rock Wallaby	✓
Regent Honeyeater	✓
Diamond Firetail	✓
Speckled Warbler	✓
Grey-crowned Babbler	✓
Black-chinned Honeyeater	✓
Turquoise Parrot	✓
Hooded Robin	✓
Brown Treecreeper	✓
Barking Owl	✓
Painted Honeyeater	✓
Greater Long-eared Bat	✓
Squirrel Glider	✓
Eastern Cave Bat	✓
Greater Broad-nosed Bat	✗
Masked Owl	✗
Grey-headed Flying-fox	✗
Koala	✗
Yellow-belled Glider	✗
Gang-gang Cockatoo	✗
Glossy Black Cockatoo	✗
Large eared Pied Bat	✗
Eastern Bent-wing Bat	✗
Powerful Owl	✗
East-coast Freetail-bat	✗
Spotted-tailed Quoll	✗
Eastern False Pipistrelle	✗

Table 4: Threatened fauna species known to occur in the Northern Perimeter Zone

4 MANAGEMENT RECOMMENDATIONS

4.1 AREAS OF HIGH CONSERVATION SIGNIFICANCE

The sites listed below have exceptional importance for the conservation of vertebrate fauna in the study area, particularly threatened species. Given limited resources, protection and enhancement of these sites and habitats will generate the maximum benefit to threatened species conservation and to vertebrate diversity in the study area.

4.1.1 The Northern Perimeter Zone

The Northern Perimeter Zone is defined as an area one kilometre either side of the northern boundary of the reserve, where a particularly large number of threatened species occur (Map 5). At least eight Key Threatening Processes operate in the Northern Perimeter Zone, which cover the following broad issues: clearing of native vegetation; high frequency fires; predation by the Red Fox; competition and grazing by Feral Goats; predation by the Feral Cat; competition and grazing by Feral Rabbits; removal of dead wood and trees; bushrock removal. Wild Dogs also pose a threat to native fauna in the Northern Perimeter Zone through predation, as does the invasion of exotic plant species and removal of hollow-bearing trees.

- Abatement of these threatening processes in the Northern Perimeter Zone should be a high priority for park management in accordance with the relevant Threat Abatement Plans.
- Many of the management recommendations provided below, including those regarding cooperative land management, land acquisition and further survey should be prioritised to the Northern Perimeter Zone, as indicated.

4.1.2 Baerami Oil Shale Mines

The disused Baerami Oil Shale Mines near Ruebens Creek (see Map 5) are known to be used by the Eastern Bent-wing Bat and Large-eared Pied Bat and it is considered likely that the site was used by Eastern Bent-wing Bats as a maternity roost in the past (Hoye 2001). The mines have already been the subject of specific survey effort and the number of roosting Eastern Bent-wing Bats has been observed to sharply decline between 1987 and 1999 (Hoye 1995, 1999, 2001). This decline is postulated to be due to changes in shaft access through grilling and shaft collapse (Hoye 2001)

- The maintenance of the Baerami Owl Shale mines as a roost site for Eastern Bent-wing Bat and Large-eared Pied Bat should take high priority in park management planning. To this end a number of projects and associated monitoring programs are required at these sites, as detailed in section 4.6.1 below.
- If possible, hot wildfires should be prevented from occurring in the immediate vicinity of the mines to prevent scorching of roost sites and/or infiltration of smoke.

4.1.3 Known localities of the Barking Owl

Surveys completed for this project have indicated that the dry woodlands of the Hunter Valley Escarpment are of considerable regional importance for this rare owl. As the majority of preferred habitat for this species is not currently reserved or protected, it is paramount that where territories are known on reserves, caution be exercised to ensure that they are not inadvertently modified in a manner that negatively impacts on the owl. There are four Barking Owl records within north-eastern Wollemi National Park, and a fifth record of the species just east of the park boundary, whose territory is likely to extend into the study area (Map 5). The territories of these owls are likely to be complex, probably extending linearly along creeklines (where prey availability is high) or along park boundaries where preferred habitat occurs. Since the exact territories cannot be determined without detailed study, a simplified approach for management purposes is adopted here, consisting of delineating a two kilometre radius around known records. Though this distance is somewhat nominal, it is likely to include the core habitat areas of these individual owls.

- Any park management activities conducted within a two kilometre radius of a known Barking Owl location should critically appraise potential impacts on the species roosting and nesting requirements.

- In the case of hazard reduction burning, creeklines within the designated burn area should be traversed to identify potential nest or roost sites, often indicated by wash on ground, litter or tree trunks. If nest or roost sites are located, the fire boundaries should be amended accordingly to exclude these sites. Hollow-bearing trees should be carefully protected from hot fires. Alternatively, hazard reduction burns should be excluded from known Barking Owl territories altogether.

4.1.4 Brush-tailed Rock-wallaby colonies

The recent DEC surveys detected the Brush-tailed Rock-wallaby at several locations (Map 5), including once in the Appletree Creek Valley where the species had not previously been recorded. These locations, together with those where the Brush-tailed Rock-wallaby was previously known to occur (Wong 1994 and DEC 2005a) hold very high conservation significance, and should be the subject of continued research into Fox control as part of the statewide Fox Threat Abatement Plan, as well as further monitoring and research, as recommended in section 4.6.1 below.

4.2 RECOVERY PLAN ACTIONS

There are a number of recovery plans for species that occur within the study area that have been approved by the Minister or are in final draft stages. The threats and recovery actions outlined in these plans that are relevant to the study area are discussed below.

4.2.1 Large Forest Owls

None of the recovery actions outlined in the Draft Recovery Plan for Large Forest Owls provide specific management recommendations for immediate on ground implementation in Wollemi National Park. Of the listed threats to the species, fire is the most relevant to north-eastern Wollemi National Park, together with previous logging activities along some creeklines. In light of this, it is recommended that:

- Too frequent hazard reduction burning, using low intensity fire with short burn intervals, not be undertaken within known Powerful Owl or Sooty Owl territories.
- A mosaic pattern be used when fuel reduction burns are undertaken. This will ensure that sufficient refugia are left unburnt, particularly along creek lines and gorges for Powerful and Sooty Owls, while a mix of burnt-unburnt patches contributes to the vegetation structural diversity required for Masked Owls.
- Hollow-bearing trees, both living and dead, be retained, even in semi-cleared country at the park boundary. Furthermore, mature trees should be allowed to develop along creeklines that have previously been logged, in order to provide further nesting and roosting opportunities for the Large Forest Owls in the long term, as well as den sites for prey species.

4.2.2 Barking Owl

Of the threats listed to the Barking Owl in the Draft Recovery Plan, the most relevant are likely to be predation on fledglings by Cats and Foxes, and potentially occupation of hollows by feral Honey Bees (NPWS 2003a). These threats are poorly understood, however, and further research is required before specific management recommendations can be made. The recommended management of threats posed by fire is outlined in section 4.1.3 above.

4.2.3 Koala

The Draft Recovery Plan for the Koala (NPWS 2003d) indicates that many remaining Koala populations on the ranges of the Sydney Basin occupy secondary class habitat. Available data indicate that the Koala occurs in very low densities in the northern escarpment of the study area and again in the east near Howes Valley adjoining Yengo National Park. In Wollemi National Park the key habitat areas are those where Grey Gum is in abundance or where patches of Grey/White Box (*E. molucanna/albens*) or Red Gums (*E. tereticornis, E. blakelyii*) occur. Of the threats listed to the Koala in the Draft Recovery Plan, the most relevant to north-eastern Wollemi National Park is related to fire. Predation by Dogs may also be a threat, however Koala remains were not located in any of the 44 Dog scats collected in the region during the DEC surveys. Koalas are known to survive extensive and intense wildfires (K. Madden pers. obs. in DEC 2004b), but are threatened in areas where no refugia persist. In Wollemi National Park there are considerable refuge areas in the incised gorges, and the

DEC surveys revealed that Koalas make use of these areas during days of extreme heat (E. Magarey pers. obs.). In most instances the preferred tree species are located in gullies and sheltered slopes or on basalt caps and fertile valley floors (e.g. Hungerford and Martindale Creek headwaters).

The Draft Recovery Plan highlights a number of generic recommendations to managing threats to the Koala on reserved lands. In summary these are:

- That fire be excluded, where possible, from areas known to contain Koalas.
- That mosaic patterns be used in fuel reduction burns to ensure refuges of unburnt habitat are always available. Such burns should be carried out outside the spring-summer period when Koalas are breeding and most likely to be on the ground and therefore vulnerable to fire. Burns should avoid crown scorch and crown burns.
- That preferred feed trees not be felled during mop-up operations in areas known to be used by Koalas, or during the construction of fire breaks and fire trails.

4.2.4 Yellow-bellied Glider

Recent surveys for the Yellow-bellied Glider have significantly expanded knowledge on the species distribution in the Sydney Basin reserve system, indicating it is more common than once considered. Surveys in Wollemi and Yengo National Parks have indicated that the tall forests in sandstone gullies and gorges represent high quality habitat for the Yellow-bellied Glider. These distribution trends are not recognised by the current Recovery Plan for the species (NPWS 2003e). The preferred sap feed tree across the Sydney Basin is the Grey Gum, which is widespread in the eastern and northern part of the reserve.

Of the threats listed to the Yellow-bellied Glider in the Recovery Plan, the most relevant to north-eastern Wollemi National Park is related to fire. The recovery plan indicates that there are no known studies on the impact of wildfire on the Yellow-bellied Glider. It is likely that as long as wildfire and hazard reduction burning events leave a natural mosaic of varying burn intensities across the landscape, with unburnt refugia in incised gorges, the Yellow-bellied Glider is unlikely to be threatened on a landscape scale.

4.2.5 Brush-tailed Rock-wallaby

Of the threats listed to the Brush-tailed Rock-wallaby in the Draft Recovery Plan, the most relevant to north-eastern Wollemi National Park are likely to be predation by the Red Fox and aspects relating to fire regimes (DEC 2005j). Very hot widespread fires may adversely affect the species by preventing their escape, while frequent burning may change vegetation structure and characteristics at refuge and foraging sites (DEC 2005j). The plan acknowledges, however that the threatening processes affecting Brush-tailed Rock-wallabies are poorly understood, multi-level, usually inter-related and the inter-relationships are often complex. Until a better understanding of the threatening processes of the Brush-tailed Rock-wallaby is gained, the control of threatening processes will continue to be problematic.

Specific on-ground management recommendations for the Brush-tailed Rock-wallaby cannot be provided at this stage. Instead, the following guidelines should be followed:

- That management of the Brush-tailed Rock-wallaby sites is coordinated with management of the species across the state. The key to this will be to maintain regular communications with the NSW Brush-tailed Rock-wallaby recovery team.
- That the Fox TAP program continues to be implemented and eventually guides Fox control programs.
- That hot wildfires be prevented from entering known Brush-tailed Rock-wallaby colonies when possible.
- That monitoring of known locations and further investigation into the locations newly discovered by DEC in 2004-5 be undertaken, as outlined in section 4.6.1 below.

4.3 FIRE AND BIODIVERSITY

4.3.1 Lessons so far from the Woronora Plateau post-fire fauna surveys

The impact of controlled burning and wildfire on fauna is poorly understood. Research currently being undertaken by DEC (2004b) is one of very few studies to offer a comparison of fauna composition between long unburnt vegetation and vegetation that has undergone an extensive and severe wildfire. Even fewer studies have examined the impacts of frequent burning on the suite of fauna in an ecosystem; more often fire impact studies have been species specific.

The study (DEC 2004b) on the Woronora Plateau in the south of Sydney is the most relevant guide to the impact of extensive and severe wildfire on fauna in north-eastern Wollemi National Park. Both areas are characterised by dry sandstone woodlands and forests and while rainfall levels differ substantially, there is considerable species overlap for many of the fauna groups. It is not unreasonable to hypothesise that the fauna of Wollemi National Park would respond to fire in similar as that on the Woronora Plateau. The following discussion summarises current findings of the Woronora Plateau study.

The Woronora Plateau study has found that the impacts of wildfire depend on the intensity of the fire. High intensity fire has had a much more dramatic impact on species abundance than has low or moderate intensity fire. Arboreal mammal abundance was found to be greatly reduced in areas of high intensity fire. In Wollemi National Park, the Squirrel Glider, Yellow-bellied Glider and Koala are threatened species at risk from high intensity fires. Results are unambiguous for arboreal mammals with small home ranges such as the Greater Glider. Unburnt forests were shown to have ten times the number of Greater Gliders than forests burnt by high intensity fire. Squirrel Gliders and Eastern Pygmy-possums have similarly small home ranges and are therefore vulnerable to extirpation during such fire events. Koalas are more mobile and while high intensity fire is recognised as a major threat they are known to have survived such conflagrations. Such is the case in Avon Catchment (DEC 2004b), Nattai National Park (DEC 2004c), Campbelltown and Yengo (NPWS 2003d).

The richness and diversity of bird assemblages are significantly reduced in sandstone woodlands following high intensity fire. Honeyeaters are one group of birds that were shown to suffer greatly reduced numbers in the Woronora study. The consumption of the shrub layer during fire removes the primary source of food and cover. Composition of post fire environments was shown to preference canopy-using bird species.

Loss of key habitat resulted in similar downturns in the richness and diversity of reptile species in sandstone woodlands. Most affected were litter-dwelling skinks while those associated with rocky habitats were less affected though still suffered reduced numbers.

The study is also showing that the recovery of fauna populations to pre-fire levels takes considerable time. There is evidence of only slow increases in abundance of some species even at three years after fire. Such a trend reinforces that subsequent fires within this time are likely to suppress an already reduced fauna population.

The study reveals that while the impacts of the high intensity of fire have been catastrophic in the short term and at a small scale, there has been no recorded loss of species from the Woronora Plateau as a result. This is because there is a mosaic of burn intensities within the study area, with some areas remaining lightly burnt or unburnt. These areas are most likely to act as refugia in which species will survive and from which species will in time recolonise the intensely burnt environments. Subsequent fires that burn unburnt areas after only short fire intervals are likely to severely affect local population numbers.

Research into the impacts of fire on fauna on the Woronora Plateau will continue until five years after the wildfire event (summer 2006-7). A final report detailing findings will then be produced. This report is likely to include key findings that are directly relevant to north-eastern Wollemi National Park and may assist in the formation of fire management strategies that maximise fauna diversity in the park.

4.3.2 Recommendations for fire management

Understanding and managing the impacts of fire in high fire frequency environments such as Wollemi National Park would be aided by fire intensity mapping and the delineation of sensitive fauna habitats. At present there is no information to guide reserve managers as to the degree to which vegetation cover has been burnt. Additionally there is no way of defining the impacts of fire intensity on particular

habitats. Currently available vegetation community mapping (Bell 1998) is too coarse and inaccurate for this purpose. As a result we recommend that:

- Fire intensity mapping be carried out following all major wildfire events.
- Detailed vegetation mapping be undertaken across north-eastern Wollemi National Park to enable clearer delineation of fire sensitive fauna habitats and vegetation communities.

In the mean time, the following generic recommendations for fire management in relation to fauna are made:

- Fire management should aim for a mosaic of fire regimes.
- Mosaic burning should retain examples of all fauna habitats in a long unburnt state.
- Fire planning should recognise the role of unburnt refugia in the recolonisation of burnt landscapes, particularly after extensive and intense wildfire.
- Unburnt refugia should remain unburnt for more than four years following extensive and intense wildfire.

A number of threatened species warrant particular consideration when planning hazard reduction burns and when attempting to control wildfires. These species include the Brush-tailed Rock-wallaby, Barking Owl, Koala, as well as the Eastern Bent-wing Bat and Large-eared Pied Bat roost sites.

4.4 PEST SPECIES AND BIODIVERSITY

Four of the introduced species known to occur within north-eastern Wollemi National Park are listed as a Key Threatening Process as follows: predation by the Red Fox; predation by the Feral Cat; competition and grazing by Feral Goats; competition and grazing by Feral Rabbits. Of these, predation by the Red Fox is likely to be having the most significant impact on threatened species in the study area. The impact of Feral Cats is largely unknown, as though the species has only been observed on four occasions, its elusive nature may simply mean that it goes largely undetected. Goats are very uncommon in the study area at present, but have the potential to expand and cause problems in the future. Any populations that come to the attention of land managers should be a priority for control. The preferred habitat of Rabbits is highly localised and there is little potential for expansion of their current range in the park. They are no threatened fauna species populations that appear to be threatened by this pest, and thus control of Rabbits is currently of low priority. Though not listed as a Key Threatening Process, Wild Dogs pose a significant threat to native fauna through predation and are listed as a pest under the Rural Lands Protection Act (1998). Control of Wild Dogs is currently considered second in priority to Fox control in the study area.

Problems associated with Wild Dogs and Foxes are noted in the Plan of Management for the reserve (NPWS 2001). In order to help guide feral animal control programs, the following is noted:

- Approximately half of all Wild Dog and Fox records on the Atlas of NSW Wildlife are located within the Northern Perimeter Zone, a zone identified as having very high conservation significance due to the presence of a large number of threatened species.
- The threatened species considered most sensitive to Fox predation are the Brush-tailed Rock-wallaby and Spotted-tailed Quoll and to a lesser extent the Speckled Warbler, Diamond Firetail, Koala, Squirrel Glider and Yellow-bellied Glider. Impacts of Foxes on other threatened species are considered to be low (NPWS 2001a).
- It is unlikely that Foxes can be removed from the study area entirely, so control programs should be centred around priority sites or habitats that will achieve the maximum benefit for biodiversity. Control of Foxes, with regards to their impacts on biodiversity, should be focussed on the Northern Perimeter Zone as well as known locations of the above threatened species.
- Control of Foxes is most important in the first few years following fire when the ground layer is open providing little refuge for ground-dwelling mammals and birds.
- The foraging efficiency of Foxes seems to be maximal in open habitats where they are able to range widely and freely (Environment Australia 1999). They readily use roads, tracks and other cleared access ways through denser vegetation or complex topography. One option to minimise Fox impacts on threatened species is to reduce such access points to a minimum and to maintain bait stations along those access paths which are retained (Environment Australia 1999).

- Priorities for Wild Dog control, with regards to their impacts on biodiversity, are known locations of Koala and Brush-tailed Rock-wallaby, as well as habitats within the Northern Perimeter Zone.
- Control of Cats is very difficult and at present there are no particular sites that require attention. Further survey into the abundance and distribution of Cats in the area is recommended. Following this, if deemed necessary, control should be considered in the vicinity of records and habitat of Giant Burrowing Frog, Hooded Robin, Grey-crowned Babbler, Diamond Firetail, Speckled Warbler, Spotted-tailed Quoll, Eastern Pygmy-possum, Squirrel Glider and Eastern Bent-wing Bat.
- Any control programs must consider the impacts that baiting or removal of feral animals from the system are likely to have, and take this into account before going ahead with broad-scale control measures. For example, Dog baiting can have an adverse impact by serving to increase Fox populations and endangering Dingo populations, while evidence collected elsewhere suggests that both Fox and Dog baiting can have an adverse impact on Quoll populations (Belcher 2004).
- The use of 1080 baiting in areas where Quolls are known should be very carefully considered. Burying baits deeper than seven centimetres below the ground surface (rather than burying them in raised mounds) will decrease the number of baits removed by Quolls (Glen and Dickman 2003).
- The impact of Fox or Dog removal should be monitored and used to guide further management actions. Baiting (particularly aerial baiting) within the remote sections of the centre of the park should be avoided until further research on the heritage of Dogs/Dingoes is determined. Recent research undertaken within Yengo National Park has indicated that hybrid Dogs are most concentrated around the perimeter of the park while dogs in the core of the park have a very high degree of Dingo heritage (T. Horwood pers. comm.). A similar pattern is likely to occur within Wollemi National Park.
- The distribution of Common Mynas, Common Starlings and Eurasian Blackbirds within the Northern Perimeter Zone should be monitored, and if the species are found to move further into the park, or to increase in number in the Box Woodlands at the edge of the park (on which a number of threatened species depend), action should be taken to control the birds. Any such action must be sure to target the introduced species and not impact on native bird species.

4.5 TREE HOLLOW MANAGEMENT

A large proportion of the fauna species known to occur within north-eastern Wollemi National Park utilise tree hollows for shelter, roosting, nesting and/or breeding. As the park comprises a massive area of multi-aged forests and woodlands, suitable tree hollows are widespread and abundant throughout the large majority of the park. A complex mosaic of tree ages occurs across the landscape, due to the activity of numerous processes, such as fire and erosion, over hundreds of years. Due to the nature of the landscape, much of the park has avoided the impacts of modern human disturbance, and where human disturbance has occurred, it is highly localised and has usually affected particular communities rather than the park as a whole. In addition, the geomorphology of the region provides a complex array of caves, rock fissures and outcrops, which provide an alternative sheltering resource for numerous fauna species. Consequently, sheltering resources are not limited throughout most of the park, and hence do not require any specific management actions, provided that a mosaic approach to forest management is retained, as described in previous sections of this report.

The majority of human disturbance to north-eastern Wollemi National Park has occurred near the periphery of the park within vegetation communities closely associated with past or present agricultural activities. Evidence of logging is present in some accessible gully systems, most notably within the Box-Red Gum alluvial forests as well as woodlands on the escarpment foot-slopes. This logging has reduced the diversity of tree ages and the number of large trees, and hence limited the number of tree hollows available to fauna. Furthermore, alternative rocky shelter sites are limited within these habitats. These habitats largely occur within the Northern Perimeter Zone and are of high conservation priority to numerous threatened fauna species. Hollow-dependent species occurring within these habitats include the Squirrel Glider, Powerful Owl, Barking Owl, Masked Owl, Turquoise Parrot, Hooded Robin and Brown Treecreeper.

The restricted availability of sheltering resources within the Northern Perimeter Zone necessitates the implementation of management actions that ensure the re-development of tree-hollow resources over the long term. In light of this it should be recognised that:

- Large remnant hollow bearing trees are vitally important in the disturbed alluvial forests and woodlands in the Northern Perimeter Zone, as they often provide the only shelter resource

available to hollow-dependent threatened species in these habitats. Hence these large remnant trees should be retained at all costs, whether they occur alone or in a remnant patch, and whether on or off park.

- Retention of tree hollow resources in the Northern Perimeter Zone will require a cooperative approach between DEC and private land owners, as much of the high conservation value habitat occurs off reserve.
- Fire is an important contributor to hollow formation. While the perpetuity of hollows is dependent on a disturbance regime that promotes mortality and regeneration, too frequent fires can cause an area to be depleted of hollows, particularly when the area has previously been logged (Gibbons and Lindenmeyer, 2002). The mosaic burning pattern the occurs across the majority of the park preserves unburnt refugia and enables a balance between hollow destruction, preservation and formation. However the situation in the Northern Perimeter Zone is more fragile, and the area is more prone to hollow reduction by frequent fire. Measures that reduce the frequency of high intensity fires over short time intervals within the Northern Perimeter Zone are therefore warranted.

4.6 OFF-RESERVE CONSERVATION AND LAND ACQUISITIONS

4.6.1 Additions to Wollemi National Park

Data collected from the DEC surveys indicates that any acquisitions and additions to Wollemi National Park should be prioritised toward areas within the Northern Perimeter Zone. Given limited resources reservation of more of the Northern Perimeter Zone would provide maximum benefit to threatened species and vertebrate diversity in the study area. Habitats that are of highest value within this zone include the escarpment slopes and lower footslopes adjoining valley flats where one or more of the following are true

- Tree species such as *Eucalyptus albens/molucanna, E. dawsonii, E. crebra, E. sideroxylon and E. fibrosa* and *E. punctata* are in abundance.
- Creek flats or riparian systems near the edge of cleared country are present and include some remnant vegetation. This would include tree species of *E. blakelyii, E, tereticornis, E. melliodora, Casuarina cunninghamiania* subsp. *cunninghamiana.*
- Understorey is either present or capable of regenerating on lower slopes or valley floor fragments.
- Remnant trees or remnant patches are not isolated within a cleared environment.

4.6.2 Conservation on private lands in the Northern Perimeter Zone

Currently the Northern Perimeter Zone encompasses much private land, on which numerous threatened species are known to occur. Portions of these lands that are adjacent to the park and support Box-Red Gum-Ironbark vegetation, or creek flats and riparian systems with in tact vegetation, play a very important role in the ongoing conservation of threatened species in the area. For this reason, landholders should be encouraged to actively participate in conservation programs and/or minimise the undertaking of activities that would decrease the value of these high priority habitats to native fauna. It is recommended that a program be launched across the Hunter Range area to educate neighbours of the importance of these habitats and encourage them to undertake the following.

- Prevent the progress of relevant Key Threatening Processes. This entails in situ retention of fallen wood, dead trees and bushrock, as well as the avoidance of any clearance of native vegetation. In particular, all large trees, whether living or dead, isolated or connected to other vegetation, should be retained as they are likely to provide vital hollow resources.
- Avoid activities that alter the structure of the vegetation, such as frequent burning and over-grazing. Landowners should be strongly encouraged to retain the integrity of the key Box-Red Gum-Ironbark habitats, as well as creekline and riparian vegetation.
- Retain key tree species. For the Painted Honeyeater this includes trees that support mistletoes of the genus *Amyema.* For the Regent Honeyeater this includes Mugga Ironbark and Yellow Box. For Hooded Robin this includes paddock trees (even if they are dead) and other perch sites.

- Avoid the plantation of invasive exotic plant species, particularly exotic grasses. These have the potential to invade key habitats and reduce their value to numerous threatened species, particularly the Diamond Firetail and the Speckled Warbler.
- Landowners in the Northern Perimeter Zone could also be made aware of the possibilities available to them to develop conservation partnerships, such as through voluntary conservation agreements.

4.6.3 Co-operative pest management

Control of pests in the study area, particularly in the Northern Perimeter Zone, will not be successful without the adoption of a cooperative landscape-based approach. Baiting on individual tenures will only provide short-term success due to the high mobility of Foxes and the potential of rapid re-invasion. It is strongly recommended that a cooperative targeted pest management program be developed for the catchments that feed into the study area, across all land tenures including private lands, crown lands State Forests and National Parks.

4.7 FURTHER SURVEY AND MONITORING

4.7.1 Specific threatened species projects

Land managers are faced with an ominous list of threatened fauna species. However, not all threatened species warrant equivalent management efforts. There are a number of threatened species within the study area that at this stage do not require specific targeted management actions to be undertaken. However, other threatened species require specific management actions, further survey and/or monitoring to be undertaken in order to increase their chances of long term survival within the study area. In terms of further survey, research and monitoring, the following programs are suggested, with the first two taking highest priority and the rest listed roughly in order of priority. All of the research programs listed should be undertaken in close consultation with appropriately experienced scientific personnel, experts on the species, as well as with any teams undertaking related work elsewhere in the Department of Environment and Conservation or the federal Department of Environment and Heritage, such as recovery planning or threat abatement planning.

Brush-tailed Rock-wallaby

A research project should be designed that incorporates: an investigation of known Brush-tailed Rock-wallaby localities (including those found by DEC in 2004-05) to determine if they are breeding sites; a population census; and an ongoing monitoring program to determine population trends and viability. A prioritisation of habitat areas for the Rock-wallaby within the park should then occur. Sites identified as high priority should be the target of appropriate feral predator control, implemented in consultation with the Fox TAP program.

Eastern Bent-wing Bat and Large-eared Pied Bat

There is a danger that the Baerami Oil Shale mines will cease to be used as roosts by the threatened Eastern Bent-wing and Large-eared Pied Bats if active management of the site is not undertaken. The site has high regional significance for the Eastern Bent-wing Bat, and maintenance of the colony should therefore take high priority in management of biodiversity in the park.

A number of small investigations are required at these sites:

- To carry out a survey to determine whether mine sites are currently used as maternity roosts for any of the cave roosting bat species. This should be conducted in spring/early summer months. If maternity roosts are confirmed these caves should be managed to minimise disruption from visitation and fire.
- To examine the impact of the removal of shaft entrance grills on bat numbers. A carefully stratified experimental design with control sites should be employed. This should follow liaison with scientific personnel experienced in the issue of maintaining bat populations in gated mines.

Hooded Robin

It is recommended that targeted surveys be undertaken within remnants of Box-Red Gum Woodland on creek flats and lower escarpment slopes of the Northern Perimeter Zone to ascertain whether Hooded Robins survive here and if so to identify current key areas. Such surveys should be undertaken by a recognised bird survey expert at intervals throughout the year, with a particular focus on the autumn and winter months.

Swift Parrot

The Swift Parrot has not been recorded within north-eastern Wollemi National Park on the Atlas of NSW Wildlife. However, individuals have been seen in close vicinity to the park and it is possible that the species has gone unnoticed within the study area because very few surveys have been undertaken in the winter months. The study area contains numerous winter-flowering tree species, including the parrot's favoured food trees Mugga Ironbark, White Box and Spotted Gum. When these trees are in heavy flower, or when other food sources in the region are limited, it is likely that Swift Parrots visit the park. It is recommended that targeted surveys be undertaken during such times, to determine the extent to which the habitat is used. Such surveys need to be undertaken by experienced observers familiar with the species call.

Spotted-tailed Quoll

Further survey work is required to determine the status of Spotted-tailed Quolls in Wollemi National Park the role that the area plays in the regional conservation of the species. Surveys should involve extensive cage trapping and hair tubing over an extended time period, in areas of potential habitat including moister environments, major gully lines and sheltered lower slopes in the north, east and south of the study area. A program should also be implemented to encourage neighbours and park visitors to report any sightings, together with accurate location information.

Eastern Pygmy-possum

This cryptic mammal is likely to be more numerous within the area than records indicate, as some survey techniques that target the species, particularly pitfall trapping, have not been undertaken. Based on records elsewhere, the species is most likely to occur within woodlands that have a dense shrub layer and an abundance of flowers, or else within areas that contain Cypress (*Callitris* spp.) with very little understorey (Bladen *et al.*2002; Shelley 1998). An intensive targeted trapping program would be required in order to accurately assess the abundance, distribution and conservation status of the Eastern Pygmy Possum within the locality and region. Trapping should include use of pitfall traps with drift fences, Elliott traps and nest boxes positioned against flowering shrubs and trees, as these techniques have been found to be the most effective capture method for the species in other areas (Bladen *et al.*200, Shelley 1998, M. Schulz pers. comm.).

Rosenberg's Goanna

Rosenberg's Goanna has been recorded on the southern boundary of the study area along the Hunter Main Trail, as well as 650 metres to the south in Putty State Forest (Map 6). It is likely that the goanna occurs at other locations on the sandstone plateau in the south and east of the study area. Further research into the status of this reptile in the park is warranted because the area is near the most north-westerly extent of the species as recorded on the Atlas of NSW Wildlife. A high level of visitation is required to pick up this cryptic species. Gaining an understanding of the distribution and ecology of the Rosenberg's Goanna in this far north-western part of its range would be useful for species recovery planning. Such a project could be undertaken by a research student, with the support of the regional DEC office.

4.7.2 Other future work

There is now comprehensive documentation of the fauna characteristics of north-eastern Wollemi National Park. While additional survey is warranted for some fauna groups and in inaccessible parts of the Baerami Range, priority lies in developing information systems that help guide the assessment of wildfire on sensitive fauna habitats.

Fire intensity and detailed vegetation mapping

We recommend that fire intensity mapping be included as a fundamental information resource for park managers. This data should be supplemented by detailed and accurate delineation of vegetation communities from which fauna habitat maps can be derived. Without this information there is no method through which to transparently estimate the impacts of fire on threatened fauna. Nor is it possible to make reliable estimates of populations of the most sensitive species.

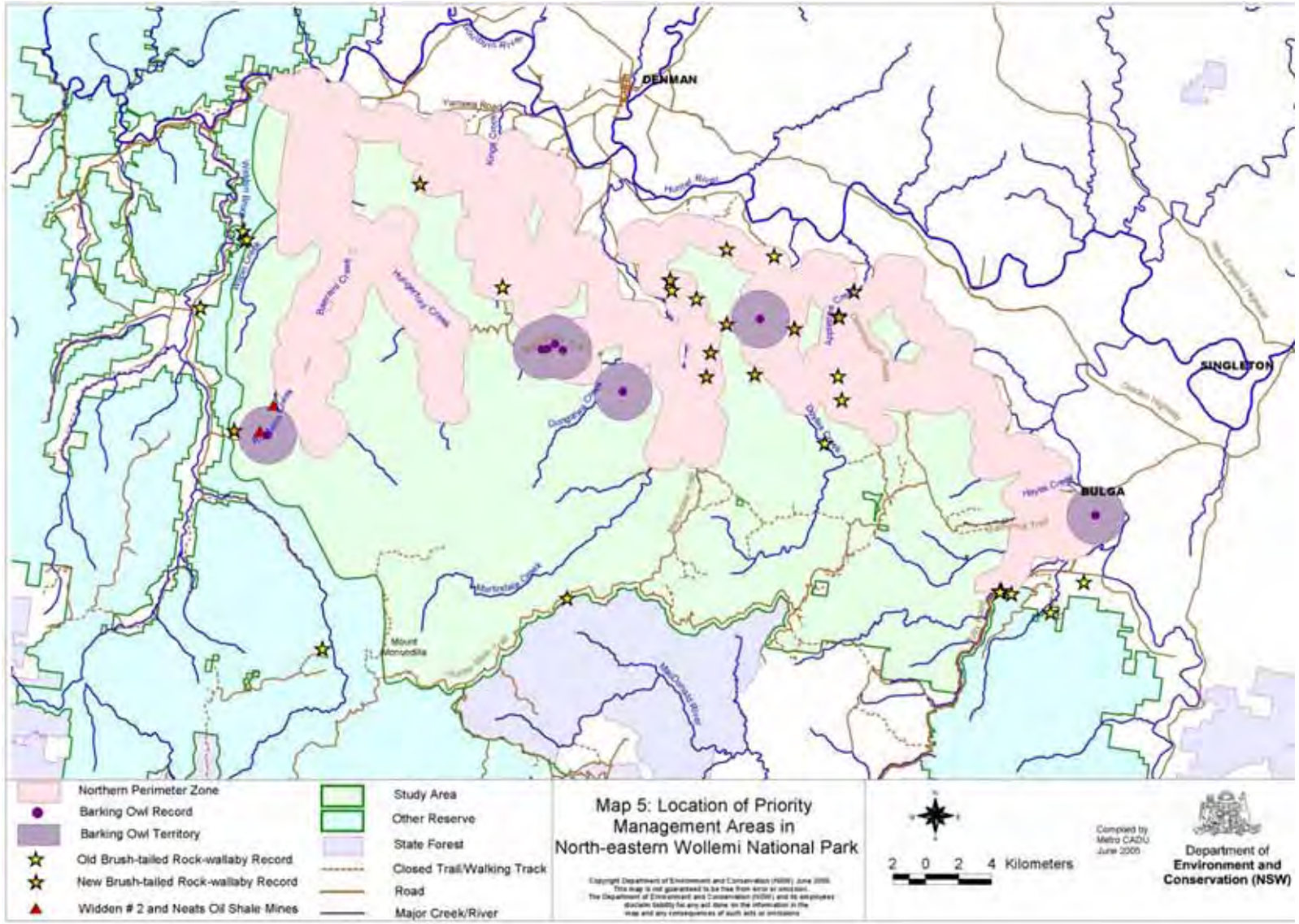
Further frog and small terrestrial mammal surveys

The drought of recent years has precluded an understanding of the distribution and abundance of both the Giant Burrowing Frog and the Red-crowned Toadlet, although we expect both species to be occasionally encountered in the north, central and eastern arms of the study area. The distribution of Fletcher's Frog is poorly understood and it is possible that populations of threatened species such as

the Stuttering Frog (*Mixophyes balbus*) occur within the study area. Small terrestrial mammals are not well surveyed as survey for them is labour intensive, costly and often yields few valuable data from which to guide management planning. However, the absence of such survey means species such as the Spotted-tailed Quoll, Long-nosed Potoroo and Eastern Pygmy- possum may be overlooked.

Fauna survey of remote sections of the park

The central Baerami Range is inaccessible to fauna survey teams without the use of helicopters. This is a significant gap in the coverage of fauna survey effort in this part of Wollemi National Park, which should be filled. Additional survey in this area is likely to assist in providing an improved understanding of distribution trends for some threatened fauna species that are associated with sandstone habitats.



Map 5: Location of Priority Management Areas in north-eastern Wollemi National Park

5 THREATENED SPECIES PROFILES

This section provides a profile of each of the threatened fauna species that are known to occur within north-eastern Wollemi National Park, together with two additional threatened species that are considered 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 how well the species is protected in the region; a map of known records of the species in the study area and the surrounding five kilometres; and an appraisal of the distribution and status of the species in north-eastern Wollemi and the surrounding area.

The list of threatened vertebrate fauna for the study area contains records of various levels of reliability. For this reason, a species profile has not been generated for all of the threatened species listed on the DEC Atlas of NSW Wildlife as occurring within the area. Only species that have been directly and reliably observed within the study area, or have been recorded on the Atlas of NSW Wildlife within two kilometres and considered likely to occur within the area, have been afforded a species profile. Table 5 presents all of the threatened species recorded on the Atlas of NSW Wildlife within five kilometres of the study area, together with annotation for each species regarding the latest record, reliability of identification and a rationale for the generation of a species profile.

Scientific name	Common name	Status in NSW (TSC Act 1995)	Status in Australia (EPBC Act 1999)	No. of locations within study area[1]		No. of locations within a five kilometre radius of study area[1]	Notes on reliability and date of last record	Species profile generated?
				DEC[2]	Other[3]			
Heleioporus australiacus	Giant Burrowing Frog	V	V	6	3	2	Observed on a number of occasions, mostly recently in March 2003	Y
Pseudophryne australis	Red-crowned Toadlet	V	-	11	1	4	Observed on a number of occasions, mostly recently in November 1997	Y
Litoria aurea	Green and Golden Bell Frog	E	V	0	0	1	Not recorded within the study area. Record exists on Hunter River approx. 4 km to north, however the spatial accuracy is very low and it appears that the frogs were actually observed at Mount Owen mine over 25 km north east of the study area in 1995. Unlikely to occur within the study area due to lack of potential habitat.	N
Varanus rosenbergi	Rosenberg's Goanna	V	-	0	1	1	Observed only once in the park and once 650 m south, each by the same observer in 2001. Not recorded elsewhere within 15 km of the study area	Y
Lophoictinia isura	Square-tailed Kite	V	-	0	0	1	Not recorded within the study area. Species was recorded once in 2002 within the vicinity of Wambo Coal mine, east of the study area. The species may use the reserve as part of its territory, but occurrence is likely to be rare.	N
Falco hypoleucos	Grey Falcon	V	-	0	0	1	Not recorded within the study area. Specimen was collected by the Australian Museum in 1895 within the vicinity of Bulga and Singleton. Unlikely to occur within the study area.	N
Callocephalon fimbriatum	Gang-gang Cockatoo	V	-	17	10	15	Regularly observed within and around the study area, most recently in May 2005	Y
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	19	8	21	Regularly observed within and around the study area, most recently in May 2005	Y
Lathamus discolor	Swift Parrot	E	E	0	0	1	Not recorded within study area. Two birds were observed within the vicinity of Bulga in 2000. Potential habitat occurs within the study area and the species may be a winter visitor.	Y
Neophema pulchella	Turquoise Parrot	V	-	24	4	4	Regularly observed within the study area, most recently in May 2005	Y
Ninox connivens	Barking Owl	V	-	7	0	1	Recorded within the study area on a number of occasions, most recently in June 2005	Y
Ninox strenua	Powerful Owl	V	-	5	0	1	Reliably recorded within and around the study area, most recently in May 2005	Y
Tyto novaehollandiae	Masked Owl	V	-	5	1	1	Reliably recorded within and around the study area, most recently in May 2005	Y
Tyto tenebricosa	Sooty Owl	V	-	1	0	3	Seen once within study area in February 2005 and recorded infrequently within 5 km of the study area	Y
Climacteris picumnus victoriae	Brown Treecreeper (eastern subsp.)	V	-	26	13	9	Regularly observed within the study area, most recently in November 2004	Y
Pyrrholaemus sagittatus	Speckled Warbler	V	-	26	19	36	Regularly observed within and surrounding the study area, most recently in February 2005	Y

Scientific name	Common name	Status in NSW (TSC Act 1995)	Status in Australia (EPBC Act 1999)	No. of locations within study area[1]		No. of locations within a five kilometre radius of study area[1]	Notes on reliability and date of last record	Species profile generated?
				DEC[2]	Other[3]			
Grantiella picta	Painted Honeyeater	V	-	0	0	5	Not recorded within study area. Recorded at four locations within 2 km of the study area, both to the east and north. Most recently recorded in 2001 in the vicinity of the Martindale Valley. May be a rare visitor to the study area.	Y
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subsp.)	V	-	13	2	5	Recorded within the study area on numerous occasions, most recently in November 2004	Y
Xanthomyza phrygia	Regent Honeyeater	E	E	2	0	7	Seen twice in study area in October 2004. Recorded within 5km of reserve on numerous occasions	Y
Melanodryas cucullata cucullata	Hooded Robin (south-eastern subsp.)	V	-	0	11	12	Recorded by Birds Australia on a number of occasions in the late 1970s, however spatial accuracy is low. Recorded at three locations since, most recently in April 2002	Y
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-	5	3	28	Reliably recorded within and around the study area, most recently in November 2004	Y
Pachycephala olivacea	Olive Whistler	V	-	1	0	0	Observed only once in the study area in 1997. Likely to be a misidentification. The nearest known population of the species lies approximately 70 kilometres to the north-east of the study area near Barrington Tops.	N
Stagonopleura guttata	Diamond Firetail	V	-	14	9	16	Reliably recorded within and around the study area, most recently in November 2004	Y
Dasyurus maculatus	Spotted-tailed Quoll	V	E	0	4	3	Infrequently recorded within and around the study area, most recently in March 2005	Y
Phascolarctos cinereus	Koala	V	-	6	3	1	Reliably recorded within and around the study area, most recently in February 2005	Y
Cercartetus nanus	Eastern Pygmy-possum	V	-	1	0	2	Identified from remains in predator scat collected in the study area in 1997 and within 5 km in 2005. Observed once within 5 km of the study area.	Y
Petaurus australis	Yellow-bellied Glider	V	-	27	18	36	Regularly observed within and surrounding the study area, most recently in March 2005	Y
Petaurus norfolcensis	Squirrel Glider	V	-	9	1	10	Reliably recorded within and around the study area, most recently in October 2004	Y
Macropus parma	Parma Wallaby	V	-	0	0	1	Not recorded within the study area. A single record exists within 5 km, detected by a hair collected at Little Darkey Creek in Yengo National Park. Not expected to occur in study area due to the scarcity of suitable habitat.	N
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	12	5	15	Reliably recorded within and surrounding the study area, most recently in February 2005	Y
Pteropus poliocephalus	Grey-headed Flying Fox	V	V	10	0	5	Reliably recorded within the study area in January and February 2005	Y
Mormopterus norfolkensis	East-coast Freetail-bat	V	-	2	0	2	Reliably recorded within the study area in 1997 and 2005	Y

Scientific name	Common name	Status in NSW (TSC Act 1995)	Status in Australia (EPBC Act 1999)	No. of locations within study area[1]		No. of locations within a five kilometre radius of study area[1]	Notes on reliability and date of last record	Species profile generated?
				DEC[2]	Other[3]			
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	21	0	6	Reliably recorded within the study area, most recently in February 2005	Y
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	11	0	5	Reliably recorded within the study area, most recently in February 2005	Y
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	29	0	2	Regularly recorded within and surrounding the study area, most recently in February 2005	Y
Myotis adversus	Large-footed Myotis	V	-	1	0	0	Identified once from an anabat call in 1997. Call easily confused using anabat analysis. Record not in typical habitat for the species. Closest records are 11km to the north-east of the study area.	N
Nyctophilus timoriensis	Greater Long-eared Bat	V	V	2	0	0	Captured in harp trap at two locations in study area in 2004. Reliable identification.	Y
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	5	0	2	Captured in harp trap at five locations in study area in 2004. Reliable identification.	Y
Vespadelus troughtoni	Eastern Cave Bat	V	-	6	0	1	Captured in harp trap at five locations and roosting in another within study area in 2004. Reliable identification.	Y

E Endangered

V Vulnerable

[1] Numbers indicate the number of locations for the species, rather than the number of individuals

[2] Includes all records collected during CRA and Biodiversity Survey Priorities fauna surveys

[3] Includes records on the NSW Wildlife Atlas obtained from sources other than DEC systematic survey

Table 5: Threatened fauna species recorded within and around north-eastern Wollemi National Park

GIANT BURROWING FROG

Species Profile

The Giant Burrowing Frog (*Heleioporus australiacus*) is a rotund ground-dwelling frog that can attain a maximum length of over ten centimetres. Its powerful limbs are used to excavate burrows where they can aestivate for long periods of time during unfavourable conditions. This species has a large black tadpole with a purple ventral surface that takes up to eleven months to metamorphose (Anstis 2002). The species has two disjunct populations, with one restricted to sandstone geology of the Sydney Basin as far south as Jervis Bay, and the other to the south between Narooma and eastern Victoria (NPWS 2001b).

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Threats

The primary threat to the Giant Burrowing Frog is development of the sandy ridgetops that are its preferred habitat (NPWS 2001b). Other threats to this species are not well known. Some threats that might be relevant within the study area include frequent fire, road mortality and infection with chytrid fungus. As a large, slow moving species, it is also likely to be vulnerable to predation by Foxes and Cats.

Local and Regional Conservation Status

The Giant Burrowing Frog is listed as Vulnerable under the NSW TSC Act (1995) and the Commonwealth EPBC Act (1999). The Sydney Basin population is thought to have declined considerably, with tadpoles being encountered far less frequently than in the past (Anstis 2002). The species has been recorded within a number of Sydney Sandstone reserves including Royal, Ku-ring-gai Chase, Garigal and Brisbane Waters National Parks and across the Woronora Plateau in areas managed by the Sydney Catchment Authority. Fewer records have been obtained in Blue Mountains and Nattai National Parks and Bargo State Conservation Area. During DEC surveys in 2004 the species was detected in northern Yengo National Park (DEC 2005c), and has previously been recorded in the southern sections of both Yengo and Wollemi National Parks.

The Giant Burrowing Frog was first recorded in the vicinity of the study area in 1975 when a specimen was submitted to the Australian Museum. However, the geographical accuracy of this record is low and it is uncertain where the individual was actually collected from or whether it was located within the study area boundary. The CRA surveys undertaken in 1997 confirmed the occurrence of the species within the area, locating individuals in six locations (Map 6). Together with observations made at Mount Coricudgy in the same year, these records significantly extended the known distribution of the species to the north-west. The species was recorded by a casual observer on Hayes Creek in 2002 and then in March 2003 three individuals were unearthed during road works along the Reubens Fire Trail in the north-west of the study area (R. Harris pers. comm.). This latter record is the furthest north that the species has been recorded to date on the Atlas of NSW Wildlife, suggesting that the sandstone geologies within the study area comprise the northern limit of the species distribution. The species is likely to occur in a number of other locations within the reserve, particularly along the major creeklines in the centre and east of the park as well as at the headwaters of smaller creeklines in the centre and south of the area. The species may also occur on sandstone ridgetops where water has been retained in sandstone ponds or where seepage occurs. Further surveys under appropriate weather conditions are required to determine the exact extent of occurrence within the park. It is clear that the study area, together with the neighbouring northern Yengo National Park, makes an extremely important contribution not only to the conservation of the species in the locality and the region, but indeed to the preservation of the species throughout its currently known range.

RED-CROWNED TOADLET

Species Profile

© Alex Dudley

The Red-crowned Toadlet (*Pseudophryne australis*) is a small (20 to 25 millimetres), strikingly coloured litter-dwelling frog. It is fairly restricted in its distribution, only occurring on the sandstone geologies of the Sydney Basin, and within this range some morphological and genetic variation exists. The Red-crowned Toadlet lays its eggs in moist leaf litter, relying on rain to wash the eggs into a temporal pond where they can complete their development (NPWS 2001c).

Threats

Development of ridgetop land and creek headwaters is the primary threat to the Red-crowned Toadlet. Other threats may include habitat alteration due to fire, bush rock removal, water pollution and Chytrid fungus (NPWS 2001c). Due to their size and morphology, this species has only a limited ability to disperse. This probably makes them vulnerable to local extinction.

Local and Regional Conservation Status

The Red-crowned Toadlet is listed as Vulnerable under the NSW TSC Act (1995). Suitable habitat for this species is widespread across the sandstone plateaux of the Sydney Basin Bioregion, with the major populations occurring in the upper Blue Mountains, around the mouth of the Hawkesbury River and the Woronora Plateau extending to Royal National Park. Throughout its range it has been recorded in numerous National Parks, including Royal, Blue Mountains and Brisbane Water National Parks, and a number of reserves within the Sydney urban area (DEC 2005a). DEC surveys in the Sydney Basin Bioregion during the last five years have revealed that the species is perhaps more common in the region than previously thought (DEC 2005d).

The Red-crowned Toadlet was first recorded within the study area by regional DEC staff in September 1996, on the Baerami Range on the central sandstone plateau. During the CRA surveys in 1997 the species was detected at a further twelve locations, 10 in the south-western corner south-east of Mount Monundilla, one near Kings Cross on the Hunter Main Trail and one on the Martindale Trail. An additional observation was made at the junction of the Hunter Main and Monundilla Trail, immediately to the west of the study area (Map 6). The frequency of these records suggests that the species is fairly densely distributed along the Hunter Range, within the headwaters of creeklines that run both north and south. Further surveys around the inaccessible Baerami Range may also reveal the species to be widely distributed in that area.

The Red-crowned Toadlet records within the study area are the northern-most records for the species. The toadlets were recorded on the northern edge of Yengo National Park during DEC surveys in 2005 (DEC 2005c) and a little further to the south during CRA surveys in 1997 (DEC 2005a). The species thus appears to be relatively widespread within the region. The large amount of potential habitat conserved within the sandstone geologies of these reserves are vital to the conservation of the species within this northern extremity of its range, and indeed to the continued preservation of the full variation of the species across its distribution.

ROSENBERG'S GOANNA

Species Profile

© Nick Corkish/DEC

Rosenberg's Goanna (*Varanus rosenbergi*) (also known as Heath Monitor) is a large, powerful lizard with an unusual distribution. It is superficially similar to the commonly encountered Lace Monitor (*V. varius*) though morphologically and taxonomically it is closer to the Sand Monitor (*V. gouldii*). It can be distinguished from the Lace Monitor by the fine barring on its lips and tail and the spots on its legs. Within NSW it occurs in the Greater Sydney Basin and in the Southern Highlands, but then occurs discontiguously through Victoria, South Australia and south western Western Australia (King and Green 1999). The population in the Sydney Basin may or may not be genetically distinct. This goanna is known to associate with sandstone environments, and is usually found in heath and woodlands where it shelters in burrows, hollow logs and rock crevices (Cogger 1996).

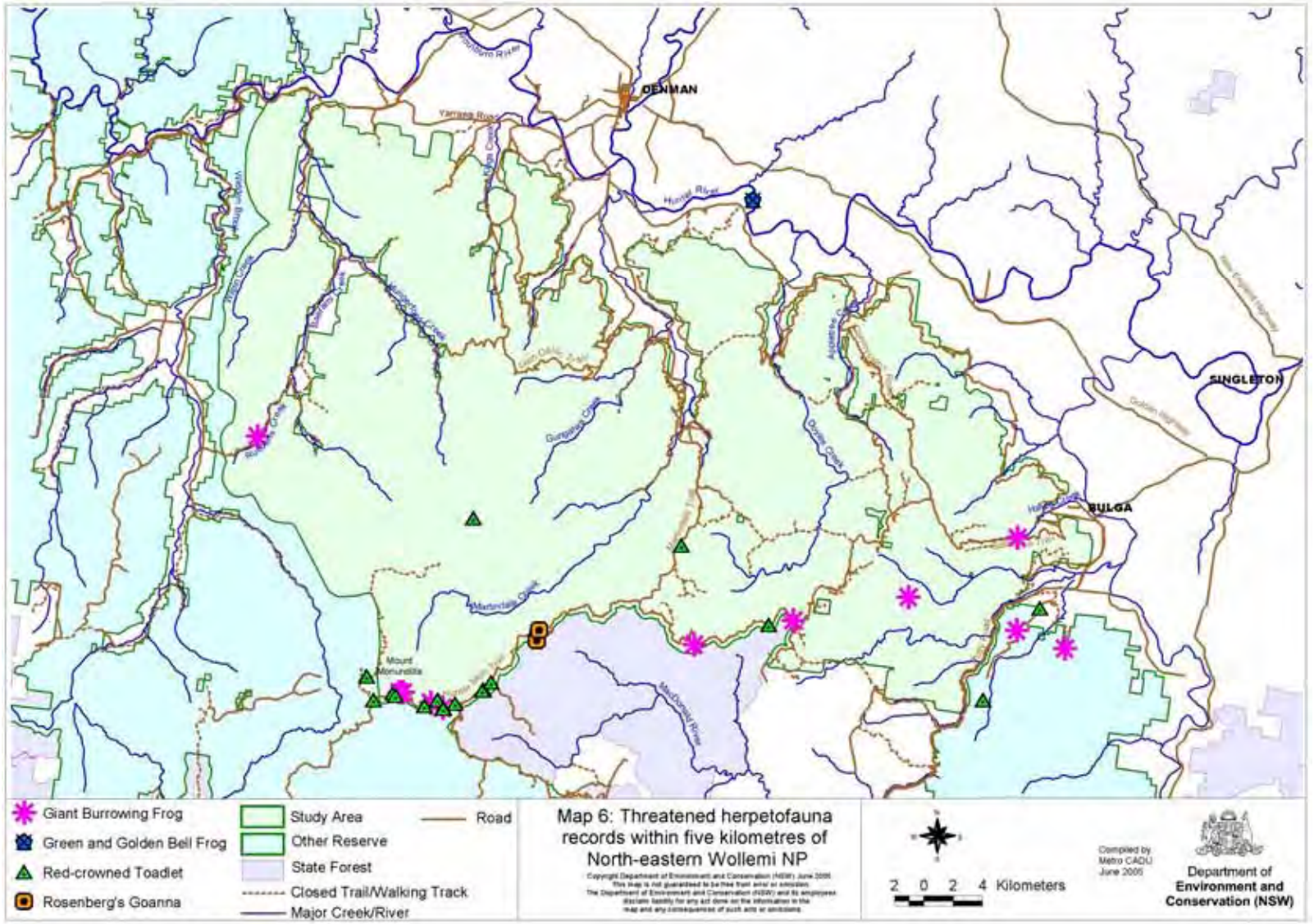
Threats

Rosenberg's Goanna is particularly threatened in urban fringes, where the species is subject to pressure from development of the flat sandstone ridgetops that are its preferred habitat. Road mortality is also of concern (NPWS 2002a). Goannas have been identified as taking baits placed for Foxes (*Vulpes vulpes*) (Thomson and Kok 2002) and this species may consume baits placed during Fox and Dog (*Canis lupus*) eradication programs. Nests and juveniles of the species may be vulnerable to predation by Foxes and Dogs (M. Schulz pers. comm.).

Local and Regional Conservation Status

Rosenberg's Goanna is listed as Vulnerable under the NSW TSC Act (1995). It is a poorly understood species and there is still much to be learnt about its distribution. Previously the NSW population was thought to be restricted to the Hawkesbury and Narrabeen sandstones and coastal areas such as Dharug and Ku-ring-gai Chase National Parks, with the Woronora Plateau and Morton National Park known to contain good habitat. Notwithstanding this, survey work over the last few years has confirmed it to be present outside of these geologies, with confirmed sightings now from Abercrombie River and Turon National Parks and for north-western Wollemi National Park, as well as from around Braidwood. In addition, there are anecdotal records of this species from the south-western slopes for as far west as Bathurst and for the region around Goulburn (R. Wells pers. comm.) and it is likely the species is under-recorded off reserve.

Rosenberg's Goanna has been recorded on the southern boundary of the study area along the Hunter Main Trail, as well as 650 metres to the south in Putty State Forest (Map 6). The closest known sighting of the species was made during CRA surveys at Hefrons Gap, approximately 30 kilometres to the west of Mount Monundilla. This is the most north-westerly occurrence of the species recorded on the Atlas of NSW Wildlife. The habitat in this location is similar to that located along the western end of the Hunter Main Trail. Although much survey work has been conducted under suitable conditions for the detection of this species, a high level of visitation is required to pick up this cryptic species and it can easily go undetected. It is possible that the goanna occurs at other locations on the sandstone plateau in the south and east of the study area. Further survey within potential habitat is recommended to ascertain the distribution of the species in the region and to gain an understanding of its ecology in this far north-western part of its range.



Map 6: Threatened herpetofauna records within five kilometres of north-eastern Wollemi National Park

GANG-GANG COCKATOO

Species Profile

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The Gang-gang Cockatoo (*Callocephalon fimbriatum*) is a small, stocky cockatoo with dark grey feathers on its body, narrowly margined with pale grey, orange and red (Pizzey and Knight 1999). Both sexes have a wispy crest that is curved forward and twisted, but the males crest and head is a bright fiery red. The species is endemic to south-eastern Australia, ranging from the mid north coast and central tablelands of NSW to far south west Victoria and occasionally into South Australia (Higgins 1999). Gang-gangs are seasonally nomadic, inhabiting tall mountain forests and woodlands in the summer then moving to lower altitudes to drier, open eucalypt forests and woodlands in the winter (Higgins 1999) when they may also be found in urban areas and farmlands. It is gregarious in nature and primarily arboreal, roosting in tall trees and foraging in pairs or family groups for seeds, berries, fruits, nuts and insects in the canopy or occasionally in the upper understorey (Higgins 1999). The Gang-gang Cockatoo requires hollows in large trees for breeding, which occurs between October and January (Pizzey and Knight 1999).

Threats

Threats to the Gang-gang Cockatoo are poorly known but are thought to include habitat destruction and degradation; in particular the loss of food trees and large old trees required for roosting and breeding (NSW Scientific Committee 2001g, 2005). Perhaps important is that a large amount of winter habitat has been cleared for agricultural and urban development. Competition for nest hollows with other species may also be problematic (NSW Scientific Committee 2001g), while Psittacine Circoviral (Beak and Feather) Disease may threaten small populations that are already stressed (DEH 2004a). Climate change may alter the extent and nature of the cool temperate vegetation that the species utilises (Olsen *et al.* 2003, NSW Scientific Committee 2005).

Local and Regional Conservation Status

The Gang-gang Cockatoo has recently been listed as a Vulnerable Species under the NSW TSC Act (1995). The listing was made on the basis of a decline in the reporting of this species across its distribution between 1984 and 2002, though the reliability of this trend was low (Barrett *et al.* 2003). In the Sydney Basin Bioregion it is abundant south of the Hunter River, though there are fewer records in the Sydney and Wollongong urban areas. Numerous records of the species occur within many reserves, including (in addition to Wollemi National Park) Kanangra-Boyd, Blue Mountains, Nattai and Yengo National Parks.

Within the study area the species has been recorded at over 25 locations between 1978 and 2005 (Map 8). The majority of these records are in the east of the park, particularly along the California Trail, the northern Commission Road and the Hunter Main Trail, but the species has also been recorded at five locations in the north-west of the park within the Baerami and Hungerford Valleys. These records have been collected during various times of the year, including spring, summer, autumn and winter, suggesting that the study area provides habitat for the cockatoo all year round. Of particular importance is the presence of the Box-Ironbark woodlands near the boundaries of the park, which provide potential winter habitat for the species. Such habitat has been extensively cleared for agricultural and urban development, while much remaining habitat outside reserves is under ongoing pressure. Importantly, north-eastern Wollemi National Park lies towards the northern limit of the Gang-gang Cockatoo's range; the species has been recorded in only four reserves further north, including Goulburn River, Mount Royal and Barrington Tops National Parks and Manobalai Nature Reserve. Conservation of the species within the study area is therefore important to the continued conservation of species at the northern edge of its range.

GLOSSY BLACK-COCKATOO

Species Profile

The Glossy Black-cockatoo (*Calyptorhynchus lathami*) is a medium to large black cockatoo, which has a diagnostic black-brown head, with yellow patches in the female, and red tail panels. It is usually seen in pairs or trios (with dependant young) in eucalypt woodland or forest, where it nests in hollows. This species feeds almost exclusively on Sheoaks (*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 affect food supplies and this species has been listed by the NSW Scientific Committee (2000b) as being affected by inappropriate fire regimes. Illegal trapping for aviculture may be a localised, minor threat (Garnett and Crowley 2000). DEH (2004a) lists the Glossy Black-cockatoo as a species that has exhibited symptoms of Psittacine Circoviral (beak and feather) Disease.

Local and Regional Conservation Status

The Glossy Black-cockatoo is listed as Vulnerable under the NSW TSC Act (1995). Being a large, conspicuous species there are numerous records in the coastal third of the state, though it is also found on the western slopes and an apparently isolated population occurs in the Narrandera-Lake Cargelligo area of the Riverina (NSW Scientific Committee 1999a). Relatively large areas of the Sydney Basin provide suitable habitat for the species and there are a large number of records throughout the Bioregion (DEC 2005a). Feeding habitat is well protected, occurring in numerous DEC reserves, including Morton, Nattai, Blue Mountains, Ku-ring-gai Chase, Yengo and southern Wollemi National Parks.

The Glossy Black-cockatoo has been recorded at 31 locations within the study area between 1980 and 2005. These locations are shown in Map 8 and include the higher rainfall environments on the Hunter Range and in the east (California Trail and Commission Road) as well as the drier north-western environments around Baerami, Hungerford and Yarrawa. All of the records lie on Narrabeen Sandstone geology, where Forest Oak (*Allocasuarina torulosa*) or Black She-oak (*Allocasuarina littoralis*) form a component of the small tree layer. It is important to note that Glossy Black-cockatoos have been directly observed on twice as many occasions in the southern and eastern environments than in the north-western corner. In contrast, the characteristic remnants of chewed *Allocasuarina* cones that are left behind after feeding have been recorded more frequently in the north. The recording of these cones may lead to an over-estimation of the abundance of Glossy Black-cockatoos as one bird or single group of birds could leave behind feeding traces at several locations. The bird may thus be more common in the eastern and southern environments than in the north-west. The study area is clearly important to the local protection of the species and contributes to its regional conservation.

SWIFT PARROT

Species Profile

The Swift Parrot (*Lathamus discolor*) is a medium-sized, green parrot with distinctive red and blue head markings. It favours open eucalypt forest and woodland where it feeds on nectar and lerp. It breeds only in Tasmania, and migrates to the mainland as far north as southern Queensland during autumn and winter. During the non-breeding season it is nomadic, with small to large flocks congregating at suitable food sources. Favoured food trees in NSW include Swamp Mahogany (*Eucalyptus robusta*), Mugga Ironbark (*E. sideroxylon*), White Box (*E. albens*) and Spotted Gum (*Corymbia maculata*) (Higgins 1999).

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Threats

The Swift Parrot has a small population of approximately 2000 individuals (Tzaros 2002) which may still be declining (Garnett and Crowley 2000). Outside the breeding area the main threat is from habitat destruction (Garnett and Crowley 2000). Due to the variable nature of the flowering of its favoured feeding trees during the non-breeding season it is nomadic and is sensitive to clearance of areas that it may rely on once every few years. Due to its rapid flight, the species often is killed in collisions with windows, vehicles and fences, though this occurs more regularly in Tasmania (Garnett and Crowley 2000). Beak and Feather (Psittacine Circoviral Disease (PCD)) has been confirmed from wild Swift Parrots in NSW and has a high potential to adversely impact on the population (NSW Scientific Committee 2002a).

Local and Regional Conservation Status

The Swift Parrot is listed as Endangered under the NSW TSC Act (1995) and as Endangered under the Commonwealth EPBC Act (1999). The majority of records in NSW occur in the three coastal Bioregions and the NSW South West Slopes Bioregion. Most of the records of Swift Parrots in the Sydney Basin Bioregion are in coastal habitats, particularly the Central Coast, but they have also been regularly recorded in drier areas of the Hunter and Capertee Valleys and the Cumberland Plain. Few records occur within reserves, though important sites include Nattai and Werakata National Parks. Intensive surveys in recent years have greatly increased the understanding of habitat usage by Swift Parrots in their wintering grounds in NSW (D. Saunders pers. comm.).

The Swift Parrot has not been recorded within north-eastern Wollemi National Park on the Atlas of NSW Wildlife. However, two individuals were observed on Wambo Road, under two kilometres to the east of the park in April 2000, and another individual was seen three kilometres to the east of that in May 2002 (Map 9). The closest regularly-visited winter habitat for the species is located in and around Werakata National Park, approximately 40 kilometres to the east of the study area. It is possible, that the study area forms a component of the winter feeding habitats within the region, even though it may only be visited on occasion. The species is likely to have gone unnoticed within the study area because very few surveys have been undertaken in the winter months. The study area contains numerous winter-flowering tree species, including the parrot's favoured food trees Mugga Ironbark, White Box and Spotted Gum. Mugga Ironbark and White Box occur infrequently within the dry woodlands on Permian geology in the north of the park. Spotted Gum only occurs in small patches on the eastern edge of the park, along Milbrodale, Hayes and Wambo Creeks. When these trees are in heavy flower, or when other food sources in the region are limited, it is likely that Swift Parrots visit the park. It is recommended that targeted surveys be undertaken during such times, to determine the extent to which the habitat is used. Such surveys need to be undertaken by experienced observers familiar with the species call. The presence of this habitat within the reserve has high conservation significance, as much of the known winter habitat areas for the species are not located on public lands.

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. The bird 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 of the species; 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. Beak and Feather (Psittacine Circoviral Disease (PCD)) is not known from this species, but has been recorded in the congeneric Orange-bellied Parrot (*N. chrysogaster*) (DEH 2004a). The species may also be threatened by competition for nesting sites with introduced birds, such as the Common Myna (*Acridotheres tristis*), as well as feral Honeybees (*Apis mellifera*).

Local and Regional Conservation Status:

The Turquoise Parrot is listed as Vulnerable under the NSW TSC Act (1995). The number of records is highest in the Sydney Basin Bioregion and along the western slopes (Nandewar, Brigalow Belt South and NSW South West Slopes Bioregions) (DEC 2005a). In the Sydney Basin Bioregion, the species is most commonly found within dry grassy woodland environments that are prominent in the Hunter and Capertee Valleys and to a lesser extent the Cumberland Plain. Important conservation reserves for this species in this Bioregion include Yengo and Goulburn River National Parks, Munghorn Gap Nature Reserve and Yerranderie State Conservation Area.

The Turquoise Parrot has been recorded at 29 locations within the study area between 1997 and 2004 (Map 9), with an average of two birds being seen at each location. Habitat for the species is concentrated along the northern perimeter of the study area as well as along the flats of Ruebens, Baerami, Hungerford and Gungalwa Creeks. The majority of records of the species in the area were collected in the Baerami and Hungerford Creek Valleys during the DEC surveys in September and October 2004. The birds were primarily observed within the alluvial Box-Red Gum-Ironbark Woodlands, but also on the adjacent escarpment slopes. Scattered records also exist for the Kings, Martindale, Doyles and Appletree Creek Valleys, suggesting that the species occupies all areas of appropriate habitat within the park, though at varying densities.

Large amounts of Turquoise Parrot habitat within the Hunter Valley have been cleared in the past for agriculture or are still under threat from urban development and expansion of mining activities. The preservation of habitat within Wollemi National Park, together with neighbouring reserves such as Yengo and Goulburn River National Parks, is therefore vital to the local and regional conservation of the species.

BARKING OWL

Species Profile

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The Barking Owl (*Ninox connivens*) is an owl of intermediate size between the larger Powerful Owl (*N. strenua*) and the Southern Boobook (*N. boobook*). It has dark brown upper-parts and a white underbody with coarse brown streaking (Higgins 1999). It is often identified by its call, which is a distinctive, dog-like barking that can be confused with Fox (*Vulpes vulpes*) or Dog (*Canis lupus*) barks. It usually inhabits dry open eucalypt forests and woodlands, where it is associated with hydrological features such as rivers and swamps (Taylor *et al.* 2002a). It nests in hollows, usually of large eucalypts, where it lays one to three eggs. It is an opportunistic feeder, eating more insects than other large forest owls, but consumes small terrestrial and arboreal mammals and birds during the breeding season. The race *connivens* occurs east of a line connecting Cooktown (Queensland) and the Flinders Ranges (South Australia) with an isolated population in the south west of Western Australia. Other races occur across northern Australia, in New Guinea and the Moluccas (Indonesia) (Higgins 1999).

Threats

The main identified threat to the species is habitat destruction, particularly the removal of woodlands and forests from more low-lying fertile areas for agriculture (Taylor *et al.* 2002b). Remaining habitat is also subject to further degradation through forestry and collection of firewood, which often involves the removal of large hollows. However, the owl is frequently located at the edge of forest blocks adjacent to cleared land, possibly due to increased prey availability at such locations (Taylor *et al.* 2002b). The owl may also suffer some competition for nest sites from feral Honeybees (*Apis mellifora*) (Garnett and Crowley 2000). The long generation time (ten years) means that the species may take a long time to recover after suffering a decline (NSW Scientific Committee 1998b). NPWS (2003a) also lists predation (particularly of fledglings), mortality from collisions with fences and vehicles, and secondary poisoning from rodenticides as threats.

Local and Regional Conservation Status

The Barking Owl is listed as Vulnerable under the NSW TSC Act (1995). Records occur throughout NSW, though it is more rare in the far west and at higher altitudes in the south-east (DEC 2005a). Records are scattered throughout the Sydney Basin Bioregion, though important locations appear to be the Capertee Valley, Hunter Valley and to a lesser extent the Cumberland Plain. Very few records occur within the Sydney sandstone reserves (DEC 2005a), with most records on private lands.

Barking Owls have been recorded at four locations within the north of the study area, though the species was only visually observed at one of these sites (Map 7). Each of these locations is within dry woodland vegetation, either on creek flats or lower slopes, which is typical of the species habitat preferences. These habitats are widespread around the northern boundaries of the study area and it is likely that the species occurs elsewhere within the Baerami, Hungerford, Kings Creek, Martindale and Doyles Creek Valleys. While still recorded very rarely, call playbacks undertaken in the dry woodland habitats of the southern Hunter Valley escarpment have resulted in considerably higher response rates than have been achieved in the Southern Sydney region (DEC 2005d). This indicates the importance of these habitats to the species on a regional scale.

The Barking Owl may never have been abundant in the southern end of its range, though it was once more widespread in dry open eucalypt forests and woodlands in the Hunter Valley. Its preferred habitat in the Hunter Valley as been widely depleted by clearing for agriculture, industry and settlements and much remaining habitat is under continued pressure from these threats. This species is now genuinely rare in the Sydney Basin Bioregion and localities that occur on reserve have very high conservation significance. It is paramount that caution be exercised to ensure that known territories are not modified in a way that may negatively impact on the owl. Management of the owl in the park and the region should be undertaken in accordance with the state-wide recovery plan (currently in draft form, NPWS 2003a).

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 it usually breeds and roosts in dense forest types, including rainforest and wet sclerophyll forest. It hunts in more open forests, where it feeds mainly on arboreal mammals, particularly Common Ringtail Possums (*Pseudocheirus peregrinus*) and Greater Gliders (*Petauroides volans*) (Kavanagh 2002). This owl usually nests in a hollow in eucalypts within or below the canopy, and normally lays two eggs. They usually maintain a territory of between 300 and 1500 hectares, with size dependent on habitat quality and prey density. The species 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 nest sites. The owl can, however, survive in areas with some levels of disturbance, such as in selectively logged forests (Kavanagh 1997) and suburban areas of Brisbane, Sydney and Melbourne (Garnett and Crowley 2000, DEC 2004a). 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). The foliage roosts of the Powerful Owl are vulnerable to regular hazard reduction burning (DEC 2005e).

Local and Regional Conservation Status

The Powerful Owl is listed as Vulnerable under the NSW TSC Act (1995). The majority of records occur within the three coastal Bioregions, but occasional sightings have also been made further west, particularly in the South Eastern Highlands Bioregion. It occurs throughout the Sydney Basin Bioregion across extensive areas from the rural-urban fringes of the Sydney Metropolitan area to west of the Dividing Range into the Central Tablelands. Most reserves within this latter Bioregion support known territories of this species. Recent work within the Sydney Catchment Authority Special Areas (Woronora and Warragamba) has found Powerful Owls to be in higher densities and more widespread within the sandstone country of the Sydney Basin than previously thought (DEC 2005d).

DEC surveys have identified Powerful Owls at five locations in north-eastern Wollemi National Park. This large majestic bird has only been seen on one occasion (it was heard on the other occasions), when in February 2005 a fauna surveyor imitated the species low-pitched hooting call. An individual responded (along with a number of Yellow-bellied Gliders) by coming in to the sound and perching above the surveyor and continuing to hoot loudly, presumably in defence if its territory. The Powerful Owl records are widely spaced across the study area (Map 7). Each record is located within the vicinity of moister habitat types, either along creeklines and lower slopes in the north and north-west or in the higher rainfall areas in the east and south. This distribution is likely to reflect the availability of hollow-bearing trees and prey items. Gully lines or tall forests are essential components of a Powerful Owl's home range for both foraging and roosting.

Relative to other localities in the Sydney Basin, the habitat within this section of Wollemi National Park is not of particularly high quality for the Powerful Owl, and although habitat is widespread in the gullies in the north, centre and east of the park, the species is only expected to occur at relatively low densities. The owls may reach greater density at the higher elevations in the south of the area, where preferred prey items such as Greater Glider and Common Ringtail Possum are more abundant. The species has been recorded at six locations in the northern section of Yengo National Park, including a roosting pair observed along Partridge Creek in January 2005. Greater quality habitat for this species is available in the more southerly areas of the Sydney Basin. Management of the owl should be undertaken in accordance with the state-wide recovery plan (currently in draft form, DEC 2005e).

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 (Higgins 1999). It inhabits a wide range of woodland habitats with large hollows for roosting and open areas for hunting. It feeds mostly on ground-dwelling mammals such as rats (*Rattus*) and Antechinus (*Antechinus*), and occasionally on diurnal birds, Sugar Gliders (*Petaurus breviceps*) and insects (Kavanagh 2002). It appears to forage near ecotones, either at the boundary of forests of different structural composition or at the forest edge, and may this benefit from the mosaic of burnt-unburnt patches in the landscape after fire (DEC 2005e). The owl has a home range of 800 to 1200 hectares (Kavanagh 2002). 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 in New Guinea and adjoining islands, some of which are sometimes considered separate species (Higgins 1999).

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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 owl 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 under 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 (DEC 2005a). Within the Sydney Basin Bioregion, records are concentrated in the south, the central coast and to a lesser extent across the southern Blue Mountains. Records are scattered within a number of DEC reserves, including, in addition to Wollemi National Park, Royal, Blue Mountains, Nattai, Kanangra-Boyd, Brisbane Water and Dharug National Parks and Berowra Valley Regional Park (DEC 2005a). The core areas of the species distribution in NSW are located on the Central Coast and Lower Hunter Valley and much habitat in these areas is not reserved and is under continued pressure from habitat fragmentation and clearance.

Masked Owls have been recorded at six widely spaced locations within north-eastern Wollemi National Park, including five sites in the north in the Baerami, Hungerford, Gungalwa and Appletree Creek catchments, and once in the east on the California Trail (Map 7). On five occasions the birds were detected by their harsh screech or chattering call, heard either in response to call playback survey or opportunistically. In all cases the sites are surrounded largely by woodland habitats, ranging from Box-Red Gum-Ironbark Woodland in the north and north-west to Stringy-bark, Grey Gum and Ironbark dominated woodlands in the east. The species has not been detected within the higher elevation areas of the park, despite systematic surveys being undertaken here. These findings are consistent with observations elsewhere, as the Masked Owl is known to prefer woodlands with an open understorey and sparse ground cover for foraging, as well as forest or woodland near minor drainage lines for roosting. Given this, the Masked Owl is expected to occur at moderate abundance

across the northern half of the study area, and at lower abundance on the central sandstone plateau and eastern section of the park.

The Central Coast and Hunter Valley support the most significant Masked Owl population remaining in the Sydney Basin Bioregion. The area is under heavy pressure from urban and industrial development, which threatens much of the remaining primary habitat for the species. Localities within reserves will become increasingly important to the survival of the species, and thus though Wollemi National Park only supports low densities and relatively marginal habitat it is important to the long term conservation of the species in the region. Management of the owl in the region should be undertaken in accordance with the state-wide recovery plan (currently in draft form, DEC 2005e).

SOOTY OWL

Species Profile

The Sooty Owl (*Tyto tenebricosa*) is a medium to large 'barn' owl, with sooty grey plumage that is finely spotted and flecked with white. It is found in tall wet forests, including wet sclerophyll and rainforest, where it is often first detected by its distinctive 'falling bomb' call. It roosts and breeds in hollows, often located in emergent trees which may be greater than 100 years of age, as well as in sandstone overhangs (Kavanagh 1997). Pairs probably maintain permanent territories that are between 200 and 800 hectares in area (Higgins 1999). It feeds on a wide range of arboreal and terrestrial mammals (Kavanagh 2002). In Australia the subspecies *tenebricosa* is distributed along the east coast between the Conondale Ranges (Queensland) to north east of Melbourne (Victoria). A smaller subspecies (*arfaki*) occurs in New Guinea (Higgins 1999).

Threats

Garnett and Crowley (2000) list the main threat as habitat clearance for agriculture and urban development, with additional fragmentation or degradation caused by logging, burning, dieback and urbanisation. The exact impacts of logging are not entirely clear (Higgins 1999). Where the species is at the margins of its ecological tolerance, frequent fire may threaten its occurrence when it results in the replacement of mesic plants with fire tolerant species and impacts on nest and roost sites.

Local and Regional Conservation Status

The Sooty Owl is listed as Vulnerable under the NSW TSC Act (1995). Due to its nocturnal habits, the Sooty Owl is not often recorded using established bird detection methods. Recent improvements in survey technique have greatly improved the detectability of this and other owl species (Kavanagh 1997). In NSW it is restricted to the three coastal Bioregions, with a few records in the extreme east of the South Eastern Highlands Bioregion. The distribution of this species in the Sydney Basin Bioregion is strongly tied to the presence of wet sclerophyll forests and rainforests. The Illawarra escarpment behind Wollongong and the Watagan Ranges between the Central Coast and Newcastle support the largest areas of high quality habitat (NPWS 2002a). In these areas it has been most often recorded in Illawarra Escarpment and Jilliby State Conservation Areas, with other records in Royal, Blue Mountains and Bouddi National Parks.

Until February 2005, Sooty Owls were not known to occur within north-eastern Wollemi National Park. At this time, however, an individual was heard calling from Appletree Creek, while surveyors were working on the Commission Road. The owl's call was imitated and the owl responded by coming all the way up to the road, perching in a tree above the observers and continuing to call, presumably in defence of it's territory. The section of Appletree Creek it initially called from supports sheltered forests and patches of tall moist Blue Gum Forest. The Sooty Owl often roosts in caves, which are likely to be abundant along the escarpment of the Appletree Creek gorge. The species has been recorded at two further locations within a five kilometre radius of the study area, including once in Putty State Forest along Medhurst Creek and once in northern Yengo National Park (Map 7).

Habitat for the Sooty Owl is limited within the study area, restricted to tall moist eucalypt forests in the centre and east such as those along the headwaters of Martindale, Hayes, Parsons and Wambo Creeks, and the upper reaches of Doyles Creek, as well as the south of the study area within tall moist forest and rainforest in the vicinity of Mount Monundilla. The Sooty Owl is expected to occur within these areas, but only at low to moderate density. It is likely to be absent from the dry gullies of the northern Baerami Range. More extensive habitat for the species exists in southern Wollemi National Park and within gorges across the southern Blue Mountains region. Management of the owl in the region should be undertaken in accordance with the state-wide recovery plan (currently in draft form, DEC 2005e).

BROWN TREECREEPER (EASTERN SUBSPECIES)

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 distinctive call. It is typically a bird of eucalypt woodlands with a grassy or open shrub understorey and abundant fallen timber and/or dead trees. Unlike most treecreepers, the species spends approximately half of the time on the ground feeding on insects, particularly ants and beetles, taken from live and dead trees, fallen branches and off the ground. It occurs in pairs or small groups in permanent territories where tree hollows are utilised for breeding (Higgins *et al.* 2001). The eastern subspecies (*victoriae*) occurs along the coast and ranges in Victoria, New South Wales and south-east Queensland, with the other two subspecies occurring either further west (*picumnus*) or further 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 vegetation remnant, natural recolonisation is unlikely (Garnett and Crowley 2000). The lack of hollows may also be the limiting factor as the species is known to compete with introduced species like the Common Starling (*Sturnus vulgaris*) (Higgins *et al.* 2001) Common Myna (*Acridotheres tristis*) and European Honeybee (*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 under 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. Within the Sydney Basin Bioregion, the species is restricted to open woodlands of the central tablelands and open coastal plains and valleys such as the Capertee and Hunter Valleys and the Cumberland Plain (DEC 2005a). These environments are all characterised by agricultural and urban clearing with small isolated fragments of native vegetation common. The species has virtually disappeared from the Cumberland Plain in the last 30 years (NSW Scientific Committee 2001a, DEC 2005a). Habitat for the species is contained within a limited number of reserves within the Sydney Basin Bioregion, including Yerranderie State Conservation Area, Nattai National Park (Burragorang and Nattai Valleys), Blue Mountains and Goulburn River National Parks and Manobalai Nature Reserve.

Brown Treecreepers are regularly observed within the dry woodlands that occupy creek flats and lower escarpment slopes of north-eastern Wollemi National Park (Map 8). The locations are all below 400 metres above sea level where Box species (*Eucalyptus albens, E. molucanna, E. dawsonii*) make up a component of the canopy or are within close vicinity. Little of the Brown Treecreeper habitat remaining within the Hunter Valley area is located within public lands or reserves, so the extent of habitat included within the northern edge of Wollemi National Park has high conservation significance and is important to the continued conservation of the subspecies.

The Brown Treecreeper also utilises private lands adjacent to the park, and landowners should therefore be strongly encouraged to retain the integrity of the habitat within this agriculture-bushland interface. Activities that alter the structure of the vegetation, such as clearing, burning and over-grazing activities should be discouraged. These areas on private land may play a buffering role for threats to the Brown Treecreeper. The retention of Box woodlands on the escarpment slopes of the reserve and adjoining valleys is primary to the protection of the subspecies.

SPECKLED WARBLER

Species Profile

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The Speckled Warbler (*Pyrrholaemus sagittata*) is a small, primarily ground-dwelling 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, noticeably longer tail and distinctive call. The female differs from the male by having a chestnut, rather than black, streak in the eyebrow. It usually occurs in the grassy understorey or low shrubs of dry sclerophyll forests and woodlands dominated by eucalypts. It feeds on insects and seeds with most foraging occurring on the ground. Pairs, and occasionally trios, live permanently in large (up to twelve hectares) 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 isolated patches may result in local extinction due to natural fluctuations (Garnett and Crowley 2000) with extinction occurring in areas with no patches over 100 hectares (NSW Scientific Committee 2001b). The species nests and forages on the ground and hence is susceptible to predation by exotic mammalian predators, loss of ground cover by stock and rabbit grazing, weed invasion (NSW Scientific Committee 2001b, Garnett and Crowley 2000) and inappropriate fire regimes.

Local and Regional Conservation Status

The Speckled Warbler is listed as Vulnerable under 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 Sydney Basin Bioregion most records are in areas supporting dry woodlands, including the Burragorang Valley, lower Hunter Valley and Goulburn River Valley. Habitat is present within a limited number of reserves in the Sydney Basin Bioregion including, in addition to northern Wollemi National Park, Nattai, Yengo and Goulburn River National Parks and Munghorn Gap and Manobalai Nature Reserves (DEC 2005a).

Records of Speckled Warbler are concentrated around the northern perimeter of the study area, near the interface between agricultural land and bushland (Map 9). Habitat for the Speckled Warbler would once have spread across the valleys that border and indent the northern perimeter of the park. Clearing for agriculture has reduced the available habitat to remnants of Box-Red Gum-Ironbark Woodland on creek flats and lower escarpment slopes, both in the reserve and on adjacent private lands. Speckled Warblers have also been observed at two locations in the east of the park, including once within basalt-influenced grassy woodland on the old ‘California’ property and once in the vicinity of Bulga. However, the species is much less widespread in this south-eastern section of the study area and this area is not considered to be a stronghold for species.

Protection of the species remaining habitat requires close cooperation between reserve managers and adjoining landholders. Landowners should be strongly encouraged to retain the integrity of the habitat on their land and reduce threatening processes such as clearing, burning and grazing activities. The retention of dry woodlands on the northern creek flats and escarpment slopes of the reserve and adjoining valleys is primary to the protection of the species. The conservation of Speckled Warbler habitat and the abundance of the species in the north of the study area has high local and regional conservation significance, as the majority of habitat elsewhere in the Hunter Valley remains threatened by agricultural, industrial and urban development.

PAINTED HONEYEATER

Species Profile

The Painted Honeyeater (G*rantiella picta*) is a small to medium sized bird (16 cm in length) with yellow edging to the flight feathers and a distinctive pink bill. Males exhibit black and white plumage and dark streaks on the flanks, while females are smaller, browner birds with no flank streaks (ACT Government 1999, DEC 2005f, Simpson and Day 1996). It is a specialist feeder, foraging almost exclusively on mistletoes of the genus *Amyema*, although it will also take some nectar and insects (ACT Government 1999, Garnett and Crowley 2000). It inhabits dry forests and woodlands, and prefers Boree, Brigalow and Box-Gum woodlands and Box-Ironbark forests (ACT Government 1999, DEC 2005f, Oliver *et al.* 2003). It exhibits a sparse distribution from south-eastern Australia to north-western Queensland and eastern Northern Territory. The greatest concentrations and almost all breeding records occur on the inland slopes of the Great Dividing Range in Victoria, NSW and southern Queensland (ACT Government 1999, DEC 2005, Garnett and Crowley 2000, Oliver *et al.* 2003). Nomadic movements throughout both breeding and non-breeding seasons have been attributed to the fruiting of mistletoes and abundance of rainfall (Keast 1968, Pizzey and Knight 1999). However, extent of vegetation is also important, with birds more likely to be found in wider blocks of Box-Ironbark woodland than in remnant strips, such as occur in windbreaks and along roadsides (Robinson 1994).

Threats

The main identified threats to the Painted Honeyeater are associated with habitat removal, modification and isolation, particularly the Box-Ironbark and Boree woodlands (Garnett and Crowley 2000). Much of the habitat used during the breeding season has been disturbed, through the clearing of woodlands and open forests, the removal of large trees with heavy mistletoe infestations and inappropriate fire regimes. Non-breeding habitat also continues to be cleared for purposes of agriculture and urban development. Heavy grazing and other agricultural practices such as pesticide and fertiliser application have also been noted as likely to impact on honeyeater habitat and populations (ACT Government 1999, DEC 2005f, Garnett and Crowley 2000).

Local and Regional Conservation Status

The Painted Honeyeater is listed as Vulnerable under the NSW TSC Act (1995). Records for the species are sparsely scattered through the centre of NSW, with concentrations in the Cobar Peneplain, Darling Riverine Plain and NSW South West Slopes Bioregions (DEC 2005a). Within the Sydney Basin Bioregion, records are concentrated between Sydney, Newcastle and Mudgee, particularly around the Hunter Valley (DEC 2005a). The species is very poorly represented in reserves in the Bioregion, having been recorded in Munghorn Gap Nature Reserve, southern Wollemi National Park and at the boundary of Goulburn River National Park (DEC 2005a).

The Painted Honeyeater has not been recorded within north-eastern Wollemi National Park, but has been seen on ten occasions at five locations to the north and east, between 1974 and 2001 (Map 9). Potential habitat for the species is widespread around the northern perimeter of the park, both on and off reserve, including along creeks and valley flats that support River Oak (*Casuarina cunninghamiana*) with mistletoe, as well as lower escarpment and dry slopes that support Box-Red Gum and Box-Ironbark woodlands. These environments form a component of the mosaic of foraging habitat for the species in the Hunter Valley, being used when mistletoe or eucalypt species are in heavy flower. As clearance has destroyed a large amount of Painted Honeyeater habitat and much of the remaining habitat is fragmented and continues to be degraded or under pressure from development, the preservation of habitat within northern Wollemi National Park has high conservation significance. Even though the species may only visit the park on occasion, such habitats are likely to be vital to the survival of the species east of the Great Dividing Range in NSW. Ongoing conservation will require cooperation between wildlife managers and private landholders. Landowners should be strongly encouraged to retain the integrity of habitat on their land and in particular to retain key tree species that support mistletoes of the genus *Amyema*.

BLACK-CHINNED HONEYEATER (EASTERN SUBSPECIES)

Species Profile

The Black-chinned Honeyeater (*Melithreptus gularis*) is a small, rather stocky and short-tailed honeyeater. It is distinguished from other *Melithreptus* honeyeaters by its relatively larger size, bright blue or jade green eye-wattle and distinctive call. It occupies dry eucalypt woodlands that feature Ironbark and/or Box species with low to moderate rainfall levels, where they are usually found in pairs or small groups of up to twelve. They feed on insects, nectar and lerp usually in the upper canopy and outermost flowers and leaves. There are two subspecies that have in the past been named as two separate species. The eastern, nominate subspecies (*gularis*) is found along the inland slopes of the Great Dividing Range, extending to the coast in the Sydney Basin and Clarence River Valley of NSW, and again between Brisbane and Rockhampton, Qld, as well as westward into south-eastern South Australia. The 'Golden-backed Honeyeater' (*laetior*) is widespread across northern Australia (Higgins *et al.* 2001).

Threats

The eastern subspecies of the Black-chinned Honeyeater is one of a suite of woodland birds that have declined throughout their range due to habitat clearance (Reid 1999). They are threatened by clearance and the fragmentation of woodland habitat and don't appear to survive in remnants less than 200 hectares (NSW Scientific Committee 2001c). The species appears to occur naturally at low densities (NSW Scientific Committee 2001c) and is relatively mobile, so the reason for this absence in small fragments is unknown (Garnett and Crowley 2000). They are also likely to experience high levels of competition from aggressive honeyeater species associated with smaller fragments and may suffer increased nest predation from such species as Pied Currawongs (*Strepera graculina*) (NSW Scientific Committee 2001c).

Local and Regional Conservation Status

The eastern subspecies of the Black-chinned Honeyeater is listed as Vulnerable under the NSW TSC Act (1995). Scattered records for this species occur in the eastern half of the state, though the highest number of records are in the Nandewar, Sydney Basin and NSW South West Slopes Bioregions. In the Sydney Basin region most records come from drier areas such as the Capertee and Hunter Valleys and western Sydney. All of these areas have been heavily cleared in the past and remain subject to ongoing threatening processes. Most of the records for the species are outside of DEC reserves. However, it has been recorded in a small number of reserves, notably Goulburn River and Werakata National Parks and Munghorn Gap Nature Reserve (DEC 2005a), as well as northern Yengo National Park (DEC 2005c).

Black-chinned Honeyeaters appear relatively abundant along Reubens Creek in the north-west of the study area and have also been recorded in the Baerami Creek, Hungerford Creek, Kings Creek, Martindale Creek and Appletree Creek Valleys (Map 8). Consistent with records obtained across their range, the species has not been recorded within any sections of the study area that receive more than 700 millimetres of rain (NSW Scientific Committee 2001c), and is restricted to the Box-Red Gum-Ironbark woodlands that occur on the creek flats and lower slopes along the northern boundary. The density of the species within these areas will vary over time in response to major flowering events.

Habitat for this species would once have been widespread within the valleys of the Hunter and Goulburn Rivers. These areas have been extensively cleared for agriculture, industry and settlements and as a result habitat is now largely restricted to remnant vegetation along creeklines and lower escarpment slopes. Many fragments in the Hunter and Goulburn River Valleys are still under threat from development. The protection of Black-chinned Honeyeater habitat within Wollemi National Park, therefore has high local and regional conservation significance and, together within neighbouring National Parks (particularly Goulburn River and Yengo National Park) is vital to the ongoing survival of the species east of the Great Dividing Range in central NSW.

REGENT HONEYEATER

Species Profile

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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*) dominated forest. The species is semi-nomadic and seems to undertake complex movements, generally dependent on where flowering food trees are available. It feeds mainly on nectar, and nests in the crown 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). There is thought to be only a single population of approximately 1,500 individuals of this species remaining, with numbers considered to be still decreasing (Garnett and Crowley 2000).

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. Grazing by domestic stock and rabbits prevents habitat regeneration (NPWS 1999a). Habitat alteration may also advantage more aggressive honeyeaters, such as miners (*Manorina* spp.) and friarbirds (*Philemon* spp.) with resulting competition.

Local and Regional Conservation Status

The Regent Honeyeater is listed as Endangered under the NSW TSC Act (1995) and as Endangered under the Commonwealth EPBC Act (1999). Compiling reliable accounts of the species occurrence was one of the priorities of the Draft Regent Honeyeater Recovery Plan (Menkhorst *et al*. 1999) thereby increasing the number of records included in the Atlas of NSW Wildlife. Records are concentrated in the eastern third of the state, with the greatest number in the Sydney Basin, Nandewar and New England Tableland Bioregions. Important areas in the Sydney Basin appear to be the Capertee and lower Hunter Valleys, the northern Cumberland Plain and the Central Coast. The species is primarily observed outside of reserves, although a small number of parks are regularly used, including Goulburn River and Nattai National Parks and Cockle Bay and Munghorn Gap Nature Reserves (DEC 2005a).

Regent Honeyeaters have frequently been recorded within five kilometres of north-eastern Wollemi National Park, first in 1970 and then regularly through the late 1990s. The majority of these sightings have been made in the Widden Valley, immediately to the west of the study area, but also within the Baerami Valley, Doyles Creek area and to the east of the park, north and south of Bulga (Map 9). The species was positively recorded for the first time within the study area in October 2004 when three individuals were spotted at two locations between Kings Creek and Mount Arndell in the north-west. One of the birds was seen on a hill slope within woodland dominated by Grey Box (*Eucalyptus molucanna*) with Black Cypress Pine (*Callitris endlicheri*) and Kurrajong (*Brachychiton populneus*), while the others were seen on a dry creek flat supporting Forest Red Gum (*E. tereticornis*) and Rough-barked Apple (*Angophora floribunda*). These habitats are fairly typical of the species as they contain favoured food trees including Mugga Ironbark (*Eucalypts sideroxylon*) and Yellow Box (*E. melliodora).*

It is significant that the Regent Honeyeaters were observed within the study area in October, as this is within the breeding season (which extends from July to November) and suggests that the species may be breeding within the park or surrounding areas. During the 1990s the species was recorded on nine occasions during the breeding season within five kilometres of the study area.

Preferred habitat for the Regent Honeyeater is widespread around the northern perimeter, both on and off reserve. These include creeks and valley flats that support River Oak with mistletoe, Red Gum and Yellow Box as well as lower escarpment and dry slopes that are dominated by Box species (*E. albens* and *E. molucanna*) and Red Ironbark. Potential habitat also occurs in the far east within the patches of Spotted Gum woodlands. As clearance has destroyed about 75% of the Regent Honeyeater's habitat across its former range (Garnett and Crowley 2000), and large amounts of the remaining habitat are fragmented and continue to be degraded, the preservation of habitat within northern Wollemi National Park, and neighbouring DEC reserves, has very high conservation significance. These habitats form an important component of the mosaic of feeding, and possibly breeding, habitats within the region. Thus, even though they may only be visited on occasion, the habitats are likely to be vital to the survival of the species. Targeted surveys are required to ascertain the exact extent to which the species currently depends on these areas. Ongoing conservation will require cooperation between reserve managers and adjoining private landholders. Landowners should be strongly encouraged to retain the integrity of habitat on their land and in particular to retain key feed tree species, including Mugga Ironbark and Yellow Box.

HOODED ROBIN (SOUTH-EASTERN SUBSPECIES)

Species Profile

The Hooded Robin (*Melanodryas cucullata*) is a medium-sized bird that typically occurs in eucalypt woodland or *Acacia* shrubland. The adult male is distinctive, having a black hood and upper body combined with a white shoulder stripe. 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 and call, distinguish this species from the Jacky Winter (*Microeca fascinans*) and female *Petroica* Robins. They utilise dead or fallen timber as perches, from which they pounce to feed mainly on insects and small lizards from the ground (Garnett and Crowley 2000). The species 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 the 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 2001d). Eggs and young have been known to be predated by native avian predators and possibly by Foxes (*Vulpes vulpes*) (Higgins and Peter 2002) and feral Cats (*Felis catus*).

Local and Regional Conservation Status

The south-eastern subspecies of the Hooded Robin is listed as Vulnerable under the NSW TSC Act (1995). It has been recorded in most Bioregions in New South Wales, though is rare in the Australian Alps, South Eastern Highlands and Riverina Bioregions, and is restricted in the NSW North Coast Bioregion. Within the Sydney Basin Bioregion it is virtually restricted to the Hunter, Capertee and Burragorang Valleys where it is closely associated with the drier woodland habitats. It once occurred on the Cumberland Plain (DEC 2005a, Keast 1995) but has since thought to have disappeared (NSW Scientific Committee 2001d). Within the Sydney Basin it has been recorded from a limited number of reserves including, in addition to Wollemi, Nattai and Goulburn River National Parks and Munghorn Gap Nature Reserve, though most records are on the boundary of the reserves.

The Hooded Robin was not recorded within north-eastern Wollemi National Park during the DEC surveys, either in 1997 or in 2004-05. However, the species has been seen at three locations either on or just within the northern boundary of the park by Birds Australia, State Forests and casual observers between 1995 and 2002 (Map 9). In addition, Hooded Robins have been recorded at over ten locations within five kilometres of the study area, between 1977 and 2002. It is uncertain whether the fact that the species has not been observed within the local area since 2002 represents a real loss of the species from the area over recent years, a real decline in numbers, or is simply because the birds have avoided detection in recent times. Their tendency to dwell at the interface between cleared and wooded land, often perching on fences and dead trees, makes them quite visible and easy to detect. However, the species has been described as a winter visitor to some areas of central eastern NSW (Higgins and Peter 2002), a time of year when few bird surveys are conducted and hence the species may go undetected. Indeed, the Hooded Robin has been observed in the region of the study area more frequently in the autumn-winter months than in spring and summer (DEC 2005a). This could explain the lack of DEC records, as all DEC diurnal bird surveys were undertaken in the spring and summer. It is important to note, however, that the Hooded Robin has suffered declines in other parts of the Hunter Valley in recent years. Potential habitat for the species appears widespread around the northern boundary of the study area, within the Box-Red Gum Woodlands, but there may be a factor limiting the occurrence of the species is this area.

Habitat for the Hooded Robin would once have been widespread across the valleys that border and indent the northern perimeter of the park. Clearing for agriculture has reduced the available habitat to isolated paddock trees and remnants of Box-Red Gum Woodland on creek flats and lower escarpment slopes, both in the reserve and on private lands. It is recommended that targeted surveys be undertaken within these habitats to ascertain whether Hooded Robins survive here and if so to identify current key areas. Such surveys should be undertaken at intervals throughout the year, with a particular focus on the autumn and winter months. Landholders should be encouraged to retain paddock trees (even if they are dead) and other perch sites for the species. The protection of dry woodlands on creek flats both on the reserve and on adjoining private lands will be important to the survival of the species within the region.

GREY-CROWNED BABBLER (EASTERN SUBSPECIES)

Species Profile

The Grey-crowned Babbler (*Pomatostomus temporalis*) is the largest of the four Australian babbler species, and the only one with a light-coloured crown. Other distinctive features are a long, decurved bill and a dark band that passes from the bill through the eye, giving it a "masked" appearance (Higgins and Peter 2002). There are two subspecies in Australia, the nominate being *temporalis*, which occurs in eastern Australia from Cape York to north-east NSW then south and west through central NSW and Victoria to south-eastern South Australia (Higgins and Peter 2002). It is widespread on the inland slopes of the Great Dividing Range in NSW and on the western plains. Grey-crowned Babblers live in open forest and woodland, *Acacia* shrubland and adjoining farmland, preferring Box-Gum woodlands on slopes and Box-Cypress and open Box woodlands on alluvial plains (DEC 2005g, Garnett and Crowley 2000). They feed on invertebrates gleaned from vegetation or the ground (Garnett and Crowley 2000). The birds form family parties, consisting of a breeding pair and offspring from prior breeding years, which are thought to be vital for predator avoidance and cooperative feeding of the young (King 1980).

Threats

The Grey-crowned Babbler 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 the degradation and fragmentation of woodland habitats. (Reid 1999). Remaining Babbler habitat occurs in isolated fragments throughout its range, from which they gradually disappear (Garnett and Crowley 2000). This disappearance has been attributed to the consequences of habitat fragmentation on family-group sizes and the resulting reduction in breeding success and higher rates of nest predation (Garnett and Crowley 2000, NSW Scientific Committee 2004c). Once lost from a habitat fragment, natural recolonisation is unlikely (Robinson and Traill 1996). Agricultural practices, such as grazing and associated weed invasion also pose a threat, as does increased competitor abundance in disturbed habitats, removal of important feeding sites such as logs and fallen timber from habitat remnants, as well as Cat predation.

Local and Regional Conservation Status

The eastern subspecies of the Grey-crowned Babbler is listed as Vulnerable under the NSW TSC Act (1995). It is most common in the central western Bioregions of NSW, particularly the NSW South Western Slopes and Brigalow Belt South, but also occurs in the NSW North Coast Bioregion such as in the Clarence River Valley (DEC 2005a). Within the Sydney Basin Bioregion the species is largely restricted to the Hunter Valley, with a few records also in the Capertee Valley, where it is closely tied to the drier woodland habitats. Within the Bioregion it is poorly represented in reserves, having been recorded, in addition to Wollemi National Park, in Goulburn River, Yengo and Werakata National Parks and Munghorn Gap Nature Reserve (DEC 2005a).

Grey-crowned Babbler has been recorded at eight locations within north-eastern Wollemi National Park, including three times by Birds Australia and five times during the DEC surveys in late 2004 (Map 8). It has also been recorded on numerous occasions within a five kilometre radius, particularly to the north-east. The DEC records were all collected on the escarpment slopes and plains, within Box-Red Gum or Box-Ironbark woodland. The species is likely to be relatively widespread within these habitats along the northern boundary of the park, as well as on adjacent uncleared private lands. The Babbler may be threatened by more aggressive birds, particularly at the bushland/agricultural interface. In open Grey Box (*Eucalyptus molucanna*) woodland during the 2004/05 surveys a pair of Noisy Miners was seen harassing a pair of Grey-crowned Babblers, dissuading them from leaving the ground or perching in shrubs or on stumps (N. Williams pers. comm.). The woodland habitat on private lands may provide a buffer for such impacts on the park itself and thus plays a very important role.

Habitat for this species would once have been widespread within the valleys of the Hunter and Goulburn Rivers. These areas have been extensively cleared for agriculture, industry and settlements and as a result habitat is now largely restricted to remnant vegetation along creeklines and lower escarpment slopes. Many fragments in the Hunter and Goulburn River Valleys are still under threat from further development. The protection of Grey-crowned Babbler habitat within Wollemi National Park therefore has high local and regional conservation significance and, together within neighbouring National Parks is vital to the ongoing survival of the species east of the Great Dividing Range in central NSW.

DIAMOND FIRETAIL

Species Profile

The Diamond Firetail (*Stagonopleura guttata*) is an attractive finch, which is distinguished by its bold black breast band 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 1999). 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). They are usually encountered in pairs, though are known to form small flocks in autumn, winter and early spring. They build bottle-shaped nests in trees or sometimes mistletoe and usually produce four to six eggs (Pizzey and Knight 1999). The species is endemic to south-eastern Australia, with records extending from Rockhampton (Queensland) to the Eyre Peninsula and Kangaroo Island (South Australia) (Pizzey and Knight 1999). Most populations occur on the inland slopes of the Great Dividing Range with only small pockets near the coast (Blakers *et al.* 1984).

Threats

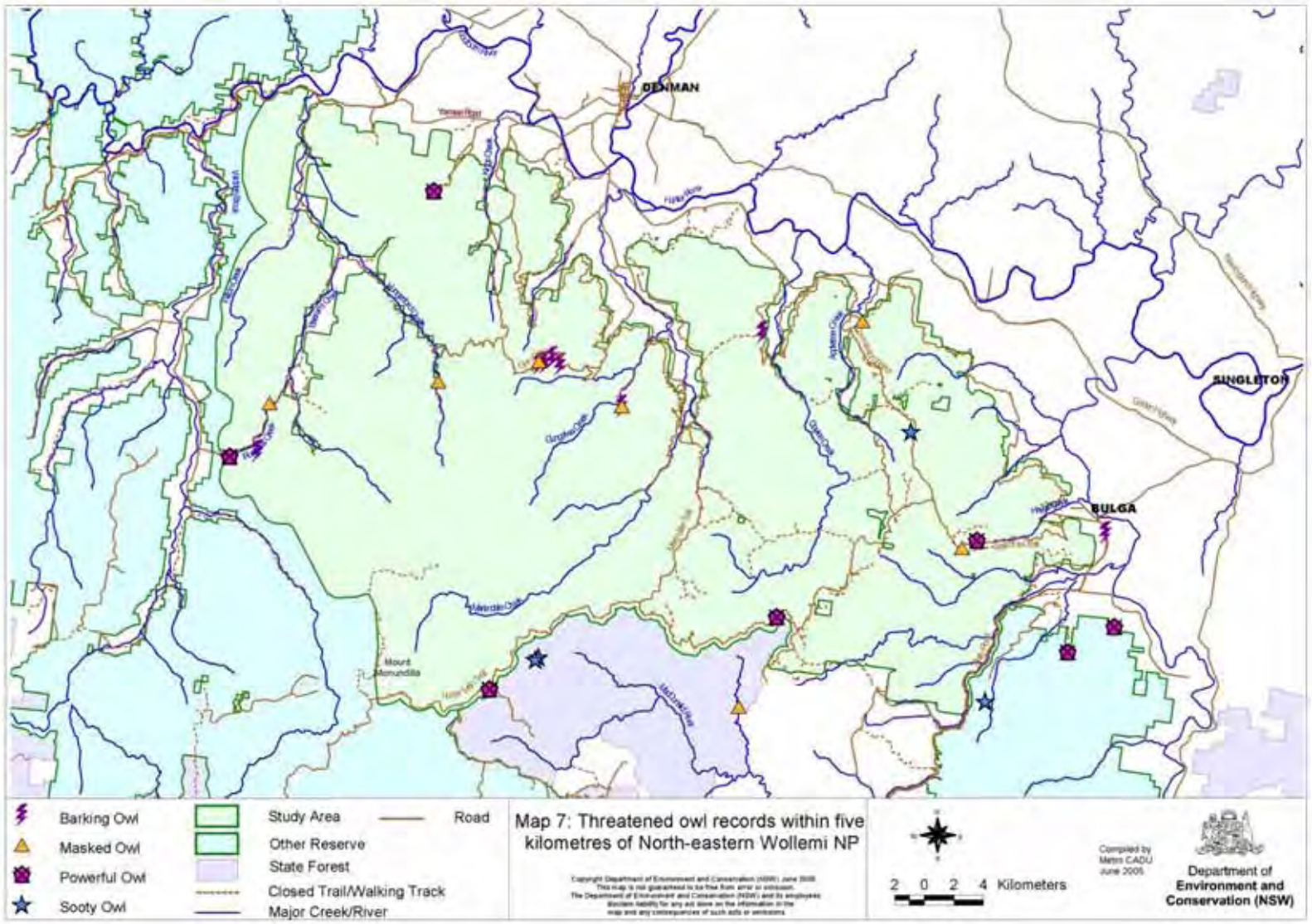
Much of the Diamond Firetail's habitat has been cleared and it is therefore included in the suite of woodland birds that have declined in south-eastern Australia (Reid 1999). It appears unable to survive in areas that lack remnants larger than 200 hectares (NSW Scientific Committee 2001e). Clearing and 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 feral Cats may be another threat as the species forages on the ground (Smith *et al.* 1995).

Local and Regional Conservation Status

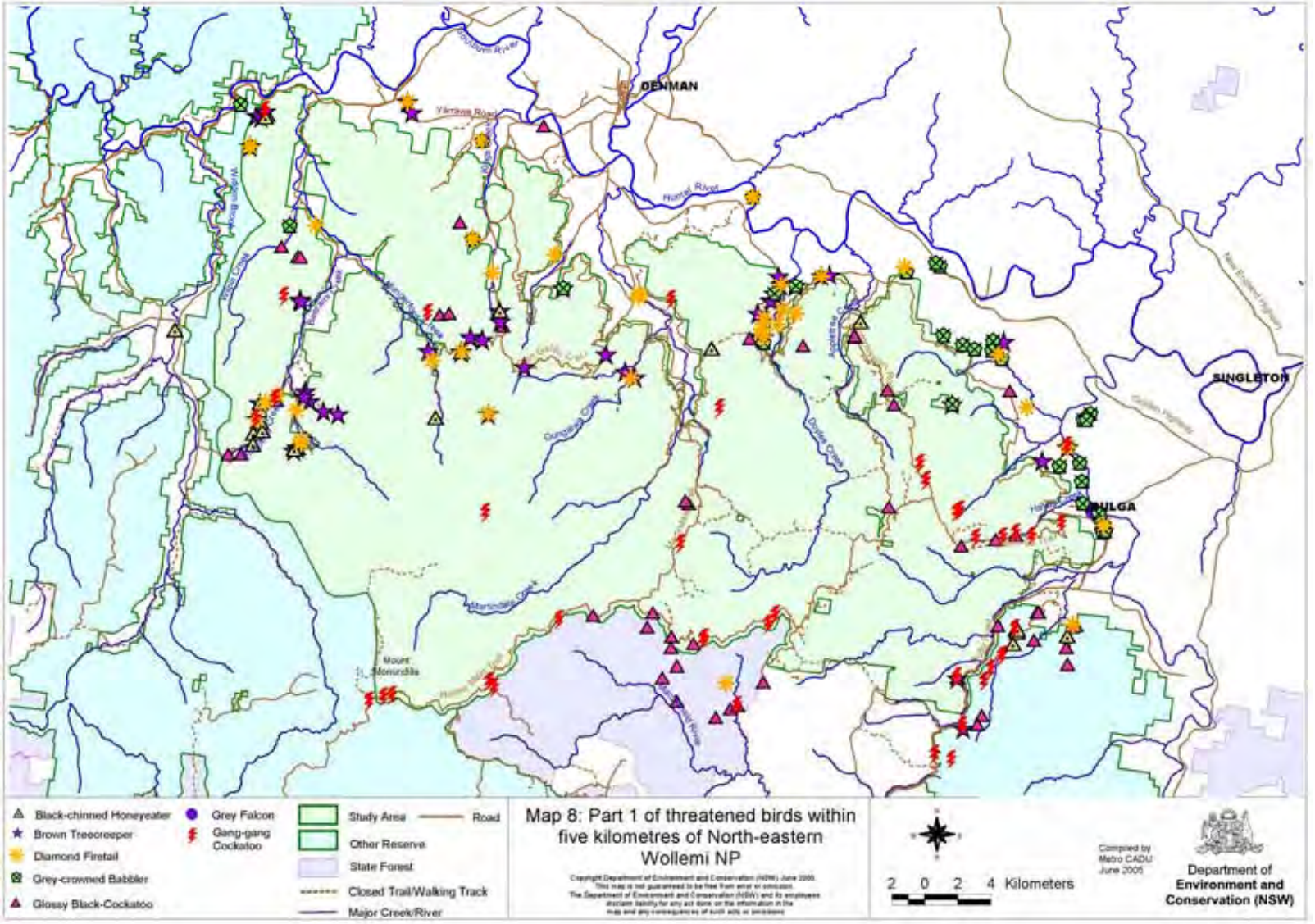
The Diamond Firetail is listed as Vulnerable under the NSW TSC Act (1995) and as Near Threatened nationally by Garnet and Crowley (2000). It is widely recorded in the eastern two thirds of the state, with scattered records in the far west, although it is less frequently seen in the three coastal Bioregions and in the high country of the Australian Alps. Within the Sydney Basin Bioregion the species is closely associated with grassy box woodlands found on the more fertile soils on the inland valleys and plains, including the Capertee, upper Hunter and Burragorang, and occasionally on the Cumberland Plain. These environments are generally poorly represented in reserves, though records are known from (in addition to Wollemi) the Burragorang Valley in Nattai National Park, Goulburn River National Park and Munghorn Gap Nature Reserve (DEC 2005a).

The Diamond Firetail was observed at thirteen locations within or on the boundary of north-eastern Wollemi National Park during 2004-05, and at an additional five locations between 1997 and 2001. The sightings are concentrated within creek flats and lower escarpment slopes that support Box-Red Gum woodlands with a grassy understorey (Map 8). The species has also been recorded on several occasions within the wider, largely cleared sections of the valleys to the north of the park, including Kings Creek, Martindale Creek and Hunter River Valleys. Habitat for the Diamond Firetail would once have been widespread across these valleys. However, clearing for agriculture has reduced the amount of available habitat to remnant patches of grassy Box-Red Gum Woodland on creek flats and lower escarpment slopes, both in the reserve and on private lands.

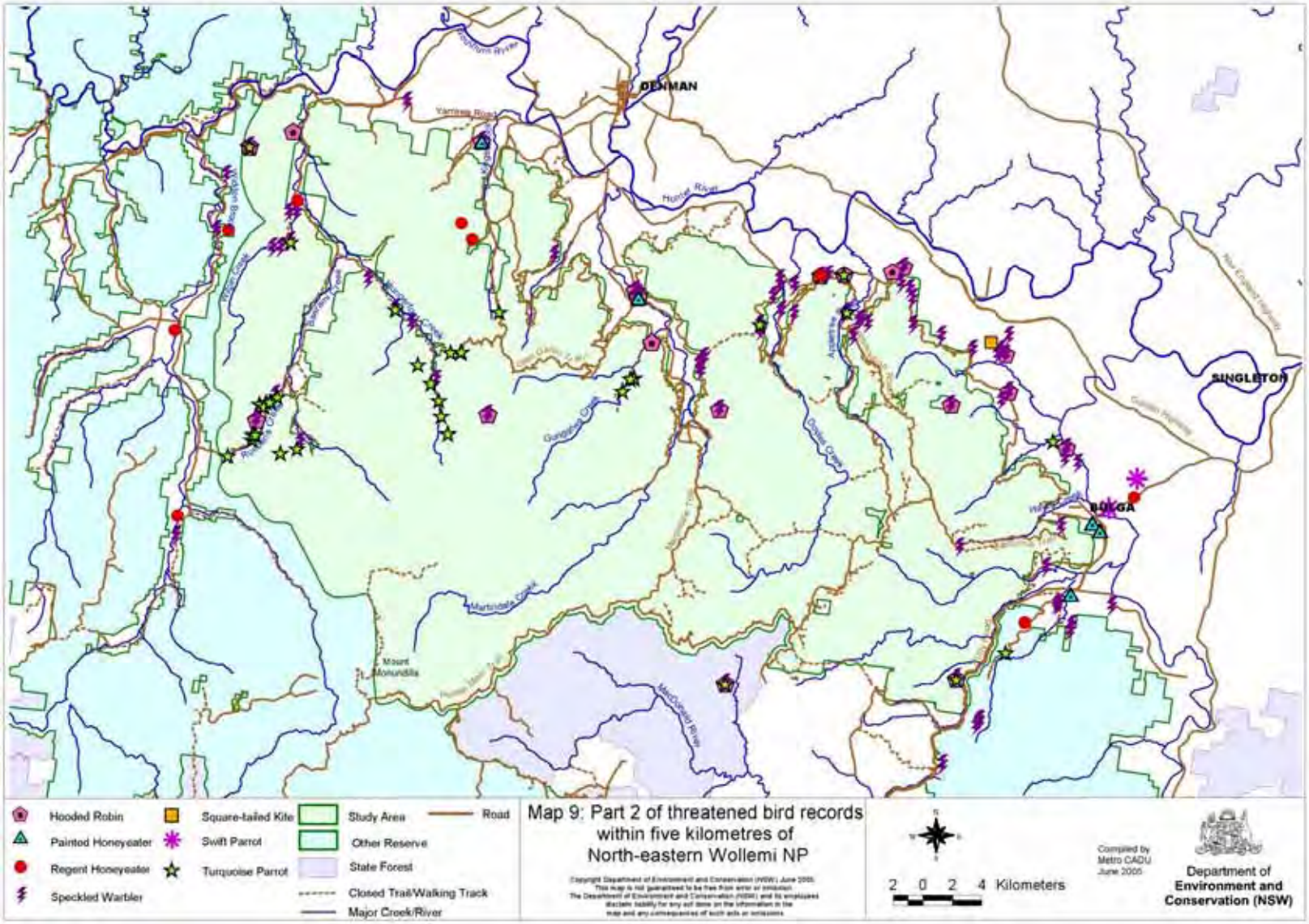
Protection of the species remaining habitat requires close cooperation between reserve managers and adjoining landholders. Landowners should be strongly encouraged to retain the integrity of habitat on their land and to reduce threatening processes such as further clearing, grazing and invasion of exotic grasses. The conservation of these dry woodland environments is essential to the survival of the species in the region, as it is for the suite of declining woodland birds.



Map 7: Threatened owl records within five kilometres of north-eastern Wollemi National Park



Map 8: Part 1 of threatened diurnal bird records within five kilometres of north-eastern Wollemi National Park



Map 9: Part 2 of threatened diurnal bird records within five kilometres of north-eastern Wollemi National Park

SPOTTED-TAILED QUOLL

Species Profile

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The Spotted-tailed or Tiger Quoll (*Dasyurus maculatus*) is a medium-sized marsupial carnivore that is identifiable by its rufous to dark brown fur and white spots which are present on the body and tail. It is essentially terrestrial, but is also an agile climber. It feeds on a wide variety of birds, reptiles, mammals and invertebrates and will also take carrion and domestic poultry (NPWS 1999b). It uses several 'latrines' within its territory for defecation (NPWS 1999b). Two subspecies of Spotted-tailed Quolls have been recognised: D. *maculatus gracilis* from north Queensland and D. *m. maculatus* from south-eastern Queensland, New South Wales, Victoria and Tasmania (Edgar and Belcher 1995). However, genetic work has shown that the true genetic split occurs between Tasmania and the rest of the mainland (Firestone *et al*. 1999). Within NSW the species utilises a variety of habitats on both sides of the Great Dividing Range, including sclerophyll forest and woodlands, coastal heath and rainforest (NPWS 1999b). Habitat requirements include suitable den sites, an abundance of food and large areas of in tact vegetation (NPWS 1999b).

Threats

The main problems confronting the Spotted-tailed Quoll are believed to be habitat loss, degradation and fragmentation (Belcher 2004). Other threats include: predation and competition by introduced predators such as Cat (*Felis catus*), Fox (*Vulpes vulpes*) and Dog (*Canis lupis*); disease such as toxoplasmosis; road mortality; and direct mortality at the hands of humans (Mansergh 1984). Quolls were heavily persecuted as killers of domestic fowl, and have been hunted and trapped to extinction in many parts of the country. In more recent years evidence has been collected to suggest that aerial, ground and mound baiting using 1080 (sodium monoflouroacetate) has significant negative impacts on Quoll populations (Belcher 2004), while Dingo control has the potential to impact on Quolls through the competitive release of Foxes and Cats (Glen & Dickman 2005). Inappropriate fire regimes and the removal of dead wood and dead trees may also impact on the species (NSW Scientific Committee 2003b).

Local and Regional Conservation Status

The Spotted-tailed Quoll is listed as Vulnerable under the NSW TSC Act (1995) and as Endangered under the Commonwealth EPBC Act (1999). The southern populations are believed to have contracted in range by up to 50 percent in recent years (Maxwell *et al.* 1996). Within NSW the species has been most frequently recorded in the NSW North Coast, Sydney Basin and South East Corner Bioregions (DEC 2005a). The distribution of potential habitat within the Sydney Basin Bioregion is extensive although the occupancy rate of this habitat is likely to be low. Since 1990, the greatest density of records within the Sydney Basin Bioregion occur on the Central Coast between Hornsby and Newcastle, in the upper Blue Mountains and to a lesser extent in the Kangaroo Valley (DEC 2005a). The species may have recently become extinct in other areas. The species has been recorded in a number of conservation reserves in the Sydney Basin Bioregion, most recently within Blue Mountains, Brisbane Water, Popran and Wollemi National Parks (DEC 2005a).

The Spotted-tailed Quoll is amongst the most cryptic of ground mammals. Where sparse, it is notoriously difficult to trap and can require an immense effort to detect using standard survey techniques (Lunney and Matthews 2001). The majority of recent records for the species in the Sydney Basin come from traces left by the animals (such as tracks, remains or scats), road kills and opportunistic sightings. The Spotted-tailed Quoll has been observed on just two occasions within north-eastern Wollemi National Park, each along roads in the east of the park (Map 10). In addition, scats of the species have been identified from two locations, one collected from a rock platform on Parsons Ridge in the south-east and one on the Hunter Main Trail approximately 1.5 kilometres south-

east of Mount Monundilla. Within the study area the species has only been recorded within environments that receive at least a moderate level of rainfall. However, Spotted-tailed Quolls have been killed on Rosemount Road near the junction of Kings Creek and Goulburn River, and a possible sighting made in the Widden Valley, to the west of the study area, areas which each have relatively low rainfall and dry woodland vegetation (Map 10).

Potential habitat for Quolls occurs primarily in the east and south of the study area, within the moister environments. However, the species may also use the major gully lines and sheltered lower slopes in the north and centre of the area, foraging in riparian areas where prey density is high. Quolls are also likely to utilise the escarpments and rocky ridges within the study area, particularly using the rocky outcrops for shelter and den sites. Elsewhere the species has been found to avoid mid slopes (Belcher 2004). The paucity of records suggests that the study area is likely to support a low abundance of Spotted-tailed Quolls and provide important habitat for roaming individuals, but it is unlikely to be a stronghold for the species. However, further survey work, including extensive cage trapping and hair tubing over an extended time period, is required to determine the species distribution and abundance within north-eastern Wollemi National Park and the role that the area plays in the regional conservation of the species. Priority should be given to increasing public awareness of this species and its identification and to encouraging neighbours and park visitors to report any sightings, together with accurate location information. The use of 1080 baiting in areas where Quolls are known should be very carefully considered. Burying baits deeper than seven centimetres below the ground surface (rather than burying them in raised mounds) will decrease the number of baits removed by Quolls (Glen and Dickman 2003).

KOALA

Species Profile

The Koala (*Phascolarctos cinereus*) is a distinctive 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 1999c). They generally move about a home range, the size of which varies on the density of food trees and population size, though individuals, particularly dispersing juveniles, are known to travel up to 50 kilometres (Martin and Handasyde 1995; NPWS 1999c). 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 altered the genetic diversity of many of the populations (Martin and Handasyde 1995).

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Threats

NPWS (1999c) 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; 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). Throughout its entire range loss, fragmentation and degradation of habitat is its greatest threat (NPWS 2003d). Reed *et al*. (1990) reported that a survey in 1986-87 found 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 its distribution. Within the Hunter Range region all of the listed threatening processes are likely to be important, including road mortalities as the species attempts to move between habitat areas (such as across the Putty Road).

Local and Regional Conservation Status

The Koala is listed as Vulnerable under the NSW TSC Act (1995). The species is widespread across the eastern third of the state and, being an easily recognisable species, there are a number of records throughout the Sydney Basin Bioregion. Concentrations appear to be located around the Central Coast, Blue Mountains, the fringes of the Cumberland Plain and the Woronora Plateau (DEC 2005a). Records from reserves within this bioregion are less common, though sightings have been made in many including Morton, Dharug, Nattai, Blue Mountains, Brisbane Water, Wollemi, Yengo and Morton National Parks (DEC 2005a).

Historic records suggest that Koalas have a preference for higher fertility soils that support a distinctive suite of eucalypt species. The species would once have been more abundant and widespread in the upper Hunter Valley, particularly in the fertile valley floors and plains that have now been cleared for agriculture and settlements. It is hypothesised that due to extensive clearing the species has retreated to marginal habitats, commonly found on creek flats and escarpment slopes on the perimeter of agricultural country. Koalas have been recorded at five locations in such habitats (Map 10), where favoured feed trees such as Forest Red Gum (*Eucalyptus tereticornis*) and Grey Gum (*E. punctata*) occur. Habitat is also widespread on sheltered sandstone slopes and gullies in the east of the park, where the species has been recorded three times.

Koalas, particularly males, can be wide ranging and it is likely that this species roams across the northern escarpment and east into northern Yengo National Park and Pokolbin State Forest. This stretch of contiguous habitat is highly important to the regional conservation of the species.

EASTERN PYGMY-POSSUM

Species Profile

The Eastern Pygmy-possum (*Cercartetus nanus*) is a small (between 14 and 21 centimetre) possum that is found in a wide variety of habitats, including rainforest, sclerophyll forest and woodland and heaths. It is generally nocturnal, and is an opportunistic omnivore, including nectar, pollen, insects, seeds and fruit in its diet. Each individual has a number of nests, which are usually constructed in tree hollows, throughout their territory, and will move up to 125 metres, through tree, shrub and ground layers (Turner and Ward 1995). It is distributed between far south east Queensland and the far south east of South Australia, and Tasmania, though it is only found at higher altitudes in the north of its range and is generally more abundant in southern latitudes (Bowen and Goldingay 2000, Menkhorst 1995).

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Threats

The NSW Scientific Committee (2001f) listed the following potential threats to the Eastern Pygmy-possum: isolated sub-populations with little dispersal potential which increase the risk of local extinction; habitat loss and fragmentation caused by clearing; inappropriate fire regimes that may effect understorey plants; the loss of nest sites through intensive forestry and firewood collection; and predation by Foxes and Cats.

Local and Regional Conservation Status

The Eastern Pygmy-possum is listed as Vulnerable under the NSW TSC Act (1995). This listing appears to be chiefly based on Bowen and Goldingay (2000), which showed that despite intensive survey effort throughout the known distribution, relatively few individuals have been detected. However, the survey techniques used in many of these surveys may have underestimated the abundance of this species. Over a two week period in early 2000, 22 individuals were removed from a ten kilometre stretch of trench dug as part of a natural gas pipe laying procedure between Cataract and Cordeaux dams (NPWS 2002a). Kavanagh (2004) concluded that the species is inadequately studied in NSW for its conservation status to be accurately assessed.

Records of the Eastern Pygmy-possum are sparsely distributed throughout eastern NSW and in the central west and north west of the state (DEC 2005a). The majority of records are from the South East Corner and Sydney Basin Bioregions (DEC 2005a). Within the Sydney Basin Bioregion records are concentrated within the Blue Mountains, Central Coast and the Woronora Plateau (DEC 2005a). The species has been recorded in a number of reserves including Morton, Royal, Blue Mountains, Ku-ring-gai Chase and Brisbane Water National Parks (DEC 2005a). Broadscale regional habitat mapping for this species (NPWS 2000) indicates that most of the suitable habitat occurs in the sandstone areas surrounding the Sydney metropolitan area.

The Eastern Pygmy-possum has not been directly observed in or within five kilometres of north-eastern Wollemi National Park. However, it has been identified from remains within predator scats, including once within the reserve (Dog or Fox scat collected on the Martindale Trail in 1997) and three times within two kilometres of the boundary (once in a Fox scat in Yengo National Park and twice in an owl pellet in Putty State Forest (Map 10). This cryptic mammal is likely to be more numerous within the area than records indicate, as some survey techniques that target the species, particularly pitfall trapping, have not been undertaken. Potential habitat is relatively widespread and food sources abound. Based on records elsewhere, the species is most likely to occur within woodlands that have a dense shrub layer and an abundance of flowers, or else within areas that contain Cypress (*Callitris* spp.) with very little understorey (Bladen *et al.*2002; Shelley 1998). The possum has rarely been recorded within the Hunter Valley, however, and may occur only at low abundance. An intensive targeted trapping program would be required in order to accurately assess the abundance, distribution and conservation status of the Eastern Pygmy Possum within the locality and region. Trapping should include use of pitfall traps with drift fences, Elliott traps and nest boxes positioned against flowering shrubs and trees, as these techniques have been found to be the most effective capture method for the species in other areas (Bladen *et al.* 2002, Shelley 1998, M. Schulz pers. comm.).

YELLOW-BELLIED GLIDER

Species Profile

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The Yellow-bellied Glider (*Petaurus australis*) is a medium-sized nocturnal mammal found in tall open sclerophyll forests and woodlands of eastern Australia. As an arboreal species, it requires mature hollow bearing trees within which to den during the day, and at night from which to leap and glide using a membrane that extends from the wrists to the ankles (NPWS 1999d). It is characterised by grey fur above and a whitish to orange fur underneath with large bare ears. The species is more often heard than seen, as it frequently emits a distinctive throaty call, which can be heard from some distance. It feeds on eucalypt nectar, sap, manna and invertebrates found under shedding bark. Its feeding habits to extract sap can leave deep V-notched incisions in the bark of eucalypts, with individuals and families demonstrating preference for repeated use of individual trees for many seasons (Mackowski 1988). Yellow-bellied Gliders are known to utilise a home range of between 30 and 65 hectares (Goldingay and Kavanagh 1991). The southern, nominate subspecies ranges between south-eastern South Australia and central coastal Queensland with a separate subspecies isolated in the wet tropics of north Queensland (Russell 1995).

Threats

Yellow bellied Gliders are known to be greatly affected by the reduction of nesting resources when the availability of hollow-bearing trees are lost through clearing, fragmentation or timber extraction (NPWS 1999d). Predation by Cats and Foxes are also thought to contribute to the species vulnerability. Impacts of fire regimes are poorly understood, although some scientists suggest that availability of food is reduced after fire (NPWS 1999d).

Local and Regional Conservation Status

The Yellow-bellied Glider is listed as Vulnerable under the NSW TSC Act (1995). The species appears to have a patchy distribution within the Sydney Basin Bioregion (DEC 2005a), with most localities restricted to taller moist forests associated with incised sandstone gullies. The locations of populations of this species suggest a coastal preference with highly elevated, cold environments exhibiting a total absence of records in the region. Recent surveys for this species have significantly expanded knowledge on its distribution in the Sydney Basin reserve system. As little as ten years ago the species was thought to be uncommon, however, the converse has been found to be the case in the Southern Blue Mountains and Warragamba Catchment (DEC 2005d). Typical examples of population strongholds include the tall moist forests of the Central Coast, Watagan Ranges and Blue Mountains Escarpments and gullies (DEC 2005d). Numerous records are known from a large number of reserves including Jervis Bay, Morton, Nattai, Blue Mountains, Yengo, Watagans and Wollemi National Parks amongst others (DEC 2005a). In fact, the large number of records of Yellow-bellied Gliders that have been collected following extensive surveys in the past decade, together with their wide distribution and the extent to which threatening processes (logging and land clearing) have been controlled, has led some researches to suggest that the conservation status accorded to the species be reviewed and possibly down-listed (Kavanagh 2004).

Surveys undertaken within north-eastern Wollemi have provided further evidence that the species is more common in the Sydney Basin than previously thought. Tall gully forests on the Hunter Range and the eastern half of the park have been found to support good numbers of the species, as do similar habitats in Putty State Forest and northern Yengo National Park (Map 10). The glider is expected to inhabit the majority of tall gully forests and adjacent forests/woodlands in the central, southern and eastern portions of the reserve. Interestingly, the systematic surveys also identified Yellow-bellied Gliders in the drier gullies in the north, specifically along Reubens and Little Horseshoe Creeks. These northern environments were not anticipated to support the glider and the confirmation of their presence extends our knowledge of the species habitat tolerances. Grey Gum (*Eucalyptus punctata*) is clearly a preferred food resource and, as long as suitable shelter and alternative food is present, may support the occurrence of the Yellow-bellied Glider on sheltered slopes and creeklines in this part of the reserve.

SQUIRREL GLIDER

Species Profile

© DEC

The Squirrel Glider (*Petaurus norfolcensis*) is a small to medium-sized nocturnal mammal that inhabits dry sclerophyll forests and woodlands where it shelters in leaf-lined nests in tree hollows. It is similar in appearance to the smaller and more common Sugar Glider (*Petaurus breviceps*). However, the Squirrel Glider is larger, 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 1995b). It usually occurs in family groups of up to ten, consisting of one male, one or more females and their dependant young. Home ranges vary between 0.65 and 8.55 hectares, depending on vegetation type and habitat quality, and individuals have been known to move up to 500 metres in one night. It is patchily distributed along the east coast and inland slopes between north Queensland and northern Victoria (NPWS 1999e) in habitats that comprise sufficient numbers of hollow-bearing trees for shelter and winter flowering plant species for food (Quin 1995).

Threats

The greatest threat to the Squirrel Glider is loss of habitat by broadscale clearing for agriculture (Kavanagh 2004). Most clearing has fallen on open forests and woodlands growing on relatively fertile soils on gentle topography, especially in river valleys (Lunney and Leary 1988), which in many areas comprises prime habitat for the Squirrel Glider. Clearing of land for mining has also resulted in habitat loss in the Hunter Valley (N. Williams pers. comm.). NPWS (1999e) lists the following threats to the Squirrel Glider: loss of nesting resources when the availability of hollow bearing trees are lost through fragmentation or timber extraction; predation by Cats and Foxes; and the entanglement of individuals on barbed-wire fences. Impacts of fire regimes are poorly understood although the availability of food resources and shelter sites may be reduced or lost after fire. The simplification of forest structure resulting from frequent low-intensity prescribed burns, especially where domestic stock also graze, may also threaten the species (Catling 1991).

Local and Regional Conservation Status

The Squirrel Glider is listed as Vulnerable under the NSW TSC Act (1995). Across its range, habitat for the Squirrel Glider appears to occur primarily outside of public forest lands (Kavanagh 2004). Within the Sydney Basin Bioregion the dry woodlands of the Central Coast provide very high quality habitat for the species and the area has been well documented as a stronghold for the species (Smith and Murray 2003). Elsewhere in the Bioregion the species has only been patchily recorded at very low densities, including on a few reserves such as Yengo, Wollemi, Blue Mountains, Dharug and Werakata National Parks (DEC 2005a).

The Sugar Glider and Squirrel Glider are difficult to distinguish in the field, and surveyors sometimes have problems, particularly when individuals are young or are partly obscured from view by foliage or rain. Such identification difficulties were experienced along the Hunter Main and Martindale Trails, and some question remains about the identity of gliders observed here. Four individuals were identified as Squirrel Gliders here during CRA surveys, however the high elevation (above 490 metres asl) and habitat is highly unusual for this species. It is well recognised that the Squirrel Glider prefers dry woodlands below 300 metres asl and are not found in tall forests or closed forest (e.g. Goldingay and Jackson 2004). Hence, for the purposes of this report, until these records can be confirmed they will be treated with caution.

The remaining Squirrel Glider records within north-eastern Wollemi National Park derive from creek flats and lower slopes in the north of the area, within woodland or open forest that contain various Box,

Red Gum or Ironbark eucalypt species in the canopy (Map 10). Such dry low elevation woodlands are widespread along the northern perimeter of the study area and Squirrel Gliders are likely to occur wherever hollow-bearing trees (required for shelter and breeding) and at least one winter-flowering tree or shrub species occur. The Squirrel Glider also occurs within northern Yengo National Park and on private land adjacent to the reserve as well as in Goulburn River National Park.

The species would once have been abundant and widespread throughout the valleys of the Hunter and Goulburn Rivers. However, large amounts of primary habitat have been lost through clearing for agriculture, urban and industrial development, while remaining habitat is under ongoing pressure. Squirrel Glider populations in and adjoining the reserve will increase in importance as remaining coastal strongholds are cleared or fragmented for urban and industrial expansion. The contribution of the Hunter Range reserves to the viability of the species as a whole should not be underestimated. north-eastern Wollemi National Park supports highly significant habitat for the Squirrel Glider and should be managed accordingly.

BRUSH-TAILED ROCK-WALLABY

Species Profile

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The Brush-tailed Rock-wallaby (*Petrogale penicillata*) is a medium-sized macropod, characterised by its distinctive facial markings, black paws and high level of agility (NSW Scientific Committee 2003a). The tail is often used to aid identification, being long and thickly furred with a distinctive brush-like appearance near its tip (NPWS 2002b). 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 2002b). 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. The Brush-tailed Rock-wallaby was once abundant and ubiquitous throughout the mountainous country of south-eastern Australia from the Grampians in western Victoria to Nanango in south-east Queensland (Short and Milkovits 1990). The Rock-wallaby has declined significantly in the west and south of its former range, and populations have become more fragmented throughout (NSW Scientific Committee 2003a). It was thought to be extinct in Victoria 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 (especially Feral Goat (*Capra hircus*), Rabbit (*Oryctolagus cuniculus*) and domestic stock) (NSW Scientific Committee 2003a). The major threats continuing to impact on the species include ongoing predation and competition with feral species such as Goats, Foxes (*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 2003a) and inbreeding (Environment ACT 1999).

Local and Regional Conservation Status

The Brush-tailed Rock-wallaby is listed as Endangered under the NSW TSC Act (1995) and as Vulnerable under the Commonwealth EPBC Act (1999). In the Sydney Basin Bioregion the species forms part of one of the three Evolutionary Significant Units (ESU) that summarise genetically distinctive groups on the basis of DNA. The nominate ESU encompasses closely related populations in central NSW including Kangaroo Valley, Jenolan Caves, the Hunter Valley and the Warrambungles. This central ESU is one of the most fragile in NSW and all sites within it are of very high conservation significance (NSW Scientific Committee 2003a). Recent records from reserves within the Sydney Basin are mostly confined to Yengo, Wollemi, the Watagans and Morton National Parks and Parr SCA (DEC 2005a) as well as a recently discovered colony in Nattai National Park (DEC 2004c).

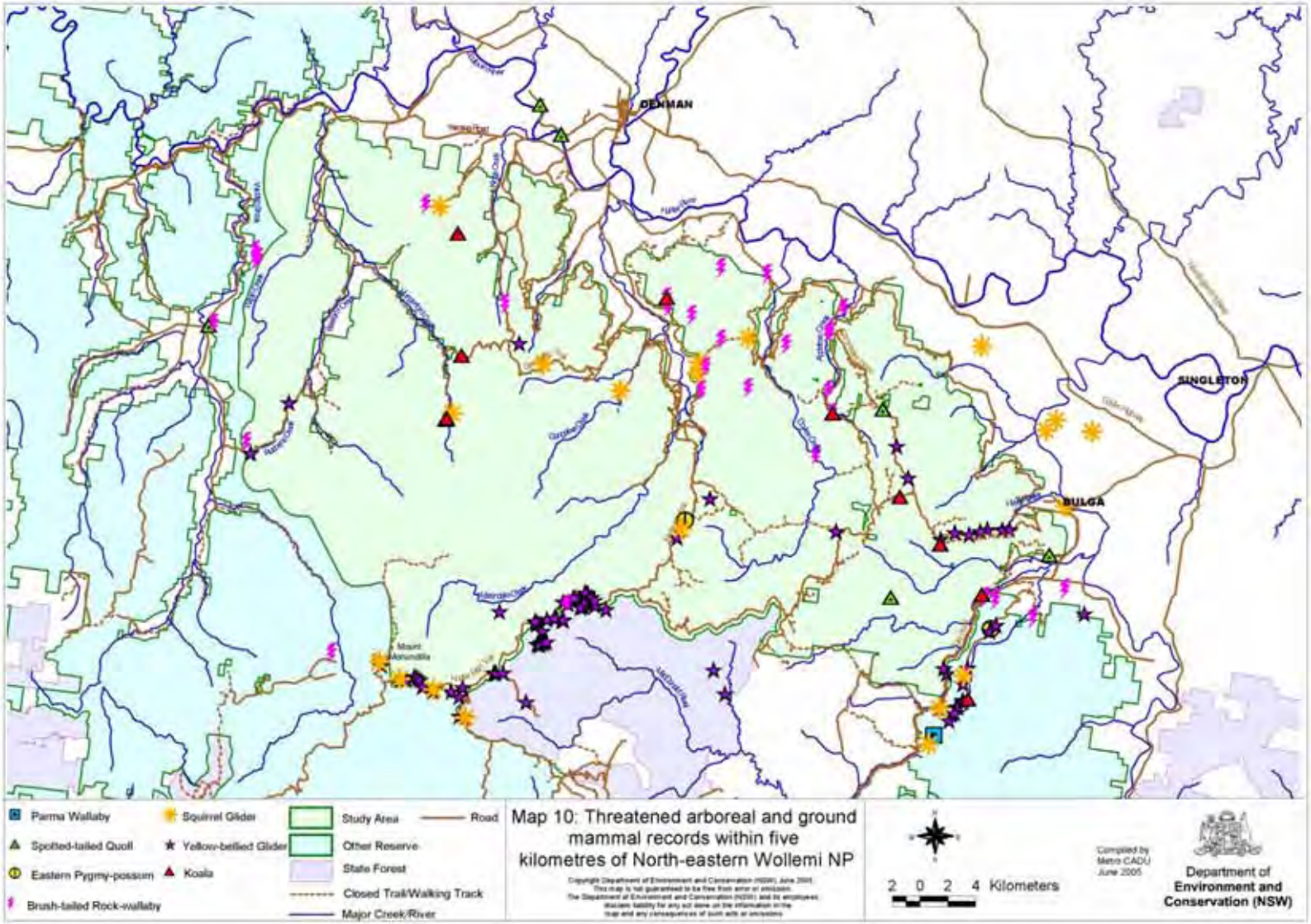
The Brush-tailed Rock-wallaby is well known in the northern end of Wollemi National Park. A report produced in 1994 summarised the known distribution of the species in the area at the time (Wong 1994). This distribution included three colonies in the Widden Valley (immediately to the west of the current study area), one colony in Kings Creek Valley, and one colony on the eastern side of Martindale Valley (Wong 1994). Since the late 1990s the species was recorded on the Atlas of NSW Wildlife at three further locations in the Doyles Creek Valley. Experimental Fox control was commenced at these sites in the early 2000s as part of the state-wide Fox Threat Abatement Plan (Fox TAP) (NPWS 2001e).

The DEC surveys undertaken in north-eastern Wollemi National Park in 2004-05 led to the discovery of further locations of the species and extended the known distribution of the colonies. Brush-tailed

Rock-wallabies were directly observed at two locations: one on the slopes above Turnbull Creek and one on the Commission Road at the top of the steep rocky escarpments above Appletree Creek. The wallabies had not previously been recorded in the Appletree Creek Valley, however high quality habitat is widespread in this section of the valley, where Brush-tailed Rock-wallaby scats were also identified. Scats were identified from a further eight locations, including one locality on the ridgeline separating Reubens Creek and Widden Brook, one south of Mount Oxford in Yarrawa, one on the eastern side of the Doyles Creek Valley above Charcoal Gully, and five localities on the Martindale Range and eastern side of the Martindale Valley (Map 10). It is unclear at this stage whether any of these locations represent previously unknown colonies of the species or whether they are extensions of known colonies. However, due to the distance (up to five kilometres) between records it is likely that the former is the case in at least some instances. Potential habitat for the Brush-tailed Rock-wallaby is widespread across the northern escarpment of the study area and it is likely that more colonies exist in remote escarpments and rocky areas that have not been visited or surveyed. The population size within the study area has not been estimated, however the sparsity of scats observed in the suitable habitats that were surveyed during this study suggests numbers to be moderately low and distribution patchy, though widespread.

The population of the Brush-tailed Rock-wallaby within northern Wollemi National Park, together with that in northern Yengo National Park, is highly significant as the area is one of the few remaining strongholds for the species, not only within the region but also within the central ESU. This population is therefore important to the conservation of the species across the state. These Rock-wallabies can be linked to populations in the south of Wollemi and southern Yengo by contiguous rocky terrain. A significant population also occurs not far to the south-east, in Watagans National Park. However, to the north the Wollemi-Yengo population(s) is the last known significant population within the central ESU. Another healthy population of the species does not occur until the Apsley and Macleay River gorges over 160 kilometres to the north (Wong 1994), where the animals are of a different ESU. Research undertaken in 1994 suggested that the colonies in the study area appear not to have suffered as serious a decline as observed in other NSW populations, particularly at Jenolan Caves, Kangaroo Valley and Warrumbungle National Park (Wong 1994). The near absence of Feral Goats from north-eastern Wollemi National Park, and the restriction of Rabbits to the vicinity of disturbed lands, means that introduced herbivores do not pose as much threat to the wallabies here as they do in other areas. However, the population remains threatened by introduced carnivores (Foxes, Dogs and possibly Cats), as well as by fire and disease. Since one of the Brush-tailed Rock-wallabies was observed on the Commission Road, road mortality may also be an issue.

The long-term survival of the wallabies within the region will require further research and careful targeted management, as well as continued implementation of the Fox TAP and its associated outcomes and recommendations. A research project should incorporate an investigation of known localities to determine if they are breeding sites, a population census and an ongoing monitoring program to determine population trends and viability. A prioritisation of habitat areas for the Rock-wallaby within the park should occur. Sites identified as high priority should be the target of appropriate feral predator control, implemented in consultation with the Fox TAP program, and appropriate fire management, including exclusion of high intensity wildfire from rocky refugia.



Map 10: Threatened arboreal and ground mammal records within five kilometres of north-eastern Wollemi National Park

GREY-HEADED FLYING-FOX

Species Profile

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is a large fruit bat that has dark grey body fur, a slightly paler grey head and a russet collar. It is the largest bat in the study area, with a wingspan of up to one metre. It is a highly mobile species and the numbers roosting at specific camps may vary depending on season and food availability. They feed on nectar and pollen of various trees including *Eucalyptus, Melaleuca* and *Banksia* as well as fruits, originally of rainforest species, but now including commercial and garden crops. They can travel up to twenty kilometres to a food source, and are an important pollinator and disperser of native plants. The species is endemic to eastern Australia, between central Victoria and Bundaberg in Queensland (NPWS 2001f). The species range has contracted, previously occurring as far north as Rockhampton (NPWS 2001f). It primarily occurs along the along the eastern coastal plain, east slopes and tablelands, although regular movements occur over the Great Dividing Range to the western slopes in northern NSW (NPWS 2001f). A number of studies have noted the annual southerly movement of animals in spring and summer and their return to north-east NSW and south-east Queensland in winter (NPWS 2001f).

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Threats

The main threats to the Grey-headed Flying-fox are: destruction of habitat, particularly of foraging habitat, by clearing for urban development and agriculture; disturbance at roosting sites, particularly of pregnant females; unregulated shooting, particularly when feeding on commercial crops or close to residential developments; electrocution on power lines, particularly in urban areas; and accumulation of pollutants and pesticides (NPWS 2001f, Duncan *et al.* 1999).

Local and Regional Conservation Status

The Grey-headed Flying-fox is listed as Vulnerable under the NSW TSC Act (1995) and is also listed as Vulnerable under the Commonwealth EPBC Act (1999). The species is regularly recorded in all three coastal bioregions (DEC 2005a). Eby *et al.* (1999) estimated there to be approximately sixteen camps within the Sydney Basin Bioregion, three of which were occupied in July 1998. Current locality data suggests the species to be primarily distributed across the coastal and hinterland environments of the Sydney Basin, although this may reflect reporting bias in the data. The species has been recorded foraging in numerous conservation reserves, including Royal, Lane Cove, Dharug, Blue Mountains, Wyrrabalong, Yengo and Werakata National Parks (DEC 2005a), as well as southern Wollemi National Park. However, a greater number of records occur off reserve, including within parks and gardens in metropolitan areas between Sydney and Newcastle. The majority of known camps are not within national parks.

Grey-headed Flying-foxes were recorded for the first time within north-eastern Wollemi National Park during DEC surveys in January 2005. Over forty individuals were observed in the east and south-east of the study area, along Putty Road, California Trail and southern Commission Road (Map 11). These individuals were either seen feeding in heavily flowering eucalypt trees (including Ironbark and Box species) or were heard calling from a distance. The species was also observed in November 2004 and January 2005 in northern Yengo National Park, less than one kilometre east of the Wollemi study area boundary (DEC 2005c). No Grey-headed Flying-fox camps are known from the study area. It is likely that these individuals derive from the recently formed colony within Burdekin Park in the town of Singleton, just under thirty kilometres to the east of the area. Between 50 and 4000 Grey-headed Flying-foxes have been recorded to utilise the camp over the last five years, and the site is often used as a maternity roost (N. Williams pers. comm.).

north-eastern Wollemi National Park forms a component of the foraging habitats on which Grey-headed Flying-foxes in the Hunter Valley depend. The Hunter Valley and Newcastle area provide highly significant habitat for the species between spring and autumn, estimated to support a large proportion of the overall Grey-headed Flying-fox population at certain times of the year (N. Williams pers. comm.). The species is expected to be a regular visitor to the study area, during times of abundant flowering or when food resources are limited in other areas. North-eastern Wollemi National Park is one of few reserves in the Hunter Valley (these also include Yengo and Werakata National Parks) that provide a natural foraging area for the Singleton colony, and it therefore holds high conservation significance to the species. The area may also play an important role during southward/northward population movements. Furthermore, the Flying-fox is likely to provide an important ecosystem function to the park by providing a means of seed dispersal and pollination for indigenous tree species.

EAST-COAST FREETAIL-BAT

Species Profile

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The East-coast Freetail-bat (*Mormopterus norfolkensis*) is a member of a complex group of bats that remain in a state of considerable taxonomic uncertainty (Churchill 1998). The species can be distinguished from other members of the group by its long forearm, upright ears and robust build (Allison and Hoye 1995, Parnaby 1992a). Reinhold *et al.* (2001) describes the ultrasonic call as "a pattern of alternating pulses", making it unique among *Mormopterus*, though it can also call without this pattern. There are very few confirmed specimens of this species on record, but it appears to be restricted to the east of the Great Dividing Range between approximately Brisbane (Queensland) and southern New South Wales (Duncan *et al.* 1999; Parnaby 1992a). Habitat preferences are poorly understood, but the species appears to favour dry eucalypt forest and woodland, though it has also been captured in rainforest and wet sclerophyll forest (Churchill 1998). It usually roosts in tree hollows (Gilmore and Parnaby 1994), though it has been recorded in the roof of a hut and under the metal caps of telegraph poles (Churchill 1998).

Threats

The threats to this species are poorly known, though it is suspected that clearing for agriculture, development and logging have serious impacts (Duncan *et al.* 1999). These threats may be of increased significance since the species' entire known distribution lies within an area of concentrated human population density and increasing urban development.

Local and Regional Conservation Status

The East-coast Freetail-bat is listed as Vulnerable under the NSW TSC Act (1995). Most records for the species in NSW occur within the NSW North Coast, South East Corner and Sydney Basin Bioregions, particularly from the Cumberland Plain and Central Coast areas (DEC 2005a). The majority of records for the species within the Sydney Basin Bioregion occur outside of reserves. However, it has been detected within Nattai, Blue Mountains, Dharug, Wollemi, Yengo and Marramarra National Parks and Western Sydney Regional Park (DEC 2005a).

The East-coast Freetail-bat has been detected twice within north-eastern Wollemi National Park: once captured in a harp trap on the California Trail and once identified from ultrasonic call recordings on Gungalwa Creek (Map 11). It has also been recorded on three occasions to the south-east, within Putty State Forest and Yengo National Park as well as within cleared lands to the north-east. This is a moderately large high-flying species that possibly ranges widely through more open habitats, and therefore may be widespread across lower elevations in the north-east and south-east of the reserve. Current records are likely to be an underestimate of the status and distribution of the bat, since it would often fly above the range of traps and ultrasonic call detectors. However, as this species is thought to be restricted to the east coast of NSW, it is unlikely to be present in the drier western-influenced environments in the north-west of the study area. A better understanding of habitat requirements is required to make an accurate assessment of the species distribution and abundance within the region. Recent surveys of the species across the southern Sydney region have suggested an association with more fertile country (DEC 2005d), a pattern which may be replicated in the Hunter Range region.

Records of the East-coast Freetail-bat within the region hold significance as the species approaches the western edge of its known range in this area. Additionally, since few confirmed records for the species have been collected on reserves in the Sydney Basin, the bat's protection within Wollemi and Yengo National Parks holds conservation importance. The significance of reserved habitats is likely to rise in the future as development pressure continues to impede on the species occurrence elsewhere. Little is known of this species so the records collected here contribute to our understanding of its distribution and habitat preferences.

LARGE-EARED PIED BAT

Species Profile

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The Large-eared Pied Bat (*Chalinolobus dwyeri*) is readily distinguished from other members of its genus by the combination of large ears and overall black colour, with bands of white fur along the undersides of the body, that typically join to form a V-shape (Parnaby 1992a, Churchill 1998). The call (undetectable by the human ear) 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, rainforest, 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 and overhangs (Churchill 1998) as well as abandoned Fairy Martin (*Petrochelidon ariel*) nests (Schulz 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 (Duncan *et al*. 1999). 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 under the NSW TSC Act (1995) and also as Vulnerable under the Commonwealth EPBC Act (1999). The Sydney Basin appears to form a stronghold for the Large-eared Pied Bat, with only scattered records occurring to the north, south and west of the Bioregion (DEC 2005a, Hoye and Schulz in prep.). There is a concentration of records across the Blue Mountains plateau, particularly within Nattai and Blue Mountains National Parks, as well as in the upper Hunter Valley in Yengo, Wollemi and Goulburn River National Parks (DEC 2005a). However these concentrations are likely to reflect the locations of recent DEC survey effort, which has found the species to be more widespread in the Bioregion than previously considered. Records are scattered throughout the Bioregion, including southern Wollemi, Kanangra-Boyd, Royal, Gardens of Stone and Morton National Parks (DEC 2005a). However, despite this wide distribution the species is infrequently detected, suggesting that it occurs at low abundance.

The Large-eared Pied Bat is widespread within north-eastern Wollemi National Park, having been captured at ten harp trap locations and detected at an additional eleven sites by its ultrasonic call (Map 11). A roost site was discovered on the Doyles Range during DEC surveys in 2004, when two bats were observed on the ceiling of a semi-dark sandstone overhang. The density of guano deposits on the floor suggested that the site was regularly used, perhaps at times by large numbers of bats. Such overhangs are widespread across the northern escarpment and are likely to support moderate numbers of Large-eared Pied Bats. In addition, the species roosts within the derelict oil shale mines in the Baerami Valley, though it is not known to what extent. The species has been recorded within a wide range of altitudes and habitats, from the dry Box-Red Gum Woodlands in the Baerami, Hungerford, Martindale and Doyles Creek Valleys, Grey Gum-Stringybark-Ironbark woodlands in the east and tall forest on the Hunter Range. Recent work on the species in southern Sydney suggests that it may require both sandstone overhangs for shelter and proximate to this, more productive landscapes such as Box woodlands for foraging (DEC 2005d). No maternity roosts have been located within the study area. Maternity roost requirements for the species are poorly understood, but are located within deeper cave systems, which are comparatively rare.

The recent systematic surveys in north-east Wollemi, northern Yengo and Goulburn River National Parks have shown the upper Hunter region to be a stronghold for the species. The records continue to provide evidence that the bat is more common in sandstone reserves in the Sydney Basin Bioregion than previously thought, and is likely to be relatively well protected. The primary threat at this stage is likely to be predation by feral animals and wildfires that scorch roost and maternity caves. The gating and collapse of adits in the Baerami oil shale mines may also threaten the population of Large-eared Pied Bats in the park; further research should be undertaken in conjunction with that into the Eastern Bent-wing Bat (see Section 4.1 and the Eastern Bent-wing Bat species profile).

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*). It is distinguished by the possession of two pairs of upper incisors, a gap between the incisors and the canines, and larger ears (Parnaby 1992a; Churchill 1998). Its ultrasonic call pattern can be easily confused with various species of *Scotorepens* and the Greater Broad-nosed Bat, though good quality calls can be distinguished (Reinhold *et al.* 2001). It is patchily distributed throughout its range in south-eastern Australia, between south-east Queensland and western Victoria, and Tasmania. It appears to prefer wet forested habitats, particularly riparian or high rainfall areas, with large trees (taller than 20 metres) (Menkhorst and Lumsden 1995). It may be more common at high elevations in northern parts of its range (Phillips 1995), though it has been recorded between sea level and 1500 metres in Victoria (Menkhorst and Lumsden 1995) and Tasmania (M. Schulz pers. comm.). 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

Threats to the species are poorly known, but the main threat would appear to be destruction of roosting sites, through land clearance and timber harvesting (Gilmore and Parnaby 1994).

Local and Regional Conservation Status

The Eastern False Pipistrelle is listed as Vulnerable under the NSW TSC Act (1995). The species has a disjunct distribution along and to the east of the Great Dividing Range, with scattered records on the western slopes (DEC 2005a). Records for the species are scattered across the Sydney Basin Bioregion, with only a few sightings recorded north of Singleton. The species has been relatively well reported from a number of reserves in the Sydney Basin, including, in addition to Wollemi, Royal, Nattai, Blue Mountains, Kanangra-Boyd and Gardens of Stone National Parks (DEC 2005a).

The Eastern False Pipistrelle has been captured nine times at four locations in north-eastern Wollemi National Park, including along gully lines in the north (Gungalwa and Reubens Creeks) and on the Hunter Main Trail (Map 11). The species has been detected by its ultrasonic call at twelve locations, however only two of these recordings resulted in a definite identification, the other calls being of too poor quality to positively distinguish them from those of the Greater Broad-nosed Bat. The Eastern False Pipistrelle is thought to be uncommon or localised across its range (Parnaby 1992a), which appears to be the case in the Hunter Range area, having been recorded only sporadically in Wollemi and Yengo National Parks. The region is never-the-less important to the conservation of the species as it lies towards the western edge of the species' known range. As with many other bat species, a better understanding of habitat requirements and further harp trapping surveys are required in order to accurately assess its distribution and conservation status in the study area and the surrounding region.

EASTERN BENT-WING BAT

Species Profile

The Common Bent-wing Bat (*Miniopterus schreibersii*) is the most widely distributed bat in the world, occurring through Europe, Africa and Australasia (Churchill 1998). However, recent research suggests there to be three taxa in Australia (Duncan *et al.* 1999). The subspecies *oceanensis* occurs in eastern Australia and extends from central Victoria to Cape York Peninsula, Queensland (Duncan *et al.* 1999). This subspecies is commonly called the Eastern Bent-wing Bat. This species is distinguished from most other bats by the long last bone in the third wing digit and from the Little Bent-wing Bat (*M. australis*) by the longer forearm (greater than 44 mm) (Parnaby 1992a). The ultrasonic call can be distinctive, although it is often inseparable from *Vespadelus darlingtoni* and *V. regulus* (Reinhold *et al.* 2001). The species utilises a wide variety of habitats where it usually roosts in caves, though it has been known to use mines and road culverts (Churchill 1998). It is a fast flying bat that usually feeds above the canopy (Churchill 1998) and has been known to travel up to 65 kilometres in a night (Dwyer 1966 in Ayers *et al.* 1996). Though individuals often use numerous roosts, they congregate en masse at a small number of caves and abandoned mines to breed and hibernate (Churchill 1998).

© Stephen Eberhard

Threats

Damage and disturbance to hibernating and maternity roosting sites is the greatest known threat to this species. Because only relatively few nursery caves are used, significant population changes can occur if these sites are damaged (Dwyer 1995). Disturbance of hibernating colonies can lead to starvation due to loss of energy reserves (Gilmore and Parnaby 1994). Disturbance of smaller diurnal roosts by recreational caving and tourism may also be significant. Other potential threats include modification to feeding habitat by agriculture and urban development (Gilmore and Parnaby 1994) and predation by Feral Cats (*Felis catus*) and, less often, Foxes (*Vulpes vulpes*) (Dwyer 1995).

Local and Regional Conservation Status

The Eastern Bent-wing Bat is listed as Vulnerable under the NSW TSC Act (1995). The species is widely distributed in the eastern third of NSW, with the number of records decreasing with distance from the coast (DEC 2005a). Records are widespread within the Sydney Basin Bioregion and appear to be commonly encountered wherever ultrasound bat surveys are undertaken. Strong clusters of records are present in the Lower Hunter and Central Coast, Cumberland Plain, Woronora Plateau and across the southern Blue Mountains. Individuals have been recorded flying through a diverse range of reserves including Royal, Nattai, Kanangra-Boyd, Blue Mountains and Wollemi National Parks (DEC 2005a). However, roost sites for the species, particularly maternity roosts, are much less frequently recorded and poorly reserved.

The Eastern Bent-wing Bat is the most frequently recorded of the threatened microbat species in north-eastern Wollemi National Park. Almost 100 individuals have been captured at six harp trap locations and a further 23 locations were recorded using the ultrasonic call detection system (Map 11). This medium-sized bat is a high flying species which can travel at 50 kilometres per hour at many times the height of the canopy (Churchill 1998) and so is not commonly caught in harp traps. The species may thus be more widespread within the reserve than records indicate. The Eastern Bent-wing Bat has been recorded in a wide range of habitats, from the dry Box-Red Gum Woodlands in the Baerami, Hungerford, Gungalwa, Martindale and Doyles Creek Valleys, to Grey Gum-Stringybark-Ironbark woodlands in the east and tall forest on the Hunter Range. It has been captured most frequently in the north of the reserve probably because of the availability of roost sites here, most

notably the derelict oil shale mines along Ruebens Creek. The number of Eastern Bent-wing Bats roosting within these mines have been reported to decline over time, from several hundred in at least two mines in 1987 to approximately 30 in just one mine in 1999 (Hoye 2001). This decline is thought to be the result of gating of mine entrances and the collapse of adits (Hoye 2001) as the species is notoriously shy of mine entrance gating (M. Schulz pers. comm.). The Widden #2 and Neets adits were briefly investigated during the DEC surveys in October 2005. No Eastern Bent-wing Bats were seen roosting in the audit, and no fresh guano deposits were seen, however the species was trapped in close vicinity and detected by ultrasonic call near one of the entrances to Neats mine.

Of particular interest was the capture of a banded Eastern Bent-wing Bat along Ruebens Creek in September 2004. This bat was originally banded in Castle Hill, Sydney, in June 2002 (G. Hoye pers. comm.). The animal was originally captured by hand in a stormwater drain that is used regularly as a roost site. Such large movements over a long period of time have previously been recorded (G. Hoye pers. comm.), but the re-capture of individuals such as these contributes important information to our understanding of the ecology and life history of the species.

The Eastern Bent-wing Bat was more frequently recorded in the study area than in neighbouring northern Yengo National Park or Manobalai Nature Reserve (DEC 2005c; DEC 2005b). However, numerous records occur within cleared lands on the Hunter Valley floor (DEC 2005a). Although this species is widespread, and perhaps even abundant, in the Sydney Basin Bioregion, roost sites for the species are poorly reserved and the protection of roosting and foraging habitat within Wollemi National Park has high conservation significance for the species. No maternity roosts for the species were located during the DEC surveys, however the capture of heavily pregnant and lactating adult females suggests that at least one maternity colony occurs in the area. Further targeted survey work is essential to determine whether the oil shale mines currently support a maternity colony. A systematic search in spring or early summer is also required to ascertain whether maternity sites occur within any natural cave systems in the study area.

As urban and industrial expansion continues to place pressure on off-reserve roost sites, the oil shale mines in the Baerami Valley, and any naturally occurring roost sites in the park, will take on increasing importance. If maternity roosts are confirmed they should be managed to minimise disruption from visitation and fire. Management of the oil shale mine sites should aim to ascertain the reasons for the apparent decline in roosting bat numbers. A project should be undertaken to trial different strategies for mine gating and monitor the impacts on bat numbers and roosting patterns. A carefully stratified experimental design with control sites should be employed. This should follow liaison with scientific personnel experienced in the issue of maintaining bat populations in gated mines.

GREATER LONG-EARED BAT (SOUTH-EASTERN FORM)

Species Profile

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Immediately recognised as a long-eared bat by its prominent ears, the Greater Long-eared Bat (*Nyctophilus timoriensis*) has fairly uniformly dark grey-brown fur and is distinguished by its thickset body, a low ridge above a broad snout and a inter-canine width greater than 5.6 mm (Parnaby 1995, Churchill 1998). This species utilises tree hollows, crevices and loose bark as roost sites. It is known to be an agile yet slow-flying bat, making use of the understorey and ground to capture non-flying prey (Churchill 1998, DEC 2005h). Ultrasound recordings are of little use in identifying this species, as its call characteristics and frequencies overlap almost completely with other *Nyctophilus* species using Anabat call analysis (Pennay *et al.* 2004). Recent taxonomic revision has shown the mainland form of the Greater Long-eared Bat to be comprised of three distinct species with allopatric (non-overlapping) distributions, in addition to a Tasmanian subspecies (Parnaby 1995, Duncan *et al.*1999). The nominate south-eastern form occurs across much of inland southern Australia, from south central Queensland, central western NSW, north-western Victoria to south eastern South Australia. It is generally associated with dry woodlands, and semi-arid mallee and savannah (Churchill 1998).

Threats

The main threat facing this species is extensive loss of habitat. In NSW, 75% of the eastern part of the species range has been cleared (Duncan *et al.*1999). Encompassed within this change in habitat is the loss of hollow-bearing trees, which is due to large scale clearing for agriculture, or timber harvesting and grazing in otherwise uncleared areas (Australian Museum 1999, Duncan *et al.*1999). An altered fire regime is also likely to impact on the species, with a long absence of fire causing a lack of hollow regeneration, while fires of too high intensity can destroy hollow-bearing trees altogether and remove the shrub layer which is commonly used for foraging. Application of pesticides near foraging areas are also likely to cause impact, through reduction of invertebrate populations and accumulation of toxins within the bats' tissues (DEC 2005h).

Local and Regional Conservation Status

The Greater Long-eared Bat (south-eastern form) is listed as Vulnerable under the NSW TSC Act (1995) and Vulnerable under the Commonwealth EPBC Act (1999). Records for the species are sparsely distributed across the western three quarters of the state, with concentrations in the Brigalow Belt South and Murray Darling Depression Bioregions (DEC 2005a). The species only occurs in the far north-west of the Sydney Basin Bioregion, where western influenced environments occur in the Goulburn and Hunter River Valleys (DEC 2005a). Representation in reserves in the Bioregion is poor, with key areas being Goulburn River National Park, Manobalai Nature Reserve and north-eastern Wollemi National Park.

The Greater Long-eared Bat was first discovered in north-eastern Wollemi National Park during the systematic surveys in 2004, with three individuals captured at two locations in Doyles Creek and Ruebens Creek valleys (Map11). Like all Long-eared Bats, the Greater Long-eared Bat can orientate and forage without using echolocation (Churchill 1998), such that very short quite calls are often all that is recorded by ultrasound recording devices. Furthermore, call characteristics and frequencies almost completely overlap with other *Nyctophilus* species, such that they cannot be distinguished using standard parameters (Pennay *et al.* 2004). The abundance and distribution of the Greater Long-eared Bat is therefore likely to be underestimated in relation to bats that can be detected by both methods. The density of records is too low to ascertain the species habitat preferences within the study area. However, based on findings elsewhere it is expected to occur throughout the dry western-influenced woodlands on the northern creek flats and escarpment slopes, though possibly only patchily distributed at low abundance.

The presence of Greater Long-eared Bat within Wollemi National Park has high conservation significance as the species reaches the eastern limit of its range in this area and is very scarce and poorly conserved within the Sydney Basin Bioregion. Further harp trapping is required to ascertain the conservation status of the species within the region. The dry woodland habitats on both sides of the

perimeter of north-eastern Wollemi National Park are key to the survival of numerous threatened species within the region, including the Greater Long-eared Bat and hence should take high priority in park management planning. Land holders should be encouraged to maintain the structural integrity of woodland habitats near the boundary of the park, retain hollow-bearing trees and avoid over-use of pesticides near the woodland-agriculture interface.

GREATER BROAD-NOSED BAT

Species Profile

The Greater Broad-nosed Bat (*Scoteanax rueppellii*) is a large microchiropteran bat usually found in gullies draining east from the Great Dividing Range between south east New South Wales and north Queensland (Atherton Tablelands). The species can only be confused with the Eastern False Pipistrelle from which it can be distinguished by its single pair of upper incisors and its smaller ears (Parnaby 1992a). The ultrasonic call overlaps in frequency and may be confused with Eastern False Pipistrelle, Eastern Broad-nosed Bat and Inland Broad-nosed Bat, though they can be distinguished if a good call sequence is recorded (Pennay *et al.* 1994). The Greater Broad-nosed Bat utilises creeks and clearings for hunting (Churchill 1998; Hoye and Richards 1995). In southern New South Wales the species appears to be restricted to lower altitude forests (McKean 1966), while in the centre of its range it occurs at a wide range of altitudes from near sea level to upland areas (Calaby 1966 in Duncan *et al.*1999). It usually roosts in tree hollows, in cracks and fissures in trunks or under exfoliating bark, though it may also utilise old buildings (Churchill 1998).

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Threats

The threats to this species are poorly known, though they probably include habitat clearance and fragmentation for agriculture and urban development, and timber harvesting, which may remove suitable hollows and alter the availability of prey (Duncan *et al.* 1999).

Local and Regional Conservation Status

The Greater Broad-nosed Bat is listed as Vulnerable under the NSW TSC Act (1995). The majority of records for the species in NSW occur in the NSW North Coast, South East Corner and Sydney Basin, with some records in the New England Tableland Bioregion and South-eastern Highlands Bioregion (DEC 2005a). Within the Sydney Basin the species is mainly restricted to the eastern half of the Bioregion, with the greatest density of records on the Central Coast, the Cumberland Plain and to a lesser extent the southern Blue Mountains. The species is reasonably well reported from DEC reserves within the Sydney Basin, including Nattai, Kanangra-Boyd, Blue Mountains and Wollemi National Parks (DEC 2005a).

The Greater Broad-nosed Bat was positively recorded for the first time within the study area during the 2004-05 DEC surveys, during which 10 individuals were captured in harp traps at four locations and at least one individual was detected by its ultrasonic call at a fifth location on the western side of the Doyles Creek Valley (Map 11). These records come from a variety of vegetation types, including Box-Red Gum woodland on creek flats and lower slopes and Grey Gum-Ironbark-Stringybark forest on slopes and ridges. The species is likely to be widespread across the study area, particularly at lower altitudes in the north and east, though it may only occur at low densities. The species is thought to be sparse across its range (Parnaby 1992b), as suggested by these results and those recently obtained in the neighbouring Yengo National Park (DEC 2005c).

North-eastern Wollemi National Park is located towards the western limit of the known distribution of the Greater Broad-nosed Bat; the species has been recorded further west in Wollemi National Park (near Nullo Mountain) as well as in the southern Blue Mountains (DEC 2005a). The records collected during the current surveys (and those in Yengo National Park) contribute important information about the distribution and ecological tolerances of this poorly understood species. Continued survey and research of the species is crucial to guiding their conservation management. The protection of the Greater Broad-nosed Bat within the study area has high significance and is important to the ongoing conservation of the species at the edges of its range.

EASTERN CAVE BAT

Species Profile

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The Eastern Cave Bat (*Vespadelus troughtoni*) is a small mustard yellow-brown bat with dark wings. It has a patchy distribution throughout eastern Australia and remains one of the least known and understood members of its genus. It is very similar in size to the Large Forest Bat (*V. darlingtoni*), the most reliable distinguishing feature between the two species being the shape and size of the male's genitalia, with *V. troughtoni* possessing a larger more pendulous penis (Parnaby 1992a). The species is very difficult to distinguish from ultrasonic call recordings, as the frequency and call pattern overlaps with that of the Little Forest Bat (*Vespadelus vulturnus*) (Pennay *et al.* 2004). The Eastern Cave Bat displays a predominantly tropical distribution that ranges down the east coast from Cape York in Queensland to Kempsey in NSW, with smaller numbers recorded south to at least the Sydney Basin (Law *et al.* 2005). The western limit appears to be the Warrumbungle Range, with a single record from southern NSW, east of the ACT (DEC 2005i). Although little is known about the biology and ecology of this species, the general preferences of habitat seem to range from dry open forest and woodland in the west and inland through to moister wet eucalypt forest and rainforest along the coast (Churchill 1998; DEC 2005i). A cave-dwelling species, it roosts in small groups in reasonably well lit areas near the entrances of sandstone overhangs, mine tunnels, boulder piles and occasionally buildings (Churchill 1998). It has also been discovered roosting in disused Fairy Martin (*Hirundo ariel*) mud nests (Schulz 1998).

Threats

Threats to the species are poorly known as little is known about its habitat preferences, diet and breeding requirements. As for other cave-dwelling bats destruction or damage of roosting sites is likely to be the main threat (DEC 2005i). This type of disturbance is likely to result from clearing and isolation of habitat as a result of increasing development, both residential and agricultural, as well as altered fire regimes and consequential habitat species modification and from practices such as timber harvesting and grazing (DEC 2005i). Disturbance of roost sites by cave visitors may also have localised impacts on this bat.

Local and Regional Conservation Status

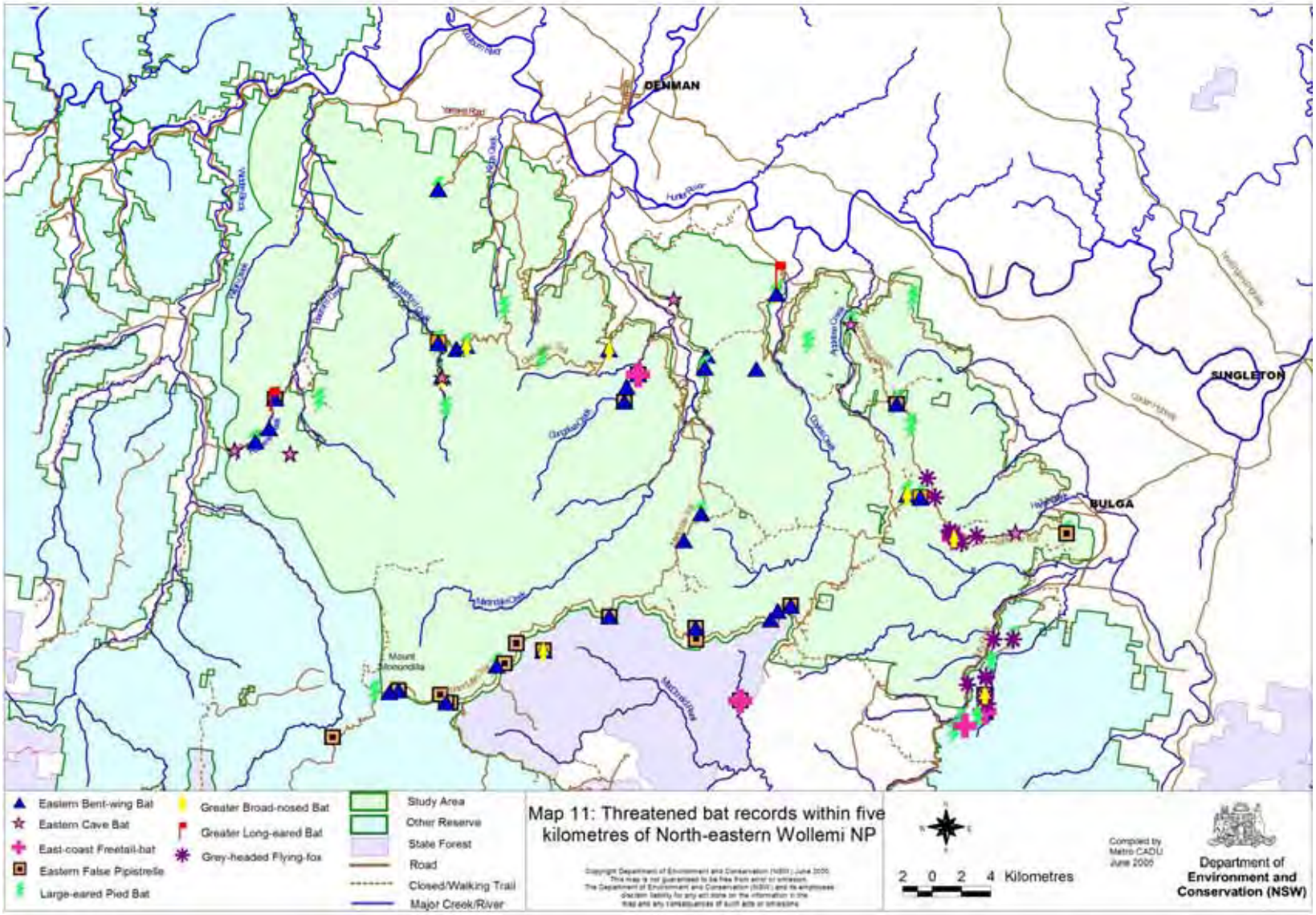
The Eastern Cave Bat is listed as Vulnerable under the NSW TSC Act (1995). This poorly understood species has only been recorded 34 times on the Atlas of NSW Wildlife between 1980 and the current surveys. The majority of records occur in the North Coast and Sydney Basin Bioregions, with a few records in the Brigalow Belt South Bioregion and one record south of Ulladulla on the NSW South Coast (DEC 2005a). The species is reported in low numbers from DEC reserves including, in addition to Wollemi, Yengo, Goulbourn River and Warrumbungle National Parks and Arakoola and Manobalai Nature Reserves (DEC 2005a). Extensive DEC surveys in various reserves and Sydney Catchment Authority Special Areas in the central area of the Sydney Basin Bioregion have failed to locate this species in that area (DEC 2005d), although targeted searches of overhangs and caves was not undertaken.

The Eastern Cave Bat was first detected in north-eastern Wollemi National Park in September 2004 when an individual was discovered roosting on the ceiling of a sandstone overhang north-east of Ruebens Knob. The species was then captured seven times in five harp traps, within both the north-west and north-east (Map 11). The bat was captured in a range of habitats, from dry woodland to shrubby exposed woodland and Spotted Gum Forest. Due to the difficulty in identifying the Eastern Cave Bat using anabat call analysis, the species abundance and distribution in the study area is likely to be underestimated in relation to bats that can be detected by this method. The roost site was located along the northern escarpment, and other such sites are likely to provide extensive roosting opportunities for the species across the north of the park. It is not known whether a maternity roost

occurs within the study area, but the observation of one post-lactating female on the California Trail suggests there is likely to be at least one in the vicinity.

The Eastern Cave Bat was also discovered in 2004 in northern Yengo National Park, where two roost sites (one with five bats and one with 20 bats) were located (DEC 2005c) and Manobalai Nature Reserve and Crown Lands (where a maternity roost was located) (DEC 2005b). The species has previously been recorded in Goulburn River National Park (NPWS 2001a). The maternity roost in Manobalai Nature Reserve was a well-lit sandstone overhang of roughly three metres by ten metres at the entrance with a steeply sloping floor and at least one dome at the rear. Similar caves are likely to occur along escarpments in the study area and in northern Yengo National Park.

The Hunter Range area appears to be a stronghold for the Eastern Cave Bat in the Sydney area and is likely to play a pivotal role in its conservation within the Sydney Basin. As with many of the bats, further research into the ecology of the species in the southern part of its range is required to obtain a better understanding of distribution and habitat requirements, in order to accurately assess conservation status in the study area and the surrounding region. It is possible that the Eastern Cave Bat is more widespread than previously thought, but due to difficulties in identification has been overlooked or mis-identified in other locations. Given the paucity of information on the Eastern Cave Bat, these records make an exciting contribution to the overall understanding of the species ecology and distribution.



Map 11: Threatened bat records within five kilometres of north-eastern Wollemi National Park

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APPENDIX A – LOCATION OF SURVEY SITES

Location, vegetation type and techniques undertaken at systematic fauna survey sites in north-eastern Wollemi National Park. Note that mapped vegetation unit as presented here does not always equal vegetation community observed in the field. Undersampled communites such as Dry Rainforest were sampled as part of this project. Transect spotlight surveys traverse a variety of vegetation types and therefore have not been aligned to a single community in this table.

Site number	Easting	Northing	Mapped broad vegetation class	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott traps	Hair tubes	Transect spotlight survey
8AOP-DH01	276900	6395900	Northern Sandstone Sheltered Forests		1								
8AOP-DH02	277750	6395990	Northern Sandstone Sheltered Forests		1								
8AOP-DH03	274200	6396500	Northern Sandstone Sheltered Forests		1	1							
DNM01O	269086	6407220	Escarpment Slopes Box-Ironbark Woodlands	1	1	1							
DNM02W	268099	6407333	Northern Sandstone Exposed Woodlands	1									
DNM03W	267163	6407871	Northern Sandstone Exposed Woodlands		1								
DNM04W	269426	6407456	Escarpment Slopes Box-Ironbark Woodlands					1	1				
DNM05W	272100	6404200	Escarpment Slopes Box-Ironbark Woodlands	1		1							
DNM06W	271367	6405274	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1									
DNM07O	270388	6405282	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1	1								
DNM08W	271723	6404728	Cleared						1				
DYL01O	301801	6390327	Eastern Sheltered Sandstone Forests						1				
DYL02W	292448	6400445	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1	1	1							
DYL03W	291200	6399765	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands		1	1							
DYL04W	291369	6399090	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1									
DYL05W	291041	6400771	Grassy Box Woodlands		1								
DYL06W	289500	6396750	Northern Sandstone Exposed Woodlands		1								
DYL07W	289592	6395804	Northern Sandstone Sheltered Forests		1								
DYL08W	290809	6397345	Northern Sandstone Sheltered Forests	1									
DYL09W	291222	6397828	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1	1	1							
DYL10H	295617	6400188	Northern Sandstone Exposed Woodlands		1								
DYL11C	289504	6397678	Dry Rainforest	1	1								
DYL12W	293692	6397289	Northern Sandstone Exposed Woodlands	1		1							
DYL13W	294651	6396946	Northern Sandstone Sheltered Forests	1	1								
DYL14W	295331	6397710	Northern Sandstone Exposed Woodlands		1								
DYL15W	295323	6399060	Grassy Box Woodlands		1								

Site number	Easting	Northing	Mapped broad vegetation class	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott traps	Hair tubes	Transect spotlight survey
DYL16W	292464	6400282	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands					1					
DYL17W	291105	6395182	Northern Sandstone Sheltered Forests	1		1		1		1			
DYL18W	293891	6399084	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1		1			1				
DYL19W	292746	6400792	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands		1								
DYL20C	290389	6399366	Northern Sandstone Exposed Woodlands	1	1								
DYL21W	289333	6399680	Northern Sandstone Sheltered Forests	1	1								
DYL22W	289768	6400890	Northern Sandstone Sheltered Forests		1								
DYL23O	291242	6394182	Eastern Sheltered Sandstone Forests	1	1								
DYL24O	291850	6393343	Northern Sandstone Exposed Woodlands		1								
DYL25W	291874	6393821	Northern Sandstone Exposed Woodlands		1								
DYL26W	292743	6401675	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands			1	1		1				
DYL27O	291179	6399476	Escarpment Slopes Box-Ironbark Woodlands				1						
DYL28O	291330	6395674	Northern Sandstone Sheltered Forests				1						
DYL29W	293986	6399269	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands				1						
DYL30W	301645	6391270	Eastern Sandstone Exposed Woodlands				1						
DYL31O	300534	6392918	Cleared				1						
DYL32O	299378	6395547	Narrabeen Wollemi Woodland Complex				1						
DYL33W	297547	6398258	Northern Sandstone Exposed Woodlands				1						
DYL34O	301122	6401104	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1		1	1						
DYL35W	301782	6399923	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1		1	1	1					
DYL36O	301072	6395647	Tall Moist Gully Forests	1	1								
DYL37W	300857	6400787	Escarpment Slopes Box-Ironbark Woodlands		1								
DYL38W	297723	6398297	Northern Sandstone Exposed Woodlands	1	1	1							
DYL39W	299113	6395837	Narrabeen Wollemi Woodland Complex	1	1	1							
DYL40W	300738	6399955	Northern Sandstone Exposed Woodlands		1								
DYL41W	300086	6395874	Northern Sandstone Sheltered Forests	1									
DYL42O	302968	6394544	Eastern Sheltered Sandstone Forests		1								
DYL43O	302059	6390016	Dry Rainforest	1	1								
DYL44O	300656	6393040	Tall Open Shale Forests	1	1	1						1	
DYL45W	302326	6388924	Eastern Sandstone Exposed Woodlands	1	1								
DYL46O	301962	6391736	Eastern Sheltered Sandstone Forests	1	1	1					1		
DYL47O	300646	6392785	Tall Open Shale Forests					1					

Site number	Easting	Northing	Mapped broad vegetation class	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott traps	Hair tubes	Transect spotlight survey
DYL48W	297877	6397560	Cleared	1									
DYL49W	301922	6398346	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1									
DYL50W	297817	6397664	Northern Sandstone Exposed Woodlands					1					
DYL51W	291269	6397600	Northern Sandstone Exposed Woodlands						1				
DYL52C	290680	6399589	Escarpment Slopes Box-Ironbark Woodlands						1				
F-MIX-00108	275000	6378850	Northern Sandstone Exposed Woodlands							1			
F-MIX-00109	288000	6379850	Eastern Sheltered Sandstone Forests							1			
F-MIX-036	283900	6396700	Escarpment Slopes Box-Ironbark Woodlands							1			
GGL01O	274153	6398207	Northern Sandstone Exposed Woodlands	1	1	1	1						
GGL02O	269570	6392068	Northern Sandstone Sheltered Forests	1	1	1							
GGL03O	269850	6393293	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1	1	1	1						
GGL04W	269093	6396613	Escarpment Slopes Box-Ironbark Woodlands	1	1	1							
GGL05W	268432	6395709	Northern Sandstone Exposed Woodlands	1	1								
GGL06O	269691	6394642	Creekline Forests	1	1	1	1		1	1			
GGL07O	268385	6392026	Northern Sandstone Sheltered Forests	1	1								
GGL08H	273944	6399264	Northern Sandstone Sheltered Forests	1	1	1	1					1	
GGL09W	274810	6397440	Northern Sandstone Exposed Woodlands	1	1								
GGL10W	268693	6393976	Northern Sandstone Sheltered Forests	1	1								
GGL11H	269888	6398991	Heath	1	1								
GGL12H	270907	6398992	Northern Sandstone Exposed Woodlands		1								
GGL13H	268347	6394684	Northern Sandstone Exposed Woodlands	1	1								
GGL14W	271314	6396520	Northern Sandstone Sheltered Forests	1	1	1			1				
GGL16W	268544	6393586	Northern Sandstone Exposed Woodlands		1								
GGL17O	269978	6392399	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands			1	1						
GGL18W	271327	6396762	Northern Sandstone Sheltered Forests				1						
GGL19W	270655	6396541	Escarpment Slopes Box-Ironbark Woodlands	1		1		1			1		
GGL21O	269433	6396942	Creekline Forests					1					
GGL23W	268050	6398427	Escarpment Slopes Box-Ironbark Woodlands	1									
GGL24W	270458	6391068	Escarpment Slopes Box-Ironbark Woodlands	1									
GGL25W	288494	6397461	Northern Sandstone Exposed Woodlands	1	1			1					
GGL26O	288219	6396757	Escarpment Slopes Box-Ironbark Woodlands	1		1							
GGL27O	288198	6395677	Northern Sandstone Exposed Woodlands		1								

Site number	Easting	Northing	Mapped broad vegetation class	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott traps	Hair tubes	Transect spotlight survey
GGL28W	287580	6395250	Escarpment Slopes Box-Ironbark Woodlands	1		1		1					
GGL29O	287900	6394000	Escarpment Slopes Box-Ironbark Woodlands	1									
GGL31W	285381	6400647	Northern Sandstone Sheltered Forests		1								
GGL32W	269934	6391730	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands						1				
GGL33O	267252	6398295	Cleared						1				
HWS35O	305461	6373740	Tall Moist Gully Forests						1				
KRB01O	258758	6405273	Escarpment Slopes Box-Ironbark Woodlands	1									
KRB02W	259101	6403853	Escarpment Slopes Box-Ironbark Woodlands	1		1							
KRB03W	258172	6403354	Northern Sandstone Exposed Woodlands	1	1								
KRB04O	257192	6402864	Northern Sandstone Exposed Woodlands	1	1	1							
KRB05W	259744	6406029	Cleared	1									
KRB06W	260071	6403556	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1	1								
KRB07M	260306	6403003	Northern Sandstone Exposed Woodlands	1	1								
KRB08W	259718	6403241	Northern Sandstone Exposed Woodlands		1								
KRB09O	258287	6403604	Escarpment Slopes Box-Ironbark Woodlands						1				
KRB10W	259625	6406013	Escarpment Slopes Box-Ironbark Woodlands						1				
LJKL97082000	286950	6377550	Eastern Sheltered Sandstone Forests								1		
LJKL97082001	286150	6383500											1
LJKL9708200A	287000	6376760											1
LJKL9708200N	286950	6377550											1
LJKL97082100	274550	6375400											1
LJKL9708210D	273400	6375250											1
LPBB9708060F	267300	6373550											1
PRN05W	307599	6378047	Escarpment Slopes Box-Ironbark Woodlands	1	1								
PRN07O	307245	6377305	Tall Moist Gully Forests							1			
PRN09W	302723	6387788	Eastern Sheltered Sandstone Forests	1	1	1			1				
PRN12O	307232	6376804	Tall Moist Gully Forests	1		1		2					
PRN14O	307827	6378961	Escarpment Slopes Box-Ironbark Woodlands	1	1	1						1	
PRN18O	311750	6384263	Residual Spotted Gum Forest				1						
PRN19O	307542	6383858	Residual Spotted Gum Forest				1						
PRN20O	304552	6383711	Eastern Sheltered Sandstone Forests				1						
PRN21O	301349	6386616	Northern Sandstone Exposed Woodlands			1	1						

Site number	Easting	Northing	Mapped broad vegetation class	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott traps	Hair tubes	Transect spotlight survey
PRN22O	308768	6384082	Residual Spotted Gum Forest	1	1	1	1			1		1	
PRN23W	312245	6383959	Residual Spotted Gum Forest	1	1	1		1					
PRN24O	306916	6386880	Residual Spotted Gum Forest		1								
PRN25O	305805	6386323	Residual Spotted Gum Forest	1	1								
PRN26O	296574	6384374	Eastern Sandstone Exposed Woodlands	1									
PRN27O	295489	6384483	Eastern Sandstone Exposed Woodlands	1									
PRN28O	297572	6383955	Eastern Sheltered Sandstone Forests	1	1								
PRN29O	294967	6383285	Eastern Sandstone Exposed Woodlands		1								
PRN30W	295648	6384576	Eastern Sandstone Exposed Woodlands		1								
PRN31O	307911	6383946	Residual Spotted Gum Forest	1	1	1					1		
PRN32O	304259	6384116	Eastern Sheltered Sandstone Forests	1		1							
PRN33O	306094	6383868	Eastern Sheltered Sandstone Forests	1	1	1							
PRN34C	305028	6385773	Eastern Sheltered Sandstone Forests	1	1								
PRN35O	304285	6384992	Eastern Sheltered Sandstone Forests	1		1							
PRN36W	302268	6386404	Narrabeen Wollemi Woodland Complex					1					
PRN37W	305068	6383365	Cleared								1		
PRN38O	307117	6383719	Eastern Sandstone Exposed Woodlands						1				
PRN39W	304747	6383496	Eastern Sandstone Exposed Woodlands						1				
PRN40W	303552	6385412	Eastern Sheltered Sandstone Forests						1				
S-F-LNE-41-002-R	266100	6373175	Narrabeen Wollemi Woodland Complex	1	1		1	2	1				
S-F-LNE-41-004-G	266700	6373300	Eastern Sheltered Sandstone Forests	1	1			1	1				
S-F-LNE-41-006-R	270750	6372750	Narrabeen Wollemi Woodland Complex	1	1			1	1				
S-F-LNE-41-007-M	269550	6373000	Narrabeen Wollemi Woodland Complex	1	1			1	1				
S-F-LNE-41-008-G	269950	6372475	Narrabeen Wollemi Woodland Complex	1	1		2	1	2				
S-F-LNE-41-010-R	267850	6372925	Narrabeen Wollemi Woodland Complex	1	1			2	1				
S-F-LNE-41-011-M	267300	6373550	Narrabeen Wollemi Woodland Complex	1	1			1	1				
S-F-LNE-41-012-G	268650	6372600	Narrabeen Wollemi Woodland Complex	1	1			1	1				
S-F-LNE-41-014-R	292075	6378100	Eastern Sandstone Exposed Woodlands	1	1			1	1				
S-F-LNE-41-015-M	292550	6378700	Eastern Sandstone Exposed Woodlands	1				1	1				
S-F-LNE-41-016-G	293425	6379050	Eastern Sandstone Exposed Woodlands	1	1		1	1	1	1			
S-F-LNE-41-018-R	287700	6377025	Eastern Sheltered Sandstone Forests	2	1			1	1				
S-F-LNE-41-019-M	288740	6377075	Eastern Sheltered Sandstone Forests	1	2				1			1	

Site number	Easting	Northing	Mapped broad vegetation class	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott traps	Hair tubes	Transect spotlight survey
S-F-LNE-41-020-G	287000	6376760	Eastern Sandstone Exposed Woodlands	2	1			1	1	1		1	
S-F-LNE-41-022-R	286700	6384750	Tall Open Shale Forest	1	1				1			1	
S-F-LNE-41-023-M	287350	6385350	Eastern Sheltered Sandstone Forests	1	1			1	1		1		
S-F-LNE-41-024-G	286150	6383500	Eastern Sheltered Sandstone Forests	1	1		1	1	1	1		1	
S-F-LNE-41-026-R	274750	6376500	Narrabeen Wollemi Woodland Complex	1	1			1	1				
S-F-LNE-41-027-M	273925	6375125	Narrabeen Wollemi Woodland Complex	1	1		1	1	1				
S-F-LNE-41-028-G	274675	6375825	Narrabeen Wollemi Woodland Complex	1	1		1	1	1	1			
S-F-LNE-41-030-R	273150	6373800	Narrabeen Wollemi Woodland Complex	1	1			2	1				
S-F-LNE-41-031-M	273400	6374975	Narrabeen Wollemi Woodland Complex	1	1		1	1	1				
S-F-LNE-41-032-G	273200	6374200	Narrabeen Wollemi Woodland Complex	1	1		1	1	1	1			
S-F-LNE-41-125-G	271950	6397500	Escarpment Slopes Box-Ironbark Woodlands	1	1	1	1	1	1	1	1		1
S-F-LNE-41-126-M	272600	6397250	Northern Sandstone Exposed Woodlands	1	1		1	1	1				
S-F-LNE-41-127-R	273450	6397300	Northern Sandstone Sheltered Forests	1	1	1	1	1	1				
S-F-LNE-41-129-G	281050	6396500	Northern Sandstone Exposed Woodlands	1	1		1	1	1	1	1		
S-F-LNE-41-130-M	276500	6395850	Northern Sandstone Exposed Woodlands	1	1		1	1	1				1
S-F-LNE-41-131-R	277950	6395800	Northern Sandstone Exposed Woodlands	1	1		1	1	1				
S-F-LNE-41-133-G	282100	6392950	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1	1		1	1	1	1			1
S-F-LNE-41-134-M	283050	6394800	Northern Sandstone Exposed Woodlands	1	1		1	1	1				
S-F-LNE-41-135-R	282250	6393950	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1	1		1	1	1				
S-F-SYD-53-032	272400	6373500	Eastern Sheltered Sandstone Forests	1									
T-F-LNE-41-026	286950	6377550	Eastern Sheltered Sandstone Forests					1					
T-F-SYD-41-011	288400	6377250	Narrabeen Wollemi Woodland Complex		1								
T-F-SYD-41-012	266900	6373550	Eastern Sheltered Sandstone Forests		1								
T-F-SYD-41-013	267800	6372950	Narrabeen Wollemi Woodland Complex		1								
T-F-SYD-41-015	297990	6383800	Eastern Sheltered Sandstone Forests		1								
T-F-SYD-41-018	270750	6372750	Narrabeen Wollemi Woodland Complex		1								
T-F-SYD-41-019	310500	6384200	Residual Spotted Gum Forest		1								
T-F-SYD-41-021	287050	6377640	Cleared				1						
T-F-SYD-41-022	287050	6377650	Cleared				1						
T-F-SYD-41-024	305450	6374000	Tall Moist Gully Forests				1						
T-F-SYD-50-061	300550	6385650	Cleared						1				
T-F-SYD-50-062	299970	6388500	Eastern Sheltered Sandstone Forests						1				

Site number	Easting	Northing	Mapped broad vegetation class	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott traps	Hair tubes	Transect spotlight survey
T-F-SYD-50-063	299250	6390700	Eastern Sandstone Exposed Woodlands						1				
T-F-SYD-50-064	297550	6398950	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands						1				
T-F-SYD-50-065	309990	6384050	Residual Spotted Gum Forest						1				
T-F-SYD-50-065/2	310000	6384079	Residual Spotted Gum Forest	1		1	1						
T-F-SYD-50-075	273650	6400200	Northern Sandstone Sheltered Forests						1				
T-F-SYD-50-076	273200	6397450	Northern Sandstone Sheltered Forests						1				
T-F-SYD-50-082	274750	6396000	Northern Sandstone Exposed Woodlands						1				
T-F-SYD-50-083	276900	6395900	Northern Sandstone Sheltered Forests						1				
T-F-SYD-50-084	278950	6395500	Northern Sandstone Exposed Woodlands						1				
T-F-SYD-50-085	281100	6396900	Escarpment Slopes Box-Ironbark Woodlands						1				
WDD01W	257797	6391746	Escarpment Slopes Box-Ironbark Woodlands	1	1	1							
WDD02W	257286	6391004	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1	1	1							
WDD03W	255595	6389365	Northern Sandstone Exposed Woodlands	1	1	1							
WDD04W	256481	6389610	Northern Sandstone Exposed Woodlands		1								
WDD05W	255229	6390311	Northern Sandstone Exposed Woodlands	1	1								
WDD06W	257734	6393052	Northern Sandstone Sheltered Forests	1	1	1							
WDD07W	261100	6393190	Escarpment Slopes Box-Ironbark Woodlands	1	1	1			1			1	
WDD08W	262027	6392492	Escarpment Slopes Box-Ironbark Woodlands	1	1	1							
WDD09W	259624	6388873	Grassy Box Woodlands		1								
WDD10W	259147	6389753	Northern Sandstone Exposed Woodlands	1	1								
WDD11W	260271	6390046	Escarpment Slopes Box-Ironbark Woodlands	1	1								
WDD12O	262014	6393513	Grassy Box Woodlands		1								
WDD13O	260351	6399871	Escarpment Slopes Box-Ironbark Woodlands	1									
WDD14W	259381	6400215	Northern Sandstone Sheltered Forests	1									
WDD15O	258506	6399685	Northern Sandstone Exposed Woodlands	1									
WDD16O	259985	6400737	Northern Sandstone Exposed Woodlands	1									
WDD17W	260482	6400209	Escarpment Slopes Box-Ironbark Woodlands			1		1		1			
WDD18W	263028	6392308	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1	1	1							
WDD19W	258927	6393418	Escarpment Slopes Box-Ironbark Woodlands								1		
WDD20O	257506	6389939	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1	1	1							
WDD21W	258922	6393551	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands	1		1							
WDD22W	260435	6390287	Escarpment Slopes Box-Ironbark Woodlands			1			1				

Site number	Easting	Northing	Mapped broad vegetation class	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott traps	Hair tubes	Transect spotlight survey
WDD24W	256951	6390219	Escarpment Slopes Box-Ironbark Woodlands					1					
WDD26W	260526	6390470	Cleared										
WDD27W	258296	6393165	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands				1		1				
WDD28W	258091	6392412	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands				1						
WDD29W	257890	6391146	Escarpment Slopes Box-Ironbark Woodlands				1						
WDD30W	257245	6390289	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands				1						
WDD31W	256292	6389973	Escarpment Slopes Box-Ironbark Woodlands	1			1					1	
WDD32W	255553	6389683	Northern Sandstone Exposed Woodlands				1						
WDD33W	262892	6392610	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands				1		1				
WDD34W	262048	6392576	Lower Slopes and Plains Box-Red Gum-Ironbark Woodlands				1						
WDD35W	261339	6393013	Escarpment Slopes Box-Ironbark Woodlands				1						
WDD36O	255600	6389572	Northern Sandstone Exposed Woodlands						1				

APPENDIX B – FAUNA SPECIES RECORDED IN NORTH-EASTERN WOLLEMI NATIONAL PARK

List of the fauna species within north-eastern Wollemi National Park, from the Atlas of NSW Wildlife. Records have been included from DEC systematic surveys, licensed data sets (Birds Australia and the Australian Museum) and incidental observations submitted by individuals, including park rangers and field officers; catchment officers; bushwalkers and naturalists; scientific researchers working in the area; and other visitors to the park.

The list contains records of various levels of reliability and spatial accuracy. Species where there is doubt about their occurrence within the study area due to possible identification inaccuracy have been marked with an asterisk ***** and due to spatial inaccuracy have been marked with an ^. Introduced species are indicated with the addition of an **!**.

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	DEC Systematic Survey	Licensed Datasets	Other Sources
Frogs							
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P		✓		
Myobatrachidae	*Heleioporus australiacus*	Giant Burrowing Frog	V	V	✓	✓	✓
Myobatrachidae	*Lechriodus fletcheri*	Fletcher's Frog	P		✓		
Myobatrachidae	*Limnodynastes dumerilii*	Bullfrog	P		✓		
Myobatrachidae	*Limnodynastes ornatus*	Ornate Burrowing Frog	P		✓		
Myobatrachidae	*Limnodynastes peronii*	Striped Marsh Frog	P		✓		
Myobatrachidae	*Limnodynastes tasmaniensis*	Spotted Marsh Frog	P		✓		
Myobatrachidae	*Mixophyes fasciolatus*	Great Barred Frog	P		✓		
Myobatrachidae	*Neobatrachus sudelli*	Painted Burrowing Frog	P		✓		
Myobatrachidae	*Pseudophryne australis*	Red-crowned Toadlet	V		✓		✓
Myobatrachidae	*Pseudophryne bibronii*	Bibron's Toadlet	P		✓		
Myobatrachidae	*Uperoleia fusca*	Dusky Toadlet	P		✓		
Myobatrachidae	*Uperoleia laevigata*	Smooth Toadlet	P		✓		
Hylidae	*Litoria caerulea*	Green Tree Frog	P		✓	✓	✓
Hylidae	*Litoria chloris*	Red-eyed Tree Frog	P		✓		
Hylidae	*Litoria citropa*	Blue Mountains Tree Frog	P		✓		
Hylidae	*Litoria dentata*	Keferstein's Tree Frog	P		✓		
Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog	P		✓	✓	
Hylidae	*Litoria latopalmata*	Broad-palmed Frog	P		✓		
Hylidae	*Litoria lesueuri*	Lesueur's Frog	P		✓		✓
Hylidae	*Litoria peronii*	Peron's Tree Frog	P		✓	✓	
Hylidae	*Litoria phyllochroa*	Green Stream Frog	P		✓		✓
Reptiles							
Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle	P		✓		
Gekkonidae	*Diplodactylus vittatus*	Eastern Stone Gecko	P		✓		
Gekkonidae	*Oedura lesueurii*	Lesueur's Velvet Gecko	P		✓		
Gekkonidae	*Oedura robusta*	Robust Velvet Gecko	P		✓		
Gekkonidae	*Phyllurus platurus*	Broad-tailed Gecko	P		✓	✓	
Gekkonidae	*Underwoodisaurus milii*	Thick-tailed Gecko	P		✓	✓	✓
Pygopodidae	*Delma plebeia*	Leaden Delma	P		✓		
Pygopodidae	*Lialis burtonis*	Burton's Snake-lizard	P		✓		
Pygopodidae	*Pygopus lepidopodus*	Southern Scaly-foot	P		✓		

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	DEC Systematic Survey	Licensed Datasets	Other Sources
Agamidae	*Amphibolurus muricatus*	Jacky Lashtail	P		✓		✓
Agamidae	*Physignathus lesueurii*	Eastern Water Dragon	P		✓		✓
Agamidae	*Pogona barbata*	Eastern Bearded Dragon	P		✓		✓
Agamidae	*Tympanocryptis diemensis* (taxonomy revised to *Rankinia diemensis*)	Mountain Heath Dragon	P		✓		✓
Varanidae	*Varanus gouldii*	Sand Monitor	P		✓	✓	
Varanidae	*Varanus rosenbergi*	Rosenberg's Goanna	V				✓
Varanidae	*Varanus varius*	Lace Monitor	P		✓	✓	✓
Scincidae	*Anomalopus leuckartii*	Two-clawed Worm-skink	P		✓	✓	
Scincidae	*Anomalopus swansoni*	Punctate Worm-skink	P		✓		
Scincidae	*Bassiana platynota*	Red-throated Cool-skink	P		✓	✓	
Scincidae	*Carlia tetradactyla*	Southern Rainbow-skink	P		✓	✓	
Scincidae	*Carlia vivax*	Tussock Rainbow-skink	P		✓		
Scincidae	*Cryptoblepharus virgatus*	Cream-striped Shinning-skink	P		✓		
Scincidae	*Ctenotus robustus*	Robust Ctenotus	P		✓	✓	✓
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Ctenotus	P		✓		✓
Scincidae	*Egernia cunninghami*	Cunningham's Spiny-tailed Skink	P		✓		
Scincidae	*Egernia modesta*	Eastern Ranges Rock-skink	P		✓	✓	
Scincidae	*Egernia striolata*	Tree-crevice Skink	P		✓	✓	✓
Scincidae	*Egernia whitii*	White's Rock-skink	P		✓		
Scincidae	*Eulamprus quoyii*	Eastern Water-skink	P		✓		✓
Scincidae	*Eulamprus tenuis*	Bar-sided Forest-skink	P		✓		✓
Scincidae	*Hemiergis decresiensis*	Three-toed Earless Skink	P		✓		
Scincidae	*Hemisphaeriodon gerrardii*	Pink-tongued Skink	P		✓		
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P		✓		
Scincidae	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink	P		✓		
Scincidae	*Lerista bougainvillii*	South-eastern Slider	P		✓		
Scincidae	*Lygisaurus foliorum* (taxonomy revised to *Carlia foliorum*)	Tree-base Litter-skink	P		✓	✓	
Scincidae	*Morethia boulengeri*	South-eastern Morethia Skink	P		✓	✓	
Scincidae	*Niveoscincus coventryi* *****	Southern Forest Cool-skink *****	P				✓
Scincidae	*Saiphos equalis*	Yellow-bellied Three-toed Skink	P		✓		
Scincidae	*Saproscincus mustelinus*	Weasel Shadeskink	P		✓	✓	
Scincidae	*Tiliqua scincoides*	Common Bluetongue	P		✓		
Typhlopidae	*Ramphotyphlops nigrescens*	Blackish Blind Snake	P		✓		✓
Boidae	*Morelia spilota spilota*	Diamond Python	P		✓		✓
Colubridae	*Boiga irregularis*	Eastern Brown Tree Snake	P		✓	✓	
Elapidae	*Acanthophis antarcticus*	Southern Death Adder	P		✓		✓
Elapidae	*Demansia psammophis*	Yellow-faced Whipsnake	P		✓		
Elapidae	*Furina diadema*	Red-naped Snake	P				✓
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	P		✓		✓
Elapidae	*Pseudonaja textilis*	Eastern Brown Snake	P		✓		✓
Elapidae	*Rhinoplocephalus nigrescens*	Small-eyed Snake	P		✓		
Elapidae	*Vermicella annulata*	Eastern Bandy-bandy	P		✓		
Birds							
Megapodiidae	*Alectura lathami*	Australian Brush-turkey	P		✓	✓	✓

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	DEC Systematic Survey	Licensed Datasets	Other Sources
Phasianidae	*Coturnix pectoralis*	Stubble Quail	P		✓	✓	
Phasianidae	*Coturnix ypsilophora*	Brown Quail	P		✓	✓	✓
Phasianidae	*Gallus gallus* [I]	Domestic Fowl [I]	U		✓		
Anatidae	*Anas gracilis*	Grey Teal	P		✓	✓	
Anatidae	*Anas rhynchotis* ^	Australasian Shoveler ^	P			✓	
Anatidae	*Anas superciliosa*	Pacific Black Duck	P			✓	
Anatidae	*Aythya australis*	Hardhead	P			✓	
Anatidae	*Chenonetta jubata*	Australian Wood Duck	P		✓	✓	✓
Anatidae	*Cygnus atratus* ^	Black Swan ^	P			✓	
Podicipedidae	*Podiceps cristatus* ^	Great Crested Grebe ^	P			✓	
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	P		✓	✓	
Phalacrocoracidae	*Phalacrocorax carbo* ^	Great Cormorant ^	P			✓	
Phalacrocoracidae	*Phalacrocorax melanoleucos* ^	Little Pied Cormorant ^	P			✓	
Phalacrocoracidae	*Phalacrocorax sulcirostris* ^	Little Black Cormorant ^	P			✓	
Pelecanidae	*Pelecanus conspicillatus* ^	Australian Pelican ^	P			✓	
Ardeidae	*Ardea alba* ^	Great Egret ^	P			✓	
Ardeidae	*Ardea intermedia*	Intermediate Egret	P			✓	✓
Ardeidae	*Ardea pacifica* ^	White-necked Heron ^	P			✓	
Ardeidae	*Egretta novaehollandiae* ^	White-faced Heron ^	P		✓	✓	
Threskiornithidae	*Platalea flavipes* ^	Yellow-billed Spoonbill ^	P			✓	
Threskiornithidae	*Platalea regia* ^	Royal Spoonbill ^	P			✓	
Threskiornithidae	*Threskiornis molucca* ^	Australian White Ibis ^	P			✓	
Threskiornithidae	*Threskiornis spinicollis* ^	Straw-necked Ibis ^	P			✓	
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	P		✓	✓	
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	P		✓	✓	
Accipitridae	*Accipiter novaehollandiae*	Grey Goshawk	P			✓	
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	P		✓	✓	✓
Accipitridae	*Aviceda subcristata*	Pacific Baza	P		✓		
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	P		✓	✓	
Accipitridae	*Haliaeetus leucogaster* ^	White-bellied Sea-Eagle ^	P			✓	
Accipitridae	*Haliastur sphenurus* ^	Whistling Kite ^	P			✓	
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	P			✓	
Falconidae	*Falco berigora*	Brown Falcon	P		✓	✓	
Falconidae	*Falco cenchroides*	Nankeen Kestrel	P		✓	✓	✓
Falconidae	*Falco longipennis*	Australian Hobby	P		✓		
Falconidae	*Falco peregrinus*	Peregrine Falcon	P		✓	✓	
Rallidae	*Fulica atra* ^	Eurasian Coot ^	P			✓	
Rallidae	*Gallinula tenebrosa* ^	Dusky Moorhen ^	P			✓	
Rallidae	*Porphyrio porphyrio* ^	Purple Swamphen ^	P			✓	
Turnicidae	*Turnix varia*	Painted Button-quail	P		✓	✓	✓
Charadriidae	*Elseyornis melanops* ^	Black-fronted Dotterel ^	P			✓	
Charadriidae	*Vanellus miles*	Masked Lapwing	P		✓	✓	
Columbidae	*Chalcophaps indica* ^	Emerald Dove ^	P			✓	
Columbidae	*Columba livia* [I] ^	Rock Dove [I] ^	U			✓	
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	P		✓	✓	
Columbidae	*Geopelia placida*	Peaceful Dove	P		✓	✓	✓
Columbidae	*Leucosarcia melanoleuca*	Wonga Pigeon	P		✓	✓	✓

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Columbidae	*Macropygia amboinensis*	Brown Cuckoo-Dove	P		✓	✓	✓
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	P		✓	✓	✓
Columbidae	*Phaps chalcoptera*	Common Bronzewing	P		✓	✓	✓
Columbidae	*Streptopelia chinensis* [I]	Spotted Turtle-Dove [I]	U			✓	
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	P		✓	✓	✓
Cacatuidae	*Callocephalon fimbriatum*	Gang-gang Cockatoo	P		✓	✓	✓
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	P		✓	✓	✓
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V		✓	✓	✓
Cacatuidae	*Eolophus roseicapillus*	Galah	P		✓	✓	✓
Cacatuidae	*Nymphicus hollandicus* ^	Cockatiel ^	P			✓	
Psittacidae	*Alisterus scapularis*	Australian King-Parrot	P		✓	✓	✓
Psittacidae	*Glossopsitta concinna*	Musk Lorikeet	P			✓	
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	P		✓	✓	✓
Psittacidae	*Neophema pulchella*	Turquoise Parrot	V		✓	✓	
Psittacidae	*Platycercus adscitus eximius*	Eastern Rosella	P		✓	✓	✓
Psittacidae	*Platycercus elegans*	Crimson Rosella	P		✓	✓	✓
Psittacidae	*Platycercus icterotis* *	Western Rosella *	P				✓
Psittacidae	*Psephotus haematonotus*	Red-rumped Parrot	P		✓	✓	
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P		✓	✓	
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	P		✓	✓	
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo	P		✓	✓	
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo	P		✓	✓	
Cuculidae	*Cuculus pallidus*	Pallid Cuckoo	P		✓	✓	
Cuculidae	*Eudynamys orientalis*	Pacific Koel	P		✓	✓	✓
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo	P		✓	✓	✓
Strigidae	*Ninox boobook*	Southern Boobook	P		✓	✓	✓
Strigidae	*Ninox connivens*	Barking Owl	V		✓		
Strigidae	*Ninox strenua*	Powerful Owl	V		✓		
Tytonidae	*Tyto alba*	Barn Owl	P		✓		
Tytonidae	*Tyto novaehollandiae*	Masked Owl	V		✓	✓	
Tytonidae	*Tyto tenebricosa*	Sooty Owl	V		✓		
Podargidae	*Podargus strigoides*	Tawny Frogmouth	P		✓	✓	✓
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	P		✓	✓	
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	P		✓	✓	✓
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	P		✓	✓	
Alcedinidae	*Alcedo azurea* ^	Azure Kingfisher ^	P			✓	
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	P		✓	✓	✓
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	P		✓	✓	
Meropidae	*Merops ornatus*	Rainbow Bee-eater	P		✓	✓	✓
Coraciidae	*Eurystomus orientalis*	Dollarbird	P		✓	✓	✓
Menuridae	*Menura novaehollandiae*	Superb Lyrebird	P		✓	✓	✓
Climacteridae	*Climacteris erythrops*	Red-browed Treecreeper	P		✓	✓	
Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subsp.)	V		✓	✓	✓
Climacteridae	*Cormobates leucophaeus*	White-throated Treecreeper	P		✓	✓	✓
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P		✓	✓	✓
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P		✓	✓	

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Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P		✓	✓	✓
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	P		✓	✓	✓
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill	P		✓	✓	
Acanthizidae	*Acanthiza lineata*	Striated Thornbill	P		✓	✓	✓
Acanthizidae	*Acanthiza nana*	Yellow Thornbill	P		✓	✓	✓
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P		✓	✓	✓
Acanthizidae	*Acanthiza reguloides*	Buff-rumped Thornbill	P		✓	✓	
Acanthizidae	*Acanthiza uropygialis* *	Chestnut-rumped Thornbill *	P				✓
Acanthizidae	*Aphelocephala leucopsis*	Southern Whiteface	P		✓		
Acanthizidae	*Calamanthus pyrrhopygius*	Chestnut-rumped Heathwren	P		✓		
Acanthizidae	*Gerygone fusca*	Western Gerygone	P		✓	✓	✓
Acanthizidae	*Gerygone mouki*	Brown Gerygone	P		✓	✓	
Acanthizidae	*Gerygone olivacea*	White-throated Gerygone	P		✓	✓	
Acanthizidae	*Origma solitaria*	Rockwarbler	P		✓	✓	✓
Acanthizidae	*Pycnoptilus floccosus*	Pilotbird	P		✓		✓
Acanthizidae	*Pyrrholaemus sagittatus*	Speckled Warbler	V		✓	✓	
Acanthizidae	*Sericornis citreogularis*	Yellow-throated Scrubwren	P		✓	✓	✓
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P		✓	✓	✓
Acanthizidae	*Sericornis magnirostris*	Large-billed Scrubwren	P		✓	✓	✓
Acanthizidae	*Smicrornis brevirostris*	Weebill	P		✓	✓	
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P		✓	✓	✓
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P		✓	✓	✓
Meliphagidae	*Entomyzon cyanotis*	Blue-faced Honeyeater	P		✓	✓	
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P		✓	✓	✓
Meliphagidae	*Lichenostomus fuscus*	Fuscous Honeyeater	P		✓	✓	
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater	P		✓	✓	✓
Meliphagidae	*Lichenostomus melanops*	Yellow-tufted Honeyeater	P		✓	✓	✓
Meliphagidae	*Lichenostomus ornatus* *****	Yellow-plumed Honeyeater *****	P				✓
Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater	P		✓	✓	
Meliphagidae	*Lichenostomus virescens* *****	Singing Honeyeater *****	P				✓
Meliphagidae	*Lichmera indistincta* *****	Brown Honeyeater *****	P			✓	
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P		✓	✓	✓
Meliphagidae	*Manorina melanophrys*	Bell Miner	P		✓	✓	✓
Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater	P		✓	✓	✓
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	P		✓	✓	
Meliphagidae	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subsp.)	V		✓	✓	✓
Meliphagidae	*Melithreptus lunatus*	White-naped Honeyeater	P		✓	✓	
Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater	P		✓	✓	
Meliphagidae	*Philemon citreogularis*	Little Friarbird	P		✓	✓	✓
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	P		✓	✓	✓
Meliphagidae	*Phylidonyris nigra*	White-cheeked Honeyeater	P		✓	✓	✓
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P		✓	✓	✓
Meliphagidae	*Phylidonyris pyrrhoptera*	Crescent Honeyeater	P		✓		
Meliphagidae	*Plectorhyncha lanceolata*	Striped Honeyeater	P		✓	✓	
Meliphagidae	*Xanthomyza phrygia*	Regent Honeyeater	E	E	✓		✓
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P		✓	✓	✓

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Petroicidae	*Melanodryas cucullata*	Hooded Robin (eastern subsp.)	V			✓	✓
Petroicidae	*Microeca fascinans*	Jacky Winter	P		✓	✓	✓
Petroicidae	*Petroica boodang*	Scarlet Robin	P		✓	✓	✓
Petroicidae	*Petroica goodenovii*	Red-capped Robin	P		✓	✓	
Petroicidae	*Petroica phoenicea*	Flame Robin	P		✓		
Petroicidae	*Petroica rosea*	Rose Robin	P		✓	✓	✓
Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler	P		✓	✓	✓
Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subsp.)	V		✓	✓	
Eupetidae	*Cinclosoma punctatum*	Spotted Quail-thrush	P		✓	✓	✓
Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	P		✓	✓	✓
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	P		✓	✓	
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P		✓	✓	✓
Pachycephalidae	*Falcunculus frontatus*	Eastern Shrike-tit	P		✓	✓	
Pachycephalidae	*Pachycephala olivacea* *****	Olive Whistler *****	V		✓		
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P		✓	✓	✓
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P		✓	✓	✓
Dicruridae	*Grallina cyanoleuca*	Magpie-lark	P		✓	✓	
Dicruridae	*Monarcha melanopsis*	Black-faced Monarch	P		✓	✓	✓
Dicruridae	*Monarcha trivirgatus* *	Spectacled Monarch *	P				✓
Dicruridae	*Myiagra cyanoleuca*	Satin Flycatcher	P		✓	✓	✓
Dicruridae	*Myiagra inquieta*	Restless Flycatcher	P		✓	✓	
Dicruridae	*Myiagra rubecula*	Leaden Flycatcher	P		✓	✓	
Dicruridae	*Rhipidura albiscapa*	Grey Fantail	P		✓	✓	✓
Dicruridae	*Rhipidura leucophrys*	Willie Wagtail	P		✓	✓	✓
Dicruridae	*Rhipidura rufifrons*	Rufous Fantail	P		✓	✓	✓
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P		✓	✓	✓
Campephagidae	*Coracina papuensis*	White-bellied Cuckoo-shrike	P		✓	✓	
Campephagidae	*Coracina tenuirostris*	Cicadabird	P		✓	✓	✓
Campephagidae	*Lalage tricolor*	White-winged Triller	P		✓	✓	
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	P		✓	✓	✓
Oriolidae	*Sphecotheres vieilloti* *****	Australasian Figbird *****	P			✓	
Artamidae	*Artamus cinereus* *****	Black-faced Woodswallow *****	P				✓
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	P		✓	✓	
Artamidae	*Artamus personatus*	Masked Woodswallow	P				✓
Artamidae	*Artamus superciliosus*	White-browed Woodswallow	P		✓		
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird	P		✓	✓	
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P		✓	✓	
Artamidae	*Gymnorhina tibicen*	Australian Magpie	P		✓	✓	✓
Artamidae	*Strepera graculina*	Pied Currawong	P		✓	✓	✓
Artamidae	*Strepera versicolor*	Grey Currawong	P		✓		✓
Corvidae	*Corvus coronoides*	Australian Raven	P		✓	✓	✓
Corvidae	*Corvus mellori* **^**	Little Raven **^**	P			✓	
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough	P		✓	✓	✓
Ptilonorhynchidae	*Ptilonorhynchus violaceus*	Satin Bowerbird	P		✓	✓	
Alaudidae	*Mirafra javanica* **^**	Horsfield's Bushlark **^**	P			✓	
Motacillidae	*Anthus australis*	Australian Pipit	P		✓	✓	

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Passeridae	*Passer domesticus* [I] ^	House Sparrow [I] ^	U			✓	
Fringillidae	*Carduelis carduelis* [I] ^	European Goldfinch [I] ^	U			✓	
Estrildidae	*Neochmia modesta*	Plum-headed Finch	P			✓	✓
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P		✓	✓	✓
Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V		✓	✓	✓
Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch	P		✓	✓	✓
Estrildidae	*Taeniopygia guttata* ^	Zebra Finch ^	P			✓	
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	P		✓	✓	✓
Hirundinidae	*Cheramoeca leucosternus* ^	White-backed Swallow ^	P			✓	
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P		✓	✓	✓
Hirundinidae	*Petrochelidon ariel*	Fairy Martin	P		✓	✓	
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	P		✓	✓	
Sylviidae	*Acrocephalus australis* ^	Australian Reed-Warbler ^	P			✓	
Sylviidae	*Cincloramphus cruralis*	Brown Songlark	P			✓	
Sylviidae	*Cincloramphus mathewsi*	Rufous Songlark	P		✓	✓	
Sylviidae	*Cisticola exilis* ^	Golden-headed Cisticola ^	P			✓	
Zosteropidae	*Zosterops lateralis*	Silvereye	P		✓	✓	✓
Muscicapidae	*Turdus merula* [I]	Eurasian Blackbird [I]	U		✓	✓	
Muscicapidae	*Zoothera lunulata*	Bassian Thrush	P		✓	✓	
Sturnidae	*Acridotheres tristis* [I]	Common Myna [I]	U		✓	✓	
Sturnidae	*Sturnus vulgaris* [I]	Common Starling [I]	U		✓	✓	
Mammals							
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P		✓		✓
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus	P			✓	✓
Dasyuridae	*Antechinus stuartii*	Brown Antechinus	P		✓		✓
Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	V	E			✓
Dasyuridae	*Sminthopsis murina*	Common Dunnart	P				✓
Peramelidae	*Perameles nasuta*	Long-nosed Bandicoot	P		✓		
Phascolarctidae	*Phascolarctos cinereus*	Koala	V		✓		✓
Vombatidae	*Vombatus ursinus*	Common Wombat	P		✓		✓
Burramyidae	*Cercartetus nanus*	Eastern Pygmy-possum	V		✓		
Petauridae	*Petaurus australis*	Yellow-bellied Glider	V		✓		✓
Petauridae	*Petaurus breviceps*	Sugar Glider	P		✓	✓	✓
Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V		✓		✓
Pseudocheiridae	*Petauroides volans*	Greater Glider	P		✓		✓
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P		✓		
Acrobatidae	*Acrobates pygmaeus*	Feathertail Glider	P		✓	✓	✓
Phalangeridae	*Trichosurus caninus*	Mountain Brushtail Possum	P		✓		
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	P		✓		✓
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	P		✓		✓
Macropodidae	*Macropus robustus*	Common Wallaroo	P		✓		✓
Macropodidae	*Macropus rufogriseus*	Red-necked Wallaby	P		✓		✓
Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E	V	✓		✓
Macropodidae	*Wallabia bicolor*	Swamp Wallaby	P		✓		✓
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	✓		
Rhinolophidae	*Rhinolophus megaphyllus*	Eastern Horseshoe-bat	P		✓		
Molossidae	*Mormopterus norfolkensis*	East-coast Freetail-bat	V		✓		

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Molossidae	*Mormopterus* species 2 (Adams *et al.* 1988)	Eastern Freetail-bat	P		✓		
Molossidae	*Mormopterus* species 3 (short penis form) (Adams *et al.*1988)	Inland Freetail-bat (short penis)	P		✓		
Molossidae	*Mormopterus* species 4 (long penis form) (Adams *et al.*1988)	Southern Freetail-bat (long penis)	P		✓		
Molossidae	*Nyctinomus australis*	White-striped Freetail-bat	P		✓		✓
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	✓		
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	P		✓		✓
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	P		✓		
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V		✓		
Vespertilionidae	*Miniopterus schreibersii oceanenis*	Eastern Bent-wing Bat	V		✓		
Vespertilionidae	*Myotis adversus* (taxonomy revised to *Myotis macropus*)	Large-footed Myotis	V		✓		
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	P		✓		
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat	P		✓		✓
Vespertilionidae	*Nyctophilus timoriensis*	Greater Long-eared Bat	V	V	✓		
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V		✓		
Vespertilionidae	*Scotorepens balstoni*	Inland Broad-nosed Bat	P		✓		
Vespertilionidae	*Scotorepens orion*	Eastern Broad-nosed Bat	P		✓		
Vespertilionidae	*Vespadelus darlingtoni*	Large Forest Bat	P		✓		
Vespertilionidae	*Vespadelus pumilus* *	Eastern Forest Bat *	P				✓
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	P		✓		
Vespertilionidae	*Vespadelus troughtoni*	Eastern Cave Bat	V		✓		
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	P		✓		✓
Muridae	*Mus musculus* [I]	House Mouse [I]	U		✓		
Muridae	*Pseudomys novaehollandiae*	New Holland Mouse	P		✓	✓	✓
Muridae	*Rattus fuscipes*	Bush Rat	P		✓		✓
Muridae	*Rattus rattus* [I]	Black Rat [I]	U				✓
Leporidae	*Lepus capensis* [I]	Brown Hare [I]	U		✓		
Leporidae	*Oryctolagus cuniculus* [I]	Rabbit [I]	U		✓		✓
Canidae	*Canis lupus* [I]	Dingo/domestic Dog [I]	U		✓		✓
Canidae	*Vulpes vulpes* [I]	Fox [I]	U		✓		
Felidae	*Felis catus* [I]	Cat [I]	U		✓		
Equidae	*Equus caballus* [I]	Horse [I]	U		✓		
Bovidae	*Bos taurus* [I]	European Cattle [I]	U		✓		
Bovidae	*Capra hircus* [I]	Goat [I]	U		✓		

APPENDIX C – FAUNA SPECIES AROUND (BUT NOT WITHIN) NORTH-EASTERN WOLLEMI NATIONAL PARK

Fauna species recorded on the Atlas of NSW Wildlife (as at 21/04/05) within a five kilometre radius of the study area boundary, but not recorded from within the study area.

Note that this area includes parts of Yengo National Park and Putty State Forest.

Family	Scientific name	Common name	NSW Legal Status	National Legal Status
Frogs				
Myobatrachidae	*Adelotus brevis*	Tusked Frog	P	
Myobatrachidae	*Limnodynastes fletcheri*	Long-thumbed Frog	P	
Myobatrachidae	*Limnodynastes salmini*	Salmon-striped Frog	P	
Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E1	V
Hylidae	*Litoria nasuta*	Rocket Frog	P	
Hylidae	*Litoria verreauxii*	Verreaux's Tree Frog	P	
Reptiles				
Scincidae	*Eulamprus heatwolei*	Warm-temperate Water-skink	P	
Scincidae	*Lampropholis amicula*	Friendly Sunskink	P	
Scincidae	*Menetia greyii*	Common Dwarf Skink	P	
Scincidae	*Pseudemoia spenceri*	Trunk-climbing Cool-skink	P	
Typhlopidae	*Ramphotyphlops proximus*	Proximus Blind Snake	P	
Typhlopidae	*Ramphotyphlops wiedii*	Brown-snouted Blind Snake	P	
Colubridae	*Dendrelaphis punctulata*	Green Tree Snake	P	
Elapidae	*Cacophis squamulosus*	Golden Crowned Snake	P	
Elapidae	*Notechis scutatus*	Mainland Tiger Snake	P	
Elapidae	*Pseudechis guttatus*	Spotted Black Snake	P	
Elapidae	*Suta spectabilis dwyeri*	Variable Black-naped Snake	P	
Birds				
Casuariidae	*Dromaius novaehollandiae*	Emu	P	
Anatidae	*Anas castanea*	Chestnut Teal	P	
Anatidae	*Dendrocygna eytoni*	Plumed Whistling-Duck	P	
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe	P	
Anhingidae	*Anhinga melanogaster*	Darter	P	
Ardeidae	*Ardea ibis*	Cattle Egret	P	
Ardeidae	*Nycticorax caledonicus*	Nankeen Night Heron	P	
Accipitridae	*Circus approximans*	Swamp Harrier	P	

Family	Scientific name	Common name	NSW Legal Status	National Legal Status
Accipitridae	*Circus assimilis*	Spotted Harrier	P	
Accipitridae	*Elanus scriptus*	Letter-winged Kite	P	
Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V	
Accipitridae	*Milvus migrans*	Black Kite	P	
Falconidae	*Falco hypoleucos*	Grey Falcon	V	
Falconidae	*Falco subniger*	Black Falcon	P	
Rallidae	*Gallinula ventralis*	Black-tailed Native-hen	P	
Rallidae	*Porzana fluminea*	Australian Spotted Crake	P	
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	P	
Charadriidae	*Vanellus tricolor*	Banded Lapwing	P	
Columbidae	*Lopholaimus antarcticus*	Topknot Pigeon	P	
Columbidae	*Phaps elegans*	Brush Bronzewing	P	
Cacatuidae	*Cacatua sanguinea*	Little Corella	P	
Psittacidae	*Lathamus discolor*	Swift Parrot	E	E
Cuculidae	*Chalcites osculans*	Black-eared Cuckoo	P	
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill	P	
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater	P	
Meliphagidae	*Grantiella picta*	Painted Honeyeater	V	
Campephagidae	*Coracina maxima*	Ground Cuckoo-shrike	P	
Sylviidae	*Megalurus timoriensis*	Tawny Grassbird	P	
Mammals				
Dasyuridae	*Antechinus swainsonii*	Dusky Antechinus	P	
Macropodidae	*Macropus parma*	Parma Wallaby	V	

APPENDIX D – FREQUENCY RANGE OF INSECTIVOROUS BAT CALLS RECORDED IN THE HUNTER RANGE AREA

This table has been compiled by Narawan Williams, based on the analysis of ultrasonic calls recorded during the 2004-05 DEC surveys of the Hunter Range Area.

Key:

The first row for each species shows the frequency range (in kilohertz) of reference calls, recorded during release of bats captured in harp traps.

The second row for each species shows the frequency range (in kilohertz) of calls recorded at anabat various sites. These only includes sequences for which a 'definite' identification was obtained, unless stated otherwise in the notes. The number in brackets next to each frequency range is the total number of call sequences referred to for frequency range sample.

There are notes under each species.

Bat species	**Northern Yengo National Park**		**Eastern Wollemi National Park (California and Commission Roads)**		**Northern Wollemi (Baerami, Hungerford, Martindale & Doyles Creek areas)**		**Manobalai Nature Reserve and Crown Lands**		**Werakata National Park**
Reference call samples followed by analysis result samples.	**Valley floors to lower slopes (6 sites)**	**Mid slopes to ridgelines (7 sites)**	**Valley floors to lower slopes (0 sites)**	**Mid slopes to ridgelines (5 sites)**	**Valley floors to lower slopes (9 sites)**	**Mid slopes to ridgelines (1 site)**	**Valley floors to lower slopes (5 sites)**	**Mid slopes to ridgelines (1 site)**	
Chalinolobus dwyeri				22–25 (1)					
		23-28(2)		21-27 (12)	22-27 (10)		22-27 (5)	22-24 (4)	
Stepped call in good sequence usually between 22- 27 kHz – easy to determine with good sequence.									
Chalinolobus gouldii		28-32 (3) 31-34(3)		29-33(2) 31-33(2)			30-34 (2)		
	29-33(1)	28-33(11)		31-34(2) 29-32 (2)	29-32 (10)	31-34 (2)	28-31(5) 26-30 (2)	28-30 (1)	
Stepped call – one of the easier species to determine.									
Chalinolobus morio		49-51(2)		50-53(3)			49-50(2)		

Bat species	Northern Yengo National Park		Eastern Wollemi National Park (California and Commission Roads)		Northern Wollemi (Baerami, Hungerford, Martindale & Doyles Creek areas)		Manobalai Nature Reserve and Crown Lands		Werakata National Park
		50-52 (4)							
	48-55(7)	47-56 (24)		48-53 (14)	47-57 (25)	49-53 (4)	45-53 (19)	49-54 (4)	49-54 (4)
Call frequencies are variable between call sequences and within call sequence.									
Falsistrellus tasmaniensis		See notes below		35-41(7)	34-38 (1)				
		35-39 (1) 36-39(1)							
Note: All these frequencies are from only probable *Falsistrellus tasmaniensis* results – no definite. This species' calls are generally hard to define against variation in *Scotorepens orion* calls and also *Scoteanax rueppellii.*									
Miniopterus schreibersii oceanensis									
		43-46 (5)		44-46 (12)	43-47 (30)		44-47 (3)		43-44 (3)
Fairly consistent in frequency – the higher numbers in Northern Wollemi are due to this species using mine shafts in Baerami Creek.									
Mormopterus norfolkensis									
		29.5-32 (2)							28-33(1) 30-32(1) 30-34 (1)
Stepped call usually between 31 – 34 kHz. A couple of the calls are below this however there was regular stepping.									
***Mormopterus* sp. 4 (long penis form)** (Adams *et al.*1988)							27-29 (10)		
		24-25 (2)			24-26 (2)		25-29 (9)	25-27 (5)	
The higher frequency range of this species overlaps with other *Mormopterus* species.									
***Mormopterus* sp. 3 (short penis form)**				See notes					

Bat species	Northern Yengo National Park		Eastern Wollemi National Park (California and Commission Roads)		Northern Wollemi (Baerami, Hungerford, Martindale & Doyles Creek areas)		Manobalai Nature Reserve and Crown Lands		Werakata National Park
(Adams *et al.*1988)									
				30-36 (4)					
Notes: This one call was only 'probable'. Other possible calls were not able to be defined as there is known overlap with other *Mormopterus* species.									
***Mormopterus* sp. 2** (Adams *et al.* 1988)		29-32 (1) 28-29 (1)					32-34 (1)		
		27-32 (6)		29-30 (3)	29-32 (8)		28-31(3)		28-32 (15)
Most pulses flat and at the lower frequency with occasional step (the higher frequency). There is overlap in frequency with other *Mormopterus* species.									
Nyctophilus geoffroyi		30-34 (1)					38-43 (1) 43-46 (2)		
Could not define between other *Nyctophilus* species.									
Nyctophilus gouldi		38-45 (5)		28-39 (1) 36-43 (5)					
Could not define between other *Nyctophilus* species.									
Nyctophilus timoriensis									
No reference calls. Could not define between other *Nyctophilus* species.									
***Nyctophilus* species**	40 (1)	40-45 (2)		38-43 (6)	41-48 (11)		39-44 (8)	43-46 (3)	
Rhinolophus megaphyllus									
	65-67.5 (3)	66.5 – 67 (5)		66-68 (2)	64-68 (14)			66 (1)	
A very distinctive call at fairly consistent frequency.									
Saccolaimus flaviventris									

Bat species	Northern Yengo National Park		Eastern Wollemi National Park (California and Commission Roads)		Northern Wollemi (Baerami, Hungerford, Martindale & Doyles Creek areas)		Manobalai Nature Reserve and Crown Lands		Werakata National Park
							17.5 (1) 21 (1)		
Call frequency and characteristics within normal range for this species.									
Scoteanax rueppellii				37-40 (2)					
					32-34 (2)				
Call often hard to define against *Scotorepens orion* and *S. balstoni* unless a good call sequence is recorded.									
Scotorepens balstoni							32-35 (5)		
	31-32 (1)	32 (1) Probable		32-34 (2)	31-35 (10)		32-35 (11)		
Most often call frequency was around 31- 33 kHz. The higher frequency of this species overlaps with *Scotorepens orion*.									
Scotorepens orion				35-36 (3)					
		34-39 (12)		34-36 (2) 35 – 38(4)	34-38 (7)				
Calls can overlap with *Scoteanax rueppellii* and *Falsistrellus tasmaniensis*.									
Tadarida australis									
	11-12 (2)	11 (2)		11-20 (3)	10-15.5 (9)		10-15 (7)		9.5-12.5 (3)
Standard frequency around 10 –12 kHz.									
Vespadelus darlingtoni				41-45 (6)					
		42-45 (9)		41-44 (9)	42-45 (6)				
Calls were at expected frequency range and characteristics.									

Bat species	Northern Yengo National Park		Eastern Wollemi National Park (California and Commission Roads)		Northern Wollemi (Baerami, Hungerford, Martindale & Doyles Creek areas)		Manobalai Nature Reserve and Crown Lands		Werakata National Park
Vespadelus troughtoni	See notes								
No Reference calls from area. Overlaps with *Vespadelus vulturnus*.									
Vespadelus vulturnus		49-52 (12) 52-55 (7)		49-52 (4) 51-54 (8)			45-48 (1) 47-50 (15) 49-52 (7)		
	48-50 (2)	51-54(1) 49-53 (11)		48-53 (7)	47-53(23)		46-50 (3) 47-52 (2)	46-51 (4)	
It appears that the call frequency is generally lower in the Valley floors and Manobalai NR which fits the general expected trend for this species.									