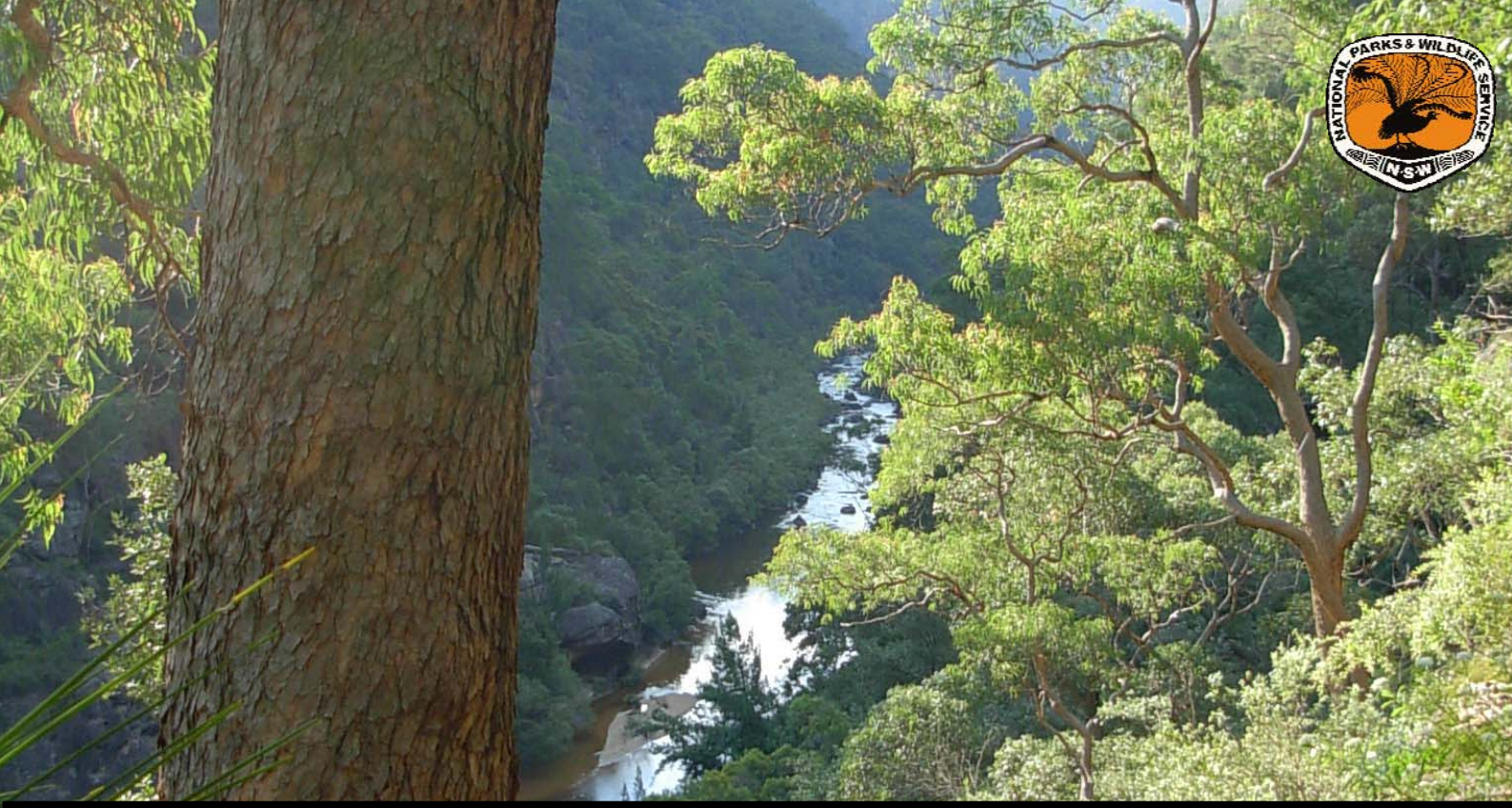

The Vertebrate Fauna of South-eastern Wollemi National Park

Department of **Environment & Climate Change** NSW

THE VERTEBRATE FAUNA OF SOUTH-EASTERN WOLLEMI NATIONAL PARK

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Cover Photos

Front cover
Feature Photo: Looking onto the Colo River: N. Williams
Gould's Long-eared Bat: N. Williams
Ironbark Forest: E. Magarey
Blue Mountains Tree Frog: N. Williams
Hanging Swamp: N. Williams

Back cover
Eastern Water Skinks: N. Williams
Fringe-lily: E. Magarey
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OVERVIEW

South-eastern Wollemi National Park (NP) comprises approximately 80 000 hectares of land within the catchment of the Colo River, north-west of Sydney. This report compiles Atlas of NSW Wildlife data on the terrestrial vertebrate fauna of this area and documents the extensive systematic surveys undertaken by the Department of Environment and Climate Change in 1997-98 and 2007-08. A total of 164 systematic survey sites have sampled birds, frogs, reptiles and mammals. This is the first time that a thorough inventory of all vertebrate fauna within south-eastern Wollemi NP has been compiled, and is the third of four stages of survey and review of fauna across the whole of Wollemi NP. Some key findings are summarised below.

- 266 native terrestrial vertebrate fauna species inhabit south-eastern Wollemi NP, including 25 frogs, 44 reptiles, 150 birds and 47 species of mammal. In addition, the Dingo, ten introduced mammals and one introduced bird species have been detected.
- The 2007-08 surveys confirmed the presence of twenty-three threatened fauna species, of which ten are considered to be a high priority for management. These are the Brush-tailed Rock-wallaby, Broad-headed Snake, Brown Treecreeper, Black-chinned Honeyeater, Spotted-tailed Quoll, Turquoise Parrot, Koala, East-coast Freetail-bat, Large-footed Myotis and Littlejohn's Tree Frog. Eight additional threatened species have previously been recorded, of which one, the Booroolong Frog, is presumed to be locally extinct and two, the Stuttering Frog and Regent Honeyeater, have not been recorded for some time, raising doubts about their persistence in the study area.
- Sandstone sclerophyll forests and woodlands dominate much of the study area, reflected in the abundance of typical sandstone species such as Dark-flecked Garden Sunskink, Spotted Pardalote, White-throated Treecreeper, Sugar Glider and Little Forest Bat. Most of the fauna species occurring in these habitats are well represented in the regional reserve system. The deep gorges that incise the sandstone plateau support tall forests and in the south near Kurrajong there are well developed stands of coastal and hinterland warm temperate rainforest. A number of species such as the Three-toed Skink are restricted to these sheltered environments, while the rainforests provide habitat for several threatened species including Stuttering Frog, Sooty Owl, Spotted-tailed Quoll and Powerful Owl. The incised sandstone plateau supports a large number of Koalas and together with neighbouring parks conserves one of the largest expanses of protected habitat for this species in the northern half of the Sydney Basin. Hanging Swamps occur in some of the narrow gully heads and cliff edges in the south of the park, supporting a distinct assemblage of birds and habitat for several threatened frog species including Littlejohn's Tree Frog.
- The north-eastern edge of the study area includes part of the Mellong Plateau, a gently undulating landscape dominated by sandy valleys that support low open woodlands which are occasionally grassy and interspersed with swampy areas. Several threatened species occur in this landscape, including Grey-crowned Babbler, Turquoise Parrot, Brown Treecreeper, Squirrel Glider and Broad-headed Snake. Pest species are also abundant on the Mellong Plateau, with Deer, Pig, Goat and Cattle together likely to be having a significant impact on threatened fauna and therefore a high priority for monitoring and control. Frequent fire is another issue on the Mellong Plateau that requires careful management.
- The northern boundary of the study area adjoins the Putty Valley, an area where wide alluvial valleys support tall grassy forests and Narrabeen Sandstone hills are dominated by Ironbarks and Grey Gums. These environments in the vicinity of Long Weeney, Putty and Wollemi Creeks provide habitat for several declining woodland species as well as East-coast Freetail-bat and Greater Broad-nosed Bat. Several threatening processes also operate within these environments including Cattle grazing, possibly disturbance by Feral Pigs, clearing and loss of hollow bearing trees. Management of these habitats will confer a proportionately high return for conservation of biodiversity in the park.
- The Colo River was accessed by raft for the surveys, leading to the discovering of water dependant species like Platypus and Water-rat. Several animals associated with rocky escarpments and overhangs were recorded, including roosts of Eastern Cave Bat and Eastern Bentwing-bat and two locations of Brush-tailed Rock-wallaby. The Colo River escarpments, and escarpments and boulder slopes along tributary creek lines, provide a regionally significant refuge for the Brush-tailed Rock-wallaby.
- The systematic fauna surveys have revealed the preferred habitat of many fauna species, however some species remain poorly understood. Further surveys are recommended for Brush-tailed Rock-wallaby and Stuttering Frog to determine the current status of, and threats to, these species. The results of such surveys would directly lead to active site management.

This project has identified numerous threatened species, highlighted key areas for threat abatement, set priorities for future land acquisition, suggested focus areas for community awareness and involvement, and provided key recommendations for further targeted survey and monitoring. The data collected for this project will later be used to model habitat for threatened species across the northern Sydney region.

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1 INTRODUCTION

1.1 PROJECT RATIONALE

In 2003 the Central Branch of the Parks and Wildlife Group of the NSW Department of Environment and Climate Change (DECC) established a biodiversity survey priorities (BSP) program for DECC managed estate within the Branch. This program recognises that information which documents the 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. Prior to establishment of the program there was only sparse and incomplete information that described 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, have been 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 work with larger regional conservation assessment projects.

Knowledge of the biodiversity values of the large sandstone reserves that border the western rim of the Sydney Basin is fundamental to understanding the conservation priorities for many species. In 2003 Wollemi National Park was recognised as having a relatively small amount of information on its fauna values (NPWS 2003a) and hence as a priority for wildlife survey. The northern section of Wollemi National Park was the subject of study in 2004-05 (Hunter Range Area, DEC 2005a) and 2005-06 (Mudgee Area, DEC 2007a). South-eastern Wollemi (Hawkesbury Area) was the next priority and the focus of this study in 2007-08.

1.2 PROJECT AIMS

The primary objectives of the surveys were to:

- Undertake a review of previous systematic fauna survey effort across the study area and identify gaps for particular fauna groups, habitats or areas.
- Undertake field sampling of terrestrial vertebrate fauna groups to fill the gaps identified above using systematic, replicable techniques to establish a baseline data set.
- Store this systematic survey data in corporate databases to make it accessible to land managers and the broader community for use in conservation planning and biodiversity monitoring.

The specific objectives of this report are to:

- Document the methodology of the survey techniques applied.
- Collate, review and document information on the terrestrial vertebrate fauna of the study area, bringing together results of the current survey with those of previous studies to provide a current species inventory.
- Identify broad-scale patterns in fauna occurrence and habitat use across the study area and identify habitats of particular conservation significance.
- Identify and profile threatened fauna species, pest species, and regionally significant fauna that are known or likely to occur.
- Identify priorities for conservation and management of fauna in the study area.

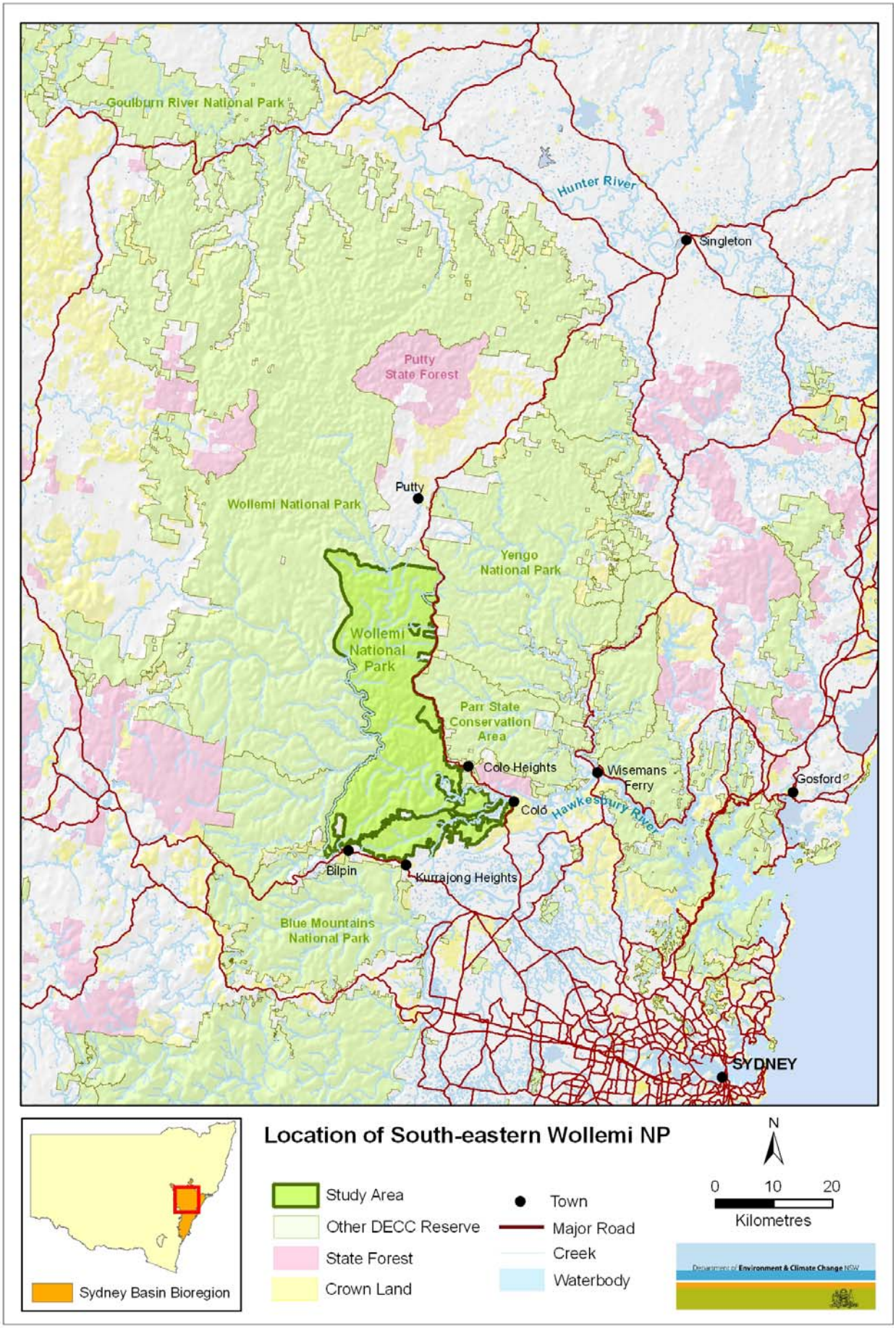
1.3 STUDY AREA

1.3.1 Location and context

Wollemi National Park covers an extensive area of dissected sandstone plateaux between the Hawkesbury River and the Hunter Valley. The section examined for the third stage of the Wollemi fauna survey project is the DECC Hawkesbury Area, located in the south-eastern corner of the park. The study area encompasses just under 80 000 hectares of land and is located approximately seventeen kilometres north-west of Windsor and 60 kilometres north-west of Sydney city centre. The area extends from the southern boundary of the park, running roughly along Bells Line of Road and the edge of the Cumberland Plain, north to the Wirraba Range. The eastern boundary of the study area follows the Putty Road, though several holdings of private land indent into the park. The western boundary is formed by the gorge of Bowens Creek and then the Colo River. From the junction of the

Colo and Capertee Rivers it runs north along the Wollemi Range. The entire study area lies within the catchment of the Colo River, a tributary of the Hawkesbury.

The study area is located within a large system of protected areas that run around the western rim of the Sydney Basin preserving the sandstone-based links between the Sydney, Hunter and Central West regions of New South Wales. To the east lies Yengo National Park and Parr State Conservation Area, to the north and west continue the remainder of Wollemi National Park and to the south-west, beyond the settlements along Bells Line of Road, lays the Blue Mountains National Park (Map 1). The study area is part of the Greater Blue Mountains World Heritage Area, and the section north of Tootie Creek and west of Angorawa Creek is part of the declared Wollemi Wilderness Area.



Map 1: Location of study area and surrounding conservation areas

1.3.2 Biogeography, geology, geomorphology and soils

The study area lays roughly in the centre 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 (inset Map 1). The Bioregion is characterised by a temperate climate with warm summers and no dry season (NPWS 2003b). The study area lies on the Blue Mountains Plateau, which occupies a large portion of the western Sydney Basin. A small portion of the eastern edge of the park is part of the Mellong Plateau, a structural anomaly located between the Blue Mountains and Hornsby Plateaux.

The geology of the study area is characterized by sedimentary strata of Triassic Age. The oldest exposed rock stratum is the Narrabeen Series, comprised primarily of quartz-lithic sandstone but also holding bands of fine-grained shale (Sanders *et al.* 1988). This Series is visible along most gullies and river valleys, most spectacularly along the Colo River gorge where jointing in the sandstone, together with the presence of soft claystone beds, has allowed the water to cut almost vertical cliffs (Gold and Prineas 1978). This series has been observed to be highly variable in the field (Sanders *et al.* 1988) particularly where large bands of shale occur. Varying combinations of shale and sandstone influences the resultant soil properties within the Narrabeen series.

Hawkesbury Sandstone, which overlies the Narrabeen Series, is the predominant geological type on upper slopes and ridges of the study area, particularly in the east and south. These coarse-grained quartz sandstones include some minor shale lenses, though these are less frequent and usually much thinner than those associated with the Narrabeen Series (Sanders *et al.* 1988). The siliceous soils derived from Hawkesbury Sandstone are some of the poorest soils in the world (Gold and Prineas 1978).

A small amount of Mittagong Formation sediments can be found as residual cappings above the Hawkesbury Sandstone. This stratum is poorly mapped in the region, often because the size of residual capping is too small to be delineated at the scale of current soil and geology mapping. Mapped cappings occur in close association with shales of the Wianamatta Group and mostly right on the park boundary, including around Mount Tootie, north of the Bells Line of Road, ridgelines in the south-eastern corner, and patches west of Putty Road. The Mittagong Formation sediments form thin layers of fine-grained iron rich sandstone and lenses of dark shale (McInnes 1997). The derived sandstone soils are slightly enriched by the eroded clay material.

Most of the Wianamatta group of rocks that were laid down extensively during the Triassic period (Gold and Prineas 1978) have been eroded away, leaving only very small patches. The sedimentary rock is comprised of a dark grey to black claystone-siltstone and laminite (Herbert 1980) that weathers to a moderately fertile soil suitable for agriculture. Within Wollemi National Park itself only tiny, thin patches of shale occur, such as along Culoul Range and at Bowen Hill. The Wianamatta group is more extensive adjacent to the park including at Mountain Lagoon, around the base of Mount Tootie, and on private lands north of Bells Line of Road. This geology often merges with that of the Mittagong formation and underlying sandstone, forming shale – sandstone transition soils.

Tertiary aged rocks are much less of a feature here than in northern Wollemi National Park. Mount Tootie and Little Tootie are Basalt caps that occur on private inholdings in the south-west of the study area, while the only mapped cap within the park itself is towards the western end of the Culoul Range Track. Diatremes, which form as extinct volcanic vents, erode away faster than the surrounding sandstone into which they were intruded, have not been accurately mapped within the study area, but field traverses have shown that a small number do occur. We were not the first to discover these diatremes however, as the richer soils derived from volcanic rocks support palatable grasses which were sought by early settlers and quickly cleared for agriculture.

The other major geological types in the study area are alluvial deposits, consisting mainly of deep sand. Quaternary Alluvium occurs along the lower reaches of the Colo River and Wheeny Creek, primarily outside the park boundary in the vicinity of Upper Colo and downstream to the Hawkesbury River. These comprise a mix of unconsolidated sands, silts, clays and gravel (McInnes 1997). The deep alluvial soils tend to have a moderate to high fertility, derived from accumulation of organic matter.

Alluvial deposits also occur in the Mellong Plateau, where deep sands have accumulated over a clay sub-soil layer (Henry 1988). The alluvial material here is sandy, derived from the surrounding

sandstone ranges, and may reach up to 10 metres in depth (Henry 1988). It forms flat wide valley floors that are occasionally poorly drained (McInnes 1997). The soil properties and low relief produce a pattern strikingly from the surrounding landscape. Creek lines to the south-west of the Mellong Plateau, such as Angorawa Creek, are also dominated by deep sandy soils, though these gullies are more incised than the plateau itself.

In the south of the study area there are a number of hanging swamps found on the sides of hills and at higher elevations. These hanging swamps are formed by water percolating through the porous sandstones from ridge tops meeting with impervious bands of shale or claystone which block the downward movement of water and causes it to flow horizontally along these layers and emerge on the surface (Pickett and Alder 1997).

1.3.3 Elevation

Most of the area lies between 300 and 500 metres above sea level (asl). The lower reaches of Wollemi Creek and the Colo River run below 200 metres asl, with the Colo dropping almost to sea level where it exits the park near Upper Colo. The spines of D'Arcy, Culoul, Wollemi and Wirraba Ranges lie above 500 metres asl, with the south-western corner around Mount Tootie and Bowen Hill, the centre of the Culoul Range, and peaks on the Wollemi and Wirraba Ranges the only locations that reach above 600 metres asl.

1.3.4 Climate

The climate of south-eastern Wollemi National Park is typical of the Sydney Basin hinterlands at moderate elevations. The Culoul Range marks a shift in rainfall patterns between the northern and southern section of the study area. The southern half of the study area receives similar rainfall patterns to the upper Blue Mountains, averaging between 1000 and 1250 millimetres of rain per year. North of the Culoul Range is drier, dropping down to an average of 750 millimetres of rain per year along the southern edge of the Putty Valley. Seasonality of rainfall is generally consistent across the Park, with the highest falls occurring between January and March, and the lowest in July and August (Bureau of Meteorology cited in Bell 1998).

Mean annual temperatures are directly related to elevation, with an annual average of 19 to 20 degrees Celsius along the Culoul, Wollemi and Wirraba Ranges and generally south of the Colo River, and averages above 20.5 degrees Celsius in the lower elevation north-eastern corner of the study area. The coolest section of the study area is in the vicinity of Mount Tootie, Little Tootie and Bowen Hill, averaging a maximum of 18 to 19 degrees Celsius and a minimum of 1.5 degrees Celsius (DECC climate data).

1.3.5 Vegetation

Concurrently with the 2007-08 wildlife surveys, a project was undertaken to describe and map the vegetation of south-eastern Wollemi NP. This will result in the production of a detailed vegetation map (available in hard copy and as a GIS layer) and a corresponding report profiling each of the vegetation communities (DECC in prep.). These documents will provide detailed discussion of the vegetation of the study area and should be read in conjunction with this report to gain an understanding of the relationship between flora and fauna of the study area.

As the revised vegetation mapping for south-eastern Wollemi NP is not currently complete, this report utilises the mapping of Bell (1998) and the vegetation communities described for the study area therein.

1.3.6 History of land use

The study area has a long history of Aboriginal habitation. The northern section is part of country that forms the territory of the Darkinjung people, while the area south of the Colo River is associated with the Daruk people. Numerous Aboriginal art sites are located in the study area, but uses of natural resources are not well documented. The writings of Parr and a few other explorers suggest that there were a large number of people living in the area in 1817, who had until then been little affected by Europeans (Macqueen 2004). The well-watered and fertile environments, such as along the lower reaches of the Colo River and around the Mellong Swamps (Macqueen 2004), would have been extensively used, with the remote and rugged sandstone environments likely to primarily provide temporal resources, sites of spiritual and cultural significance, as well as passage routes for trading and travel. Many Aboriginal place names are in use today, including Colo, Weeney, Mellong, Angorawa, Wirraba, Putty and of course Wollemi, amongst others (Macqueen 2004).

European exploration and settlement was constrained by the rugged terrain and poor soils that occur over much of the study area, with opportunities for settlement largely limited to the more fertile lands, being either outcroppings of basalt or shale or alluvial flats. Upper Colo was one of the first parts to be settled (Gold and Prineas 1978), due to its proximity to the Hawkesbury Valley. The Bells Line of Road was established in the early 1800s and in the late 1820s land west of Bilpin was allocated by lot as soldier settlements, and though extensive clearing was undertaken many veterans abandoned their holdings due to the poor condition of the road (Gold and Prineas 1978). Construction of the Putty Road began in 1817, eventually reaching Singleton in the 1940s (Bell 1998), opening up patches of fertile land that were utilised for agriculture around Colo Heights, the Mellong, Howes and Gibba Swamps and Long Weeney Creek. Mountain Lagoon was discovered by Europeans in 1830 (Gold and Prineas 1978). Though most of these agricultural areas remain under private ownership outside of the park, evidence of previous agricultural activities on marginal lands is present within the current reserve boundary, primarily along alluvial flats such as Culoul Creek and Long Weeney Creek, through the grassy woodlands of the Mellong Plateau, and in small diatremes such as that near the headwaters of Little Angorawa Creek.

Timber getting occurred in the Putty area and west of Wollemi Creek, possibly dating back to the 1930s (NPWS 1997). Isolated logging activates also occurred on both Grassy and Culoul Ranges and on most of the creek systems east of the Colo River including Hungryway, New Yard and Angorawa Creeks (NPWS 1997). Elsewhere selective harvesting for saw logs and pit props had a relatively low impact on the vegetation (NPWS 1997). Logging has not occurred within Wollemi National Park since its declaration.

Land use on neighbouring lands currently includes: orcharding along Bells Line of Road; Cattle grazing and some orcharding around Mount Tootie; the outskirts of the greater Sydney urban area around Blaxlands Ridge; small agricultural properties in the Upper Colo area including some Cattle grazing, Horse riding and a recreational camp; a timber mill just north of Colo Heights township; a Deer farm north of Tinda Creek; and larger rural properties on the southern edge of the Putty Valley that support a variety of activities including Cattle grazing.

Plate 1: Cattle grazing is one of the landuses on properties adjacent to south-eastern Wollemi NP © E. Magarey/DECC

1.3.7 Wildfire history

Little information is available on fire history prior to 1957, though it is sure that fire has long been a regular feature of Wollemi National Park and surrounding environments. Comprehensive records have been compiled and kept since 1975. In the last 20 years almost the entire study area has burnt once, with parts burnt twice and the areas northwest of Colo Heights, between Angorawa Creek and the Putty Road, and between Tari and Tinda Creeks on the Mellong Plateau having burnt three to four times (DEC 2005b). The most recent wildfire in the study area occurred in November 2006, burning the north-eastern corner of the study area between Putty and Tinda Creeks. Prior to this the north-western corner, between Dumball Creek and the Culoul Range burnt in the summer of 2002-03 and the central section between the Culoul Range and the Colo River as well as north-west of Blacksmiths Creek burnt in the summer of 2001-02. Small sections of the catchment of Wollemi Creek and that of Blacksmiths Creek have not been burnt by wildlife since 1979-80. Due to characteristics of elevation, slope and aspect the study area as a whole is rated as having the greatest potential to carry fire in the whole of Wollemi National Park, though this risk is not as great as in neighbouring Yengo National Park (DEC 2005b).

1.4 PROJECT TEAM

This project was instigated and managed by the Information and Assessment Section, Metropolitan Branch, Environmental Protection and Regulation Group, Department of Environment and Climate Change NSW. Funding was provided by the Central Branch, Parks and Wildlife Group, Biodiversity Survey Priorities Program. Elizabeth Magarey and Daniel Connolly were primarily responsible for the management of this project. Elizabeth Magarey undertook field survey planning and logistics, report writing and map production. 2007-08 (BSP) field surveys were undertaken by Narawan Williams, Elizabeth Magarey, Martin Schulz, George Madani and Clive Heywood Barker, with assistance provided by James Dawson, Natalie Izquierdo, David Monahan, Fluer Nash and Paul Glass. Staff of the Hawkesbury Area provided assistance in planning and logistical support. Kerry Oakes designed the report cover and formatted the report.

2 METHODS

2.1 PRE-EXISTING FAUNA DATA

2.1.1 Major sources of non-systematic records

The Atlas of NSW Wildlife is the state's major fauna database and was the primary resource used to access existing data on the fauna of the study area. Sightings have been entered into the Atlas over several decades. Opportunistic records within the Atlas of NSW Wildlife derive from observations made by: park rangers and field officers; bushwalkers and naturalists; scientific researchers working in the area; neighbouring landholders and other visitors to the park; and the specimen register of the Australian Museum. These records have various levels of reliability depending on the type of observation, as well as the certainty and identification experience of the observer.

In addition to the above, several dedicated surveys have been undertaken, either on a small scale or for particular fauna groups or species. The known surveys are summarised below.

- Bird surveys by the Royal Australian Ornithologists Union (RAOU) (undertaken between 1977 and 1981; Blakers *et al.* 1984) and by Birds Australia (undertaken in 1999 and 2000; Barrett *et al*. 2003). RAOU data is at a coarse spatial scale and there is no guarantee that all or even any of these sightings actually occurred at the given point locality. Consequently, some of this bird data presents a misleading picture of the species composition of the study area. Five point localities for these surveys lie within the study area. Most of the records collected by Birds Australia have a higher degree of spatial accuracy and are more useful for the purposes of this project. Birds Australia observations were made along major roads, including Putty Road, Comleroy Road and Bells Line of Road.
- Surveys for Stuttering Frog undertaken over the summer of 1999-2000. These involved call playback and passive listening undertaken at fourteen locations, with sites primarily located south of Culoul Range Firetrail and concentrated along Tootie Creek and Wheeny Creek.
- Fauna survey of the Newnes Plateau and Colo River Area by the Australian Museum in 1979. This survey involved Elliott trapping for small mammals, cage trapping for larger mammals, mist netting for bats, bird census, pitfall trapping and spotlighting. Within south-eastern Wollemi NP the survey area extended from the junction of Pinchgut Creek and the Colo River east through the catchment of Dooli Creek to the Putty Road, and north up the Colo River along Wollemi Creek. Much of the data collected was entered into the Australian Museum database and hence is contained within the Atlas of NSW Wildlife.
- Surveys for feral animal species undertaken by the Hawkesbury Area of DECC, with a focus on Pig and feral Deer particularly on the Mellong Plateau. Surveys have included aerial counts, searches for tracks and traces and observations made during control programmes. Much of this data has not been entered into the Atlas of NSW Wildlife.

Plate 2: Some surveys for Stuttering Frog were undertaken in the study area in 1999-2000, but failed to locate this Endangered species © N. Williams

2.1.2 Systematic fauna survey data

Prior to the current study one project had included implementation of systematic fauna survey techniques in south-eastern Wollemi NP (Table 1, see Section 2.3 for technique description).

Table 1: Systematic fauna survey effort prior to July 2007

	Diurnal bird survey	Diurnal herpetofauna	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Hair tube sampling	Transect spotlighting survey	Number or records stored in Atlas	Locations of sites	Timing of Survey
Comprehensive Regional Assessment Surveys	22	22	5	13	23	11	29	3	15	9	1385	Mellong Plateau, Wollemi Creek, Culoul Range, Dooli Creek, Mountain Lagoon Area	March 1997 to February 1998

2.2 SURVEY STRATIFICATION AND SITE SELECTION

The aim of the 2007-08 fauna survey was to proportionately sample the full range of habitat types contained within south-eastern Wollemi National Park. The primary surrogate used for habitat type was a stratification grid that was created to incorporate the following biotic and abiotic variables: parent geology/soil type; aspect; elevation; landscape position; broad vegetation structure. The classes used for each variable are presented in Table 2. The stratification grid was used to undertake a gap analysis of previous systematic fauna survey effort, and to identify strata that had not been previously sampled, or had been undersampled in proportion to the area they occupy within the park. The strata identified in this gap analysis were prioritised for sampling. In addition to the stratification, the distributions of existing survey sites and fauna sightings across the study area were examined to identify 'spatial gaps' in fauna knowledge. The selection of sites within specific strata was prioritised towards filling large spatial gaps in fauna data wherever possible.

Table 2: Classes used for stratification of study area

Parent geology/Soil type	Aspect	Elevation	Landscape position	Broad vegetation structure
• Narrabeen Sandstone • Hawkesbury Sandstone • Basalt • Shale Sandstone Transition • Hanging Swamp • Alluvium • Wianamatta Shale • Mittagong Sandstone • Sandstone Colluvium • Shale Cap • Tertiary Sand	• Exposed • Sheltered • Intermediate • Flat	• Greater than 600 metres above sea level • Less than 600 metres above sea level	• Gully • Not a gully	• Woodland • Rainforest • Tall forest • Heathland • Hanging Swamp • Impeded Woodland

Sites were initially selected using ArcMap 9.1, utilising the stratification layer in combination with topographic maps. Proposed site locations were then ground-truthed to ensure that they were representative of the intended stratum, had been minimally affected 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.

Appendix A provides the specific AMG and survey techniques undertaken at each survey site, while Map 2 shows the placement of sites across the study area. The tables and map include all systematic surveys undertaken within the study area by DECC between 1997 and 2008 (i.e. during both CRA and BSP programs).

2.3 SURVEY TECHNIQUES

The systematic fauna survey methods used were based on those developed by the NPWS Biodiversity Survey Coordination Unit (NPWS 1997). 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 DECC 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. 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 (usually in the early morning) and reasonable detectability (e.g. low wind and cicada activity). Almost all surveys were undertaken in spring and summer. All bird species and the abundance of individuals seen or heard were recorded. Individuals were scored as on-site if they were detected within the two 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 (50 by 100 metre) area 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

Plate 3: Active searches for reptiles included searching rock crevices © N. Williams/DECC

other likely shelter sites. Incidental observations of other fauna were also recorded.

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 creek lines 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, and then moved elsewhere. A 40 kilohertz calibration tone was recorded for a few seconds at the start and end of each recording session.

Plate 4: With the help of the Friends of the Colo a kayak trip was undertaken along the Colo River to enable systematic suvey in more remote sections of the reserve © J. Cotterell

Anabat recordings were transferred onto computer and analysed by Narawan Williams, a recognised expert in this field. Troublesome calls were further verified by Michael Pennay. 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 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, Masked Owl, Sooty Owl and Barking Owl - 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.

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, Fox, Dingo, Wild Dog and Pig. 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 head torch for animals such as cave-roosting bats, geckos and nesting birds.

Call playback for Stuttering Frog

A small number of targeted surveys for Stuttering Frog were undertaken on an opportunistic basis. The surveys included playing a pre-recorded compact disc of the species' call series, amplified through a megaphone, for five minutes followed by a ten minute listening period. These surveys were undertaken in potential rainforest habitat in sheltered gullies in the far south of the study area.

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 under-sampled 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

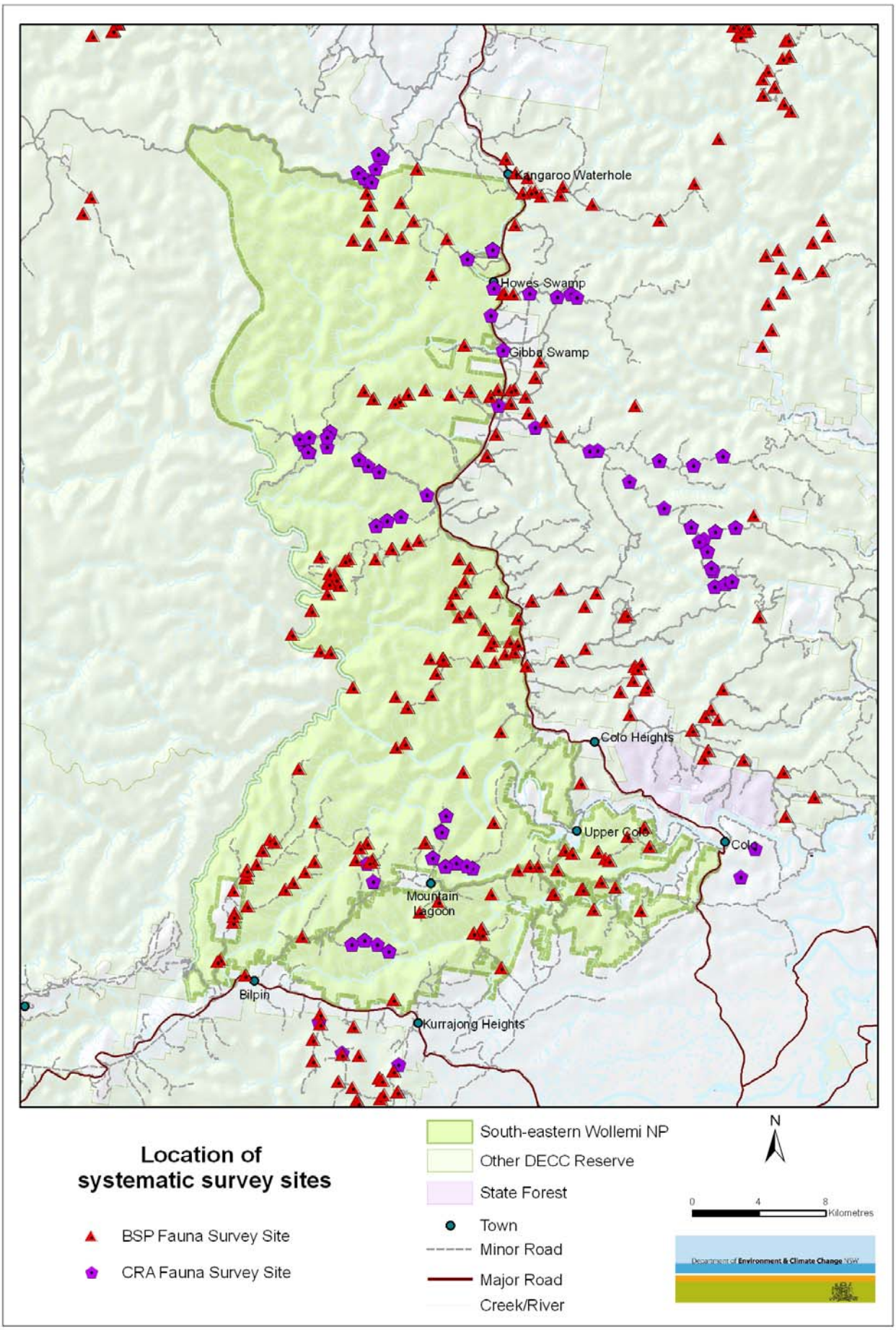
Table 3 summarises the timing of the 2007-08 BSP surveys and the techniques that were undertaken in each period.

Table 3: Timing of BSP 2007-08 systematic fauna surveys within south-eastern Wollemi NP

Survey program	Timing	Techniques employed
Biodiversity Survey Priorities Year 5 (BSP)	September – December 2007	Diurnal bird census, reptile search, site spotlighting, all night bat call detection, harp trapping, nocturnal call playback, nocturnal streamside search, Elliott trapping, pitfall trapping, opportunistic methods
	May – June 2008	Nocturnal call playback, opportunistic methods.

2.5 SURVEY SITE LOCATIONS

For the 2007-08 project, DECC established and surveyed 132 systematic survey sites. Map 2 shows the location of these survey sites, together with the 32 systematic survey sites established during the CRA surveys. A breakdown of sites by technique type and vegetation type is presented in Table 4. Appendix A provides the specific AMG and the survey techniques undertaken at each site.



Map 2: Location of systematic fauna survey sites in south-eastern Wollemi NP

Table 4: Vegetation types currently mapped within south-eastern Wollemi NP and corresponding allocation of systematic fauna survey effort as at July 2008

Vegetation Type (Bell 1998)	Area (hectares)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Hairtube detection
Hawkesbury Sheltered Dry Forest	17969	18	15	12	8	9	1	16	1	5
Narrabeen East-Wollemi Sheltered Dry Forest	9899.4	9	7	4	3	3	1	3		1
Narrabeen Sheltered Bluegum Forest	9642.4	17	15	7	7	8	7	7	1	1
Narrabeen Wollemi Woodland Complex	8879.9	6	4	1		3		4		2
Hawkesbury Mt Lagoon Exposed Woodland	8114.9	5	5	4	6	6	1	5	2	1
Hawkesbury Hornsby Plateau Exposed Woodland	7955.7	6	5	5		3		2		
Mellong Sandmass Dry Woodland	4692.2	6	6	2	2	5	2	6	2	1
Hawkesbury Arid Exposed Woodland	3827.5	1	2	1	2	1		3		
Narrabeen Wollangambe Woodland Complex	2825.8	3	3	1	2	1		1		
Narrabeen Goulburn Valley Exposed Woodland	2800.9	3	4	1		1		1		
Sandstone Gorge Warm Temperate Rainforest	1368.3	3	2	2	2	2	2	1	1	1
Remnant Shale Cap Forest	537.4	5	4	1	2	6		5		3
Mellong Sandmass Sedgeland	280.7	2	2	1	1	2	2	2		
Freshwater Melaleuca Swamp Forest	254.1	2	2	3	2	1		2	1	

Vegetation Type (Bell 1998)	Area (hectares)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Hairtube detection
Mellong Sandmass Alluvial Woodland	210.9					1				
Agricultural	206.7	1		1						
Water	189.5							1		
Narrabeen Blue Mountains Sedgeland	100	1	1							
Mellong Sandmass Swamp Woodland	90.6							2		
Cleared	88									
Culoul Residual Basalt Cap Forest	58.9									
Narrabeen Upper Cudgegong Sandslope Woodland	22									
Dry Basalt Cap Woodland	11									
Montane Basalt Diatreme Forest	8.8									
Hawkesbury Comleroy Rocky Heath	8.4									
Sandstone Gorge Dry Rainforest	8									
Moist Basalt Diatreme Forest	1.7									
Total	80 052	88	77	46	37	52	16	61	8	15

3 FAUNA SPECIES INVENTORY AND OVERVIEW OF SURVEY RESULTS

3.1 REVIEW OF PRE-EXISTING FAUNA RECORDS

All records of vertebrate fauna for the study area on the Atlas of NSW Wildlife were reviewed as part of this project. Several records were identified as having a low degree of spatial accuracy, or as potential mis-identifications or database errors. Other species were accurately recorded at the time of survey, but are now considered to be locally extinct. In order to make the species inventory provided in this report as accurate as possible, all species that have only been recorded during the first RAOU survey (between 1978 and 1981) have been excluded. This includes several water-birds for which habitat does not occur in the reserve.

Table 5 provides a list of all species that have been removed from the fauna inventory given in Appendix B of this report, together with the reason for their removal. The species in Table 5 are presented here for reference, as it is possible that some of the species will be confirmed to occur in the study area in the future. This table includes vagrants recorded on one or two occasions, but that would not be residents or regular visitors to the area.

Table 5: Fauna species recorded on Atlas of NSW Wildlife for which there is some doubt about their current occurrence in the study area and that have been removed from the species inventory provided in this report

Scientific Name	Common Name	Reason for omission from species inventory
Mixophyes fasciolatus	Great Barred Frog	Single record from Culoul Range from 1977, however may be a database error as no suitable habitat at that location. Historic sightings made in Kurrajong area (A. White pers. comm.) but no confirmed records from the actual study area. Uncertain whether the species ever occurred within the actual study area, and if so may now be locally extinct.
Litoria aurea	Green and Golden Bell Frog	Undated Australian Museum record from 'Upper Colo'. The species probably once occurred in swamps along the Colo River, but is highly unlikely to currently exist in the study area.
Litoria ewingii	Brown Tree Frog	Undated Australian Museum record from 'Kurrajong Heights'. Study area is outside known range of this frog which has otherwise not been recorded in region. It is likely this record is actually one of several similar species that do occur.
Christinus marmoratus	Marbled Gecko	Gecko from southern Australia which does not occur in region. Misidentification or database error.
Eulamprus heatwolei	Yellow-bellied Water-skink	Single record from CRA but observer uncertain of identification. Unlikely to occur in study area as usually a higher elevation species.
Boiga irregularis	Brown Tree Snake	Single undated Australian Museum record from 'Upper Colo'. May have gone undetected in the study area, though tends to be more coastal in the southern end of its range.
Anas castanea	Chestnut Teal	Records of low spatial accuracy. Suitable habitat limited within reserve proper. May utilise larger creeks in times of flood.
Anas gracilis	Grey Teal	Records of low spatial accuracy. Suitable habitat limited within reserve proper. May utilise larger creeks in times of flood.
Anas platyrhynchos	Mallard	Records of low spatial accuracy. Suitable habitat not present within reserve proper. Introduced species.
Anas rhynchotis	Australasian Shoveler	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Aythya australis	Hardhead	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.

Scientific Name	Common Name	Reason for omission from species inventory
Biziura lobata	Musk Duck	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Cygnus atratus	Black Swan	Records of low spatial accuracy prior to 1981 as well as a single record from Upper Colo just outside park boundary. Suitable habitat not present in reserve proper.
Malacorhynchus membranaceus	Pink-eared Duck	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Podiceps cristatus	Great Crested Grebe	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Poliocephalus poliocephalus	Hoary-headed Grebe	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Anhinga melanogaster	Darter	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Phalacrocorax melanoleucos	Little Pied Cormorant	Records of low spatial accuracy. Suitable habitat not present within reserve proper.
Phalacrocorax sulcirostris	Little Black Cormorant	Records of low spatial accuracy prior to 1981 as well as a single record from Colo just outside park boundary. Suitable habitat not present in reserve proper.
Pelecanus conspicillatus	Australian Pelican	Records of low spatial accuracy prior to 1981 as well as a single record from Upper Colo and Colo just outside park boundary. Suitable habitat not present in reserve proper.
Ardea alba	Great Egret	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Ardea intermedia	Intermediate Egret	Inaccurate spatial reference attached to record. Suitable habitat not present in reserve proper.
Botaurus poiciloptilus	Australasian Bittern	Records of low spatial accuracy prior to 1981. Suitable habitat not present within reserve proper. May be a rare visitor to swamps and lagoons in the lower Colo River area in times of flood.
Bubulcus ibis	Cattle Egret	Records of low spatial accuracy. Suitable habitat not present within reserve proper.
Ixobrychus flavicollis	Black Bittern	Records of low spatial accuracy prior to 1981. Suitable habitat limited within reserve proper. May be an infrequent visitor along major rivers and creek lines, particularly Colo River and its tributaries.
Ixobrychus minutus	Little Bittern	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Platalea flavipes	Yellow-billed Spoonbill	Records of low spatial accuracy. Suitable habitat not present in reserve proper.
Platalea regia	Royal Spoonbill	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Plegadis falcinellus	Glossy Ibis	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Threskiornis molucca	Australian White Ibis	Records of low spatial accuracy. Suitable habitat not present in reserve proper.
Threskiornis spinicollis	Straw-necked Ibis	Records of low spatial accuracy. Suitable habitat not present in reserve proper.
Circus approximans	Swamp Harrier	Records of low spatial accuracy. Suitable habitat not present in reserve proper.
Milvus migrans	Black Kite	Single record from Colo River immediately adjacent to park boundary. Suitable habitat not present in reserve proper.

Scientific Name	Common Name	Reason for omission from species inventory
Falco berigora	Brown Falcon	Records of low spatial accuracy prior to 1981. Unlikely to utilise habitats in the reserve proper, though may fly over the study area.
Falco longipennis	Australian Hobby	Records of low spatial accuracy prior to 1981. Suitable habitat limited in reserve proper.
Fulica atra	Eurasian Coot	Records of low spatial accuracy prior to 1981 as well as a single record from Colo just outside park boundary. Suitable habitat not present in reserve proper.
Porzana fluminea	Australian Spotted Crake	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Porzana pusilla	Baillon's Crake	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Calidris acuminata	Sharp-tailed Sandpiper	Records of low spatial accuracy prior to 1981 as well as a single record from Colo just outside park boundary. Suitable habitat not present in reserve proper.
Gallinago hardwickii	Latham's Snipe	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Tringa stagnatilis	Marsh Sandpiper	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Irediparra gallinacea	Comb-crested Jacana	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Himantopus himantopus	Black-winged Stilt	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Elseyornis melanops	Black-fronted Dotterel	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Erythrogonys cinctus	Red-kneed Dotterel	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Pluvialis dominica	Lesser Golden Plover	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Larus novaehollandiae	Silver Gull	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Columba livia	Rock Dove	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Streptopelia chinensis	Spotted Turtle-Dove	Records of low spatial accuracy. Suitable habitat not present in reserve proper.
Cacatua sanguinea	Little Corella	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Eolophus roseicapillus	Galah	Records of low spatial accuracy. Suitable habitat limited to edges of reserve and not in reserve proper.
Trichoglossus haematodus	Rainbow Lorikeet	Records of low spatial accuracy.
Centropus phasianinus	Pheasant Coucal	Record of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Tyto alba	Barn Owl	Records of low spatial accuracy prior to 1981. Suitable habitat limited in reserve proper.
Climacteris affinis	White-browed Treecreeper	Species of inland Australia. Database error.
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Record of low spatial accuracy prior to 1981. Suitable habitat limited in reserve proper.

Scientific Name	Common Name	Reason for omission from species inventory
Pyrrholaemus saggitatus	Speckled Warbler	Record of low spatial accuracy prior to 1981. Suitable habitat limited to far north of study area particularly Wollemi Creek and Long Weeney Creek catchments as well as parts of the Mellong Plateau. Possible that species persists in the study area in low numbers.
Lichenostomus fuscus	Fuscous Honeyeater	Record of low spatial accuracy prior to 1981. Suitable habitat limited in reserve proper.
Lichenostomus penicillatus	White-plumed Honeyeater	Records of low spatial accuracy. Suitable habitat limited in reserve proper.
Melanodryas cucullata	Hooded Robin	Record of low spatial accuracy prior to 1981. Suitable habitat limited in reserve proper.
Sphecotheres vieilloti	Australasian Figbird	Record of low spatial accuracy prior to 1981. Suitable habitat limited in reserve proper.
Corvus orru	Torresian Crow	Likely database error.
Alauda arvensis	Eurasian Skylark	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Passer domesticus	House Sparrow	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Carduelis carduelis	European Goldfinch	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Lonchura castaneothorax	Chestnut-breasted Mannikin	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Lonchura punctulata	Nutmeg Mannikin	Records of low spatial accuracy prior to 1981. Suitable habitat not present in reserve proper.
Stagonopleura guttata	Diamond Firetail	Records of low spatial accuracy prior to 1981. Suitable habitat limited to far north of study area particularly Wollemi Creek and Little Weeney Creek catchments and parts of the Mellong Plateau. Small possibility that species persists in the study area in low numbers.
Taeniopygia guttata	Zebra Finch	Record of low spatial accuracy prior to 1981. Unlikely to use habitats in the park proper.
Cheramoeca leucosterna	White-backed Swallow	Record of low spatial accuracy prior to 1981.
Petrochelidon ariel	Fairy Martin	Records of low spatial accuracy prior to 1981 and immediately adjacent to park boundary at Kurrajong Heights. Unlikely to use habitats in the park proper.
Pycnonotus jocosus	Red-whiskered Bulbul	Records of low spatial accuracy prior to 1981 and immediately adjacent to park boundary at Bilpin. Unlikely to use habitats in the park proper.
Acrocephalus australis	Australian Reed-Warbler	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Cincloramphus cruralis	Brown Songlark	Records of low spatial accuracy prior to 1981. Unlikely to use habitats in the park proper.
Cisticola exilis	Golden-headed Cisticola	Records of low spatial accuracy prior to 1981. Suitable habitat limited in park proper.
Megalurus gramineus	Little Grassbird	Records of low spatial accuracy prior to 1981. Suitable habitat limited in park proper.
Acridotheres tristis	Common Myna	Records of low spatial accuracy prior to 1981 and immediately adjacent to park boundary. Has potential to invade open woodland in the far north.
Sturnus vulgaris	Common Starling	Records of low spatial accuracy. Has potential to invade open woodland in the far north.
Mormopterus planiceps	Little Mastiff-bat	Species recorded from ultrasonic call near Kings Waterhole during CRA surveys. This genus has since undergone taxonomic revision and been

Scientific Name	Common Name	Reason for omission from species inventory
		split into two species in NSW, one of which is the Southern Freetail-bat, to which this record is likely to belong.
Vespadelus regulus	Southern Forest Bat	One record is a database error and the second record is from ultrasonic call analysis of low reliability. Since the species has not been detected by harp trapping or positively by its call, it has been removed.
Equus caballus	Horse	Single record is a database error. Riders known to ride horses on the eastern side of the Mellong Plateau, but no evidence of Horses have been recorded on the western side to date.

3.2 FAUNA SPECIES INVENTORY

A total of 266 native vertebrate fauna species have accurately been recorded within south-eastern Wollemi NP. This total is comprised of 25 frogs, 44 reptiles, 141 native diurnal birds, 9 nocturnal birds and 47 native mammals. In addition, the Dingo, 10 introduced mammals and one introduced bird species have been detected.

Table 6 presents the total numbers of native, threatened and introduced fauna known to occur within the study area. A complete species list for all terrestrial vertebrate fauna groups is provided in Appendix B.

Table 6: Number of vertebrate fauna accurately recorded within south-eastern Wollemi NP

Total number of native fauna species known to occur	266
Number of species listed as threatened on TSC Act	31
Number of species listed as threatened on EPBC Act	10
Number of introduced mammals	10
Number of introduced birds	1

A total of 240 fauna species were recorded during the 2007-08 BSP surveys, including 13 fauna species not previously recorded on the Atlas of NSW Wildlife. The surveys increased the number of fauna records within the study area by 50%, from 7500 to over 11100.

3.2.1 Amphibians

A total of 25 species of frog are confirmed to have been recorded in south-eastern Wollemi NP, including twelve ground frogs and thirteen tree frogs (Appendix B). The systematic nocturnal streamside searches undertaken between 1997 and 2008 detected ten of these species, while 23 species were recorded during other systematic survey techniques or opportunistically during the survey period. Only three species previously recorded within the park were not detected during the 2007-08 surveys, while two species, Littlejohn's Tree Frog and Stoney Creek Frog, were recorded for the first time.

Plate 5: The Green Tree Frog has declined in the Sydney Basin but was detected at Gibba Swamp and New Blue Gum Creek © N. Williams/DECC

Neither the Stuttering Frog nor the Booroolong Frog were detected during the BSP surveys, which is a significant finding in itself as both of these Endangered species have been recorded from the study area in the past. Habitat for the Booroolong Frog is restricted to larger creek lines in the north of the park, such as Wollemi Creek where they were previously known to occur, but given the rapid declines in numbers and distribution across its range the species is considered highly likely to be locally extinct from the study area. Habitat for the Stuttering Frog is slightly more widespread, occurring within sheltered creek lines south of the Colo River where rainforest is well developed. There is a chance that Stuttering Frog still occurs in more

inaccessible sections of the park, and targeted surveys for the species are recommended. Both of these species will be discussed further in Section 4 of this report.

Of conservation significance was the discovery of Littlejohn's Tree Frog during the BSP surveys, a species listed as Vulnerable under the TSC Act. This species is very rare within the northern half of the Sydney Basin, with its current distribution and conservation status poorly understood. The discovery of tadpoles of this species contributes important information on the species ecology, as will be discussed further in Section 4 of this report. Two other species of frog listed as Vulnerable under the TSC Act occur within the study area, being Red-crowned Toadlet and Giant Burrowing Frog. Both of these species were found to be relatively widespread through south-eastern Wollemi NP, particularly south of the Culoul Range, providing further evidence that they are currently well protected within the sandstone reserve system of the northern Blue Mountains-Hunter Range region. The occurrence of Bibron's Toadlet at several locations, including Gibba Swamp, Culoul Range and Gospers Creek, holds regional significance as this species is thought to have undergone a decline in abundance in the Sydney Basin (Thumm and Mahony 1996). The Green Tree Frog (Plate 5) is another species of uncertain conservation status, with some herpetologists considering it to have declined in some parts of its range. It is now vary rare within the greater southern Sydney region (DECC 2007a). During the BSP surveys this species was recorded for the first time in south-eastern Wollemi NP since the Australian Museum had collected specimens somewhere in the vicinity of Upper Colo many years ago. The species was detected twice just west of the Putty Road, including near Gibba Swamp and near the headwaters of New Blue Gum Creek.

Plate 6: Ornate Burrowing Frogs were recorded in sandy areas such as Angorawa Creek © E. Magarey/DECC

In most respects the frog fauna found within south-eastern Wollemi NP is largely typical of sandstone hinterland reserves, and similar to that recorded in the incised sandstone plateaux of Yengo and northern Wollemi NPs. As for these areas, the most commonly recorded species is the Common Eastern Froglet, which was detected in almost every surveyed waterbody in the study area. Other species frequently recorded are Peron's Tree Frog, Brown-striped Frog, Leaf-green Tree Frog and Eastern Dwarf Tree Frog. The *Litoria lesueurii* species complex, which includes Lesueur's Tree Frog and the Stoney Creek Frog, is also commonly encountered. The frog surveys undertaken for this project continue to improve our understanding of the distribution of these two species, which have only recently been officially recognised as distinct from one another. Both species are widespread in the study area, with Lesueur's Frog recorded on Wollemi Creek, the Colo River and Wheeny Creek and Stoney Creek Frog recorded also on Wheeny Creek as well as Tootie Creek and Long Weeney Creek.

Also of interest was the confirmation of the occurrence of Tusked Frog in south-eastern Wollemi NP. The range of this species primarily encompasses the north coast of NSW, with the cluster of records located around Angorawa Creek and the Grassy Hill track amongst the most southerly records for the species on the Atlas of NSW Wildlife. It is unusual for the species to be recorded so far from the coast in the southern end of its range. Interestingly the Tusked Frog was not recorded in the higher rainfall areas in the south, but appeared to be most common in the moderate rainfall areas in the centre of the study area. This observation could be related to the fact that conditions for frog activity were very good during the period of surveys around Angorawa Creek and Grassy Hill track, with Angorawa Creek also found to support Ornate Burrowing Frog (Plate 6), Giant Burrowing Frog, Eastern Banjo Frog, Bleating Tree Frog, Eastern Dwarf Tree Frog, Leaf-green Tree Frog, Tyler's Tree Frog and Dusky Toadlet as well as the more ubiquitous Common Eastern Froglet, Brown Striped Frog and Peron's Tree Frog.

3.2.2 Reptiles

Forty-four species of reptile are confirmed to have been recorded in south-eastern Wollemi NP. The systematic surveys undertaken between 1997 and 2008 confirmed the presence of 30 of these species during systematic diurnal reptile searches, while a further twelve species were located opportunistically during other survey work. The remaining two species (Pink-tongued Lizard and Mustard-bellied Snake) are assumed to be relatively rare as neither have been sighted in the study area since 1977. It is expected that they do still occur, however, but have evaded detection in recent years due to their cryptic nature or low numbers. The 2007-08 BSP surveys detected two species that had not previously been reported, being Red-naped Snake and Tiger Snake. The total reptile fauna now known for the study area is comprised of one turtle, four geckoes, two legless lizards, four dragons, two monitors, seventeen skinks and fourteen species of snake (Appendix B).

Plate 7: Copper-tailed Skinks are very common amongst sandstone rock outcrops © N. Williams/DECC

Plate 8: Weasel Skinks are restricted to sheltered environments. These two were observed fighting near the Colo River © N. Williams

Two of the reptiles occurring in south-eastern Wollemi NP are listed as threatened, being Broad-headed Snake (Endangered under the TSC Act and Vulnerable under the EPBC Act) and Rosenberg's Goanna (Vulnerable under the TSC Act). The sighting of two Broad-headed Snake individuals during the BSP surveys was very exciting, as this species is very rarely encountered during systematic surveys, having been only encountered only once previously during the last three years of BSP surveys in northern Wollemi and Yengo NPs and Parr SCA. Both of these threatened species will be discussed further in Section 4 of this report.

Based on the results of the systematic diurnal herpetofauna searches, the most common reptile species in the study area is Dark-flecked Garden Sunskink, detected during 29 (38 %) of searches, followed by Eastern Water Skink (26 % of sites) and Copper-tailed Skink (17 %, Plate 7). The first of these species occurs in a wide range of habitat types in sandstone environments, and is often encountered running through leaf litter or basking on rocks or logs. The latter two species occupy very different environments, with Eastern Water Skink largely restricted to permanent creek lines while Copper-tailed Skink abounds in rocky outcrops on ridgelines and exposed slopes. Also common in rocky areas is White's Skink and Lesueur's Velvet Gecko (each located during 13 % of censuses), while the Broad-tailed Gecko is generally found sheltering in rocky crevices but also sometimes under exfoliating rock. Monitors and dragons are generally less frequently encountered during systematic reptile searches than skinks and geckoes, with the Mountain Dragon the most common dragon (9 % of sites), followed by the Jacky Dragon (6 %), and the Lace Monitor detected during 10 % of searches. Dragons and monitors tend to be more frequently observed on an opportunistic basis, with all three of these species widely distributed across the reserve.

Plate 9: Green Tree Snakes are rarely encountered but occur in moist forest areas such as on Wheeny Creek © E. Magarey/DECC

In contrast to these common reptiles there are several species which are much more restricted in their range, due to having more particular habitat preferences or to the changes in climatic, soil fertility and landscape variables across the study area. For example, the Southern Rainbow Skink has only been recorded in the Mellong Plateau around Howes Swamp, while the South-eastern

Slider has been recorded along Culoul Range, Grassy Hill Track and Angorawa Creek but does not appear to occur in the higher rainfall environments in the south. Neither of these species are typical of Sydney sandstone hinterland environments, instead being more common on the drier western slopes of NSW. Their occurrence is related to the influence of the lower rainfall environments which occur in the north of the study area, environments connected to the relatively dry Putty and Hunter Valleys. The Three-toed Skink and Weasel Skink (Plate 8) are restricted due to their habitat preferences, each only occurring in moist forest environments such as sheltered minor drainage channels entering the Colo River, Wheeny Creek and Culoul Creek.

South-eastern Wollemi NP supports a notably large number of snake species (Appendix B). Eleven of these belong to the family Elapideae, which are all venomous to varying degrees and spend the majority of their time on the ground or in low vegetation. The most commonly encountered, and one of the most well known, is the Red-bellied Black-snake which is usually closely associated with watered environments such as Colo River, Dooli, Wollemi and Long Weeney Creeks amongst others. Species such as the Common Death Adder and Yellow-faced Whip Snake would also be fairly common, but are much less frequently recorded due to their more cryptic nature. The three remaining snake species belong to three different families, and are the Diamond Python, Green Tree Snake (Plate 9) and Blackish Blind Snake. These latter species are all infrequently encountered, but would each occur in a range of forested environments from rainforest and wet sclerophyll to dry sclerophyll forest.

3.2.3 Native diurnal birds

The review of records undertaken for this report indicates that at least 141 species of native diurnal bird use south-eastern Wollemi NP. Some of these are sedentary, while others are migratory, seasonal visitors or nomads. The systematic surveys undertaken in 1997-98 and 2007-08 confirmed the presence of 112 of these species during systematic diurnal bird censuses and an additional 17 species incidentally (see Appendix B for list of species). The remaining twelve species are each much rarer within the park and some, such as Regent Honeyeater are likely to be only infrequent visitors. The 2007-08 BSP surveys found two diurnal bird species that had not previously been recorded in the reserves.

Plate 11: Eastern Yellow Robin is one of the species commonly encountered in dry sclerophyll forests and woodlands © N. Williams

Seven of the diurnal bird species are listed as threatened under the TSC Act, being Gang-gang Cockatoo, Glossy Black-cockatoo, Turquoise Parrot, Brown Treecreeper (eastern subspecies), Black-chinned Honeyeater (eastern subspecies), Regent Honeyeater and Grey-crowned Babbler (eastern subspecies). Of these the study area supports a sizeable amount of habitat for only the Gang-gang Cockatoo and Glossy Black-cockatoo; habitat for the others is quite restricted in extent or of marginal quality, as will be discussed individually for each species in Section 4 of this report. Also of conservation significance is the presence of several species that are thought to be in decline, though they have not yet been listed on 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 the south-eastern Wollemi NP: Rockwarbler; White-winged Chough; Spotted Quail-thrush and Red-browed Treecreeper. In addition, a number of species are thought to have declined in the Sydney Basin Bioregion in recent years (Barrett *et al.* 2003). These include the Jacky Winter, Restless Flycatcher, Wedge-tailed Eagle, Nankeen Kestrel, Dusky Woodswallow, Australian Pipit, Scarlet Robin, White-winged Triller and White-throated Needletail. The national parks of the Blue Mountains and Hunter Range play an integral role in the ongoing regional conservation of habitats for these species.

Plate 10: This Brown Gerygone nest was found adjacent to a creekline, the species favourite habitat © N. Williams/DECC

Based on the results of the systematic diurnal bird surveys, the most common species are those that flourish in a range of dry sclerophyll woodlands and forests on the sandstone plateau. These include Spotted Pardalote (83 % of sites), White-throated Treecreeper (80 %), Eastern Spinebill (70 %), Grey Shrike-thrush (69 %), Brown Thornbill, Eastern Yellow Robin (Plate 10) and Golden Whistler (all 68 %) and Yellow-faced Honeyeater (67 %). These birds are not only habitat generalists but are also highly vocal or highly visible, making them easy to detect during bird surveys. These species are also commonly recorded in shrubby sandstone environments across northern Wollemi and Yengo NPs and Parr SCA (DEC 2007a, DECC 2008a).

A distinct group of birds occurs within the rainforests and wet sclerophyll forests with mesic shrubby understoreys that are most well developed in areas that receive higher average rainfall including the catchments of Dooli, Wheeny, Tootie and Gospers Creeks primarily in the southern half of the study area. Yellow-throated Scrubwren, for example was recorded during just three percent of systematic diurnal bird censuses, all within vegetation with rainforest elements including sheltered sections and tributaries of Wheeny, Tootie and Cabbage Tree Creeks. Other species that prefer mesic environments but will venture out of rainforest also into sheltered wet sclerophyll forest include Large-billed Scrubwren (6 % of sites), Bassian Thrush (2 %), Red-browed Treecreeper (6 %) and Brown Gerygone (15 %). Lewin's Honeyeater (40 %) was the most commonly encountered of this sheltered forest group, occurring in almost every surveyed creek line from Wollemi Creek in the north to Wheeny Creek in the south.

The far north of the study area supports different environments than are found through the majority of the reserve, primarily due to the lower average annual rainfall and more extensive occurrence of Narrabeen, rather than Hawkesbury, sandstones which tend to have more shale and hence produce higher fertility soil and more open, sometimes grassy, woodlands. A few bird species, including the threatened Brown Treecreeper and Black-chinned Honeyeater, are restricted to these drier open woodlands where Ironbarks and Grey Gum dominate the canopy. Having said this, there is also the potential for these woodland species to occur on the Mellong Plateau, as the structure of the vegetation in parts is similar to that of the more classic grassy woodlands, and both the Black-chinned Honeyeater and Brown Treecreeper have been recorded on the Mellong Plateau and adjacent woodlands on the Yengo side of the Putty Road. Other woodland birds that occur in the Mellong woodlands include the threatened Grey-crowned Babbler and Turquoise Parrot as well as Jacky Winter (Plate 12), Peaceful Dove, Weebill, Restless Flycatcher, Brown-headed Honeyeater and Striated Pardalote.

Plate 12: Jacky Winter is one of the species that occurs in drier open woodlands in the north of the study area and on the Mellong Plateau © R. Jones/DECC

The topography and geology of the Mellong Plateau has led to the development of numerous swampy areas, where large accumulations of open water are often held. These areas support a number of waterbirds that would otherwise be unlikely to utilise south-eastern Wollemi NP. Such species include Pacific Black Duck, Australasian Grebe, White-necked Heron, Dusky Moorhen and Purple Swamphen. These species, as well as other waterbirds such as Great Cormorant, also occur in wetlands along the lower reaches of the Colo River and its major tributaries, and though these wetlands are outside the park the species are likely to travel up the Colo River and to other parts of the study area in times of flood.

One of the more visible groups of birds in the reserves is the birds of prey, of which at least nine species are known to occur. These species soar and forage over a wide range of habitat types, recorded more frequently on an opportunistic basis than during systematic diurnal bird censuses. The most commonly recorded is the Wedge-tailed Eagle, which is easily recognised by the wedge-shaped silhouette of its tail which is visible when it soars above the tree canopy. Collared Sparrowhawk and Brown Goshawk have been seen deep within the park, while Whistling Kite, Little Eagle and Nankeen Kestrel are all restricted to the perimeters of the park, probably because they prefer to forage over more open vegetation types. The White-bellied Sea-eagle has only been recorded along the Colo River, and being a largely coastal species is unlikely to venture far from the major tributaries of the Hawkesbury River in this area.

3.2.4 Nocturnal birds

The suite of nocturnal birds occurring in south-eastern Wollemi NP is shared by the other large reserves of the Sydney Basin. Eight species are confirmed to occur including four owls (Southern Boobook, Masked Owl, Powerful Owl and Sooty Owl), the Tawny Frogmouth, Australian Owlet-nightjar, White-throated Nightjar (Plate 13) and Nankeen Night Heron. There is doubt about the occurrence of a ninth species, the Barking Owl, which was recorded somewhere in the vicinity of the study area in the early 1980s during the first Birds Australia Atlas, and again near Wheeny Creek campground in 2003. This species is listed as Vulnerable on the TSC Act. Typical habitat for the species does not occur along Wheeny Creek, however, and it is possible that the individual seen here could have been mistaken for the much more common and very similar looking Southern Boobook. As a small amount of habitat does occur for the Barking Owl in drier areas in the north, the species has been included in the totals provided in this report and afforded a profile in Section 4. Further surveys are required, however, before its occurrence can be confirmed. The other owl species that are listed as Vulnerable on the TSC Act (Masked, Powerful and Sooty Owls) will also be discussed in detail in Section 4.

Plate 13: White-throated Nightjars are sometimes spotted on tracks at night time © N. Williams/DECC

Based on the nocturnal call playback and spotlighting surveys, the most common nocturnal birds are Australian Owlet Nightjar, which calls year-round and so it detected during spring, summer and autumn censuses, and Southern Boobook, which primarily calls during the spring and summer months. Both of these species will utilise a wide range of habitat types, from rainforest and wet sclerophyll forests in the south to drier more open woodlands in the north and north-east. The Tawny Frogmouth and White-throated Nightjar are each much less frequently detected but nevertheless are also widespread across the park.

3.2.5 Arboreal mammals

Nine species of arboreal mammal have been recorded on the Atlas of NSW Wildlife for south-eastern Wollemi NP. The systematic site spotlighting surveys undertaken in 1997-98 and 2007-08 confirmed the presence of seven of these species, while the Short-eared Possum and Squirrel Glider were each recorded opportunistically during these surveys. Three of the arboreal mammal species that occur in the park are listed as Vulnerable under the TSC Act, being Squirrel Glider, Yellow-bellied Glider and Koala. The latter species is well known from the Colo region. The CRA and BSP surveys confirmed that an apparently healthy population of Koalas exists within south-eastern Wollemi NP, with an extensive area of occupied habitat connected to the population(s) of southern Yengo NP and Parr SCA (DECC 2008a) and south-west to those of Blue Mountains NP. In October 2008 an individual was seen crossing the Putty Road from west to east during the day time, in the vicinity of Colo Heights (M. Ewings pers. comm.). The tract of occupied protected habitat within these reserves plays a crucial role in the regional conservation of the Koala. The threatened species will be discussed further in Section 4.

Plate 14: The Sugar Glider is common across the sandstone plateau, easily detected by its yapping call © N. Williams

The most commonly detected arboreal mammal during the systematic site spotlighting surveys was the Sugar Glider (Plate 14) which was observed or heard calling during 26 % of censuses, as well as during 19 % of nocturnal call playback surveys. This species occurs in a wide range of habitat types, including on sandstone ridges tops and slopes, but is most abundant in gullies and sheltered environments, probably because of the higher density of tree hollows in such environments (as compared to ridge tops), on which the species depends for nesting (Suckling 1995), and the abundance of food resources such as Cedar Wattle (*Acacia elata*). Koala were detected during 20 % of spotlighting censuses and 5 % of nocturnal call playback surveys, making it the second most frequently detected mammal by spotlighting.

Other common species are the Feathertail Glider (9 % of spotlighting censuses), Common Ringtail Possum, Common Brushtail Possum and Greater Glider (each recorded during 7 % of spotlighting censuses). All of these species are more common on sheltered slopes

and gully lines, again probably due to the greater density of tree hollows in these environments. The first two of these species are widespread through the incised sandstone plateau, with the Common Ringtail Possum having been more frequently detected by opportunistic methods including on the Mellong Plateau, Angorawa Creek, Colo River, Gospers Creek and in the higher elevation areas north-east of Mount Tootie. The Common Brushtail Possum is more restricted in extent, exhibiting a preference for more open woodland habitats or soils of slightly enriched fertility. It has most frequently been recorded in the woodlands of the Mellong Plateau, as well as along the flats of Long Weeney Creek, in sheltered forest on Narrabeen Sandstone near Grassy Hill track, and in lower lying areas between the Colo River and Wheeny Creek in the far south-eastern corner of the reserve. The Greater Glider is known to prefer tall forests or forests on enriched soils, and in south-eastern Wollemi NP has been recorded in tall sheltered forest near Wollemi, Howes Swamp, Angorawa, Canoe, Gospers and Tootie Creeks, as well as in the enriched tall shale forest on Bowen Hill.

Plate 15: Water-rat was recorded for the first time in the study area, along the banks of the Colo River © N. Williams

3.2.6 Native ground mammals

Records exist for a total of eighteen native terrestrial ground mammal species on the Atlas of NSW Wildlife. This includes two monotremes, five dasyurids (marsupial carnivores), one bandicoot, one wombat, five macropods and four rodents. Only two of these species were not confirmed to occur during the BSP surveys, being Dusky Antechinus and New Holland Mouse. However, since only a limited amount of Elliott trapping was undertaken it is likely that these species still occur in low numbers, but escaped detection. The BSP surveys succeeded in detecting two species not previously recorded on the Atlas of NSW Wildlife for the study area, being Long-nosed Bandicoot and Water-rat (Plate 15).

Two of the native ground mammal species are listed as Vulnerable under the TSC Act, Spotted-tailed Quoll and Brush-tailed Rock-wallaby. The sighting of a Spotted-tailed Quoll on the D'Arcy Range in October 2007 was very exciting, as it confirmed that this highly cryptic species still persists in the study area. As will be discussed in Section 4, potential habitat is extensive south of the Colo River where average annual rainfall exceeds 1000 millimetres per annum, but the extent to which this habitat is occupied remains unknown. Brush-tailed Rock-wallaby were not directly observed during the BSP surveys, but scats were positively identified from three rocky overhangs, including one above Culoul Creek and two adjacent to the Colo River. Inaccessible sections of the Colo River gorge are likely to remain an important refuge for this highly threatened species, though as individuals have not been directly observed in the area since 1980 their conservation status in the reserve is not known.

Plate 16: Red-necked Wallaby (above) and Eastern Grey Kangaroo only occur on the Mellong Plateau where swampy areas provide sufficient grass for grazing © N. Williams

The native ground mammals are probably the least understood group of native animals within the study area, since only a limited amount of hair tubing, a very small amount of Elliott trapping and no cage trapping has been undertaken. The most frequently recorded species are large, highly visible animals that do not require trapping for detection, particularly Common Wombat and macropods. The Common Wombat is ubiquitous, recorded in all areas where surveys were undertaken either by direct observation, active and disused burrows, tracks or their often proudly displayed scats. The Swamp Wallaby is by far the most common macropod species, with records scattered throughout surveyed areas of the park but most dense south of the Colo River. The three remaining macropods are each quite rare. Eastern Grey Kangaroo and Red-necked Wallaby (Plate 16) are only known to occur on the Mellong Plateau, where the open woodlands and swampy conditions provide sufficient grass for foraging. Common Wallaroo has only been recorded in the south-eastern corner of the park, near Wheeny Creek and the lower reaches of the Colo River.

Records of small ground mammals are, unsurprisingly, concentrated in the areas where Elliott trapping and hair tube surveys have been

undertaken, but information can be extrapolated into unsurveyed areas. The Bush Rat and Brown Antechinus would each be common across the range of forested environments present in the reserve, while the Swamp Rat primarily occurs in more open swampy areas such as occur in parts of the Mellong Plateau. Common Dunnart, Yellow-footed Antechinus and Dusky Antechinus have each been recorded on only a handful of occasions too scattered to assess habitat preferences.

The persistence of Platypus along the Colo River was confirmed during the BSP surveys, this shy monotreme having not previously been accurately recorded on the Atlas of NSW Wildlife. The species is likely to also occur in other large permanent creek lines in the reserve, such as the lower reaches of Wollemi Creek. The other monotreme recorded in the study area, Short-beaked Echidna, is much more widespread and though only recorded on five occasions to date it is assumed to occur throughout the sandstone plateau in wet and dry sclerophyll forests and woodlands.

Unfortunately, due to the inability to distinguish Wild Dog from Dingo by tracks, scats or traces and the difficulty in separating the two subspecies at all without DNA samples, all but three records of Dogs in the study area have been entered into the Atlas of NSW Wildlife as Wild Dog/Dingo (*Canis lupus*) (see Map 12). However, there is evidence to suggest that the Dingo (*Canis lupus dingo*) still occurs in Wollemi NP, including within the study area. Though no DNA testing of Wild Dogs/Dingo has been undertaken within the park, howling attributed to the Dingo was heard along the Colo River, Angorawa Creek and Grassy Hill track during the BSP surveys in November 2007. Historically Dingo were commonly encountered in the Colo Wilderness, with the absence of Sheep grazing from the area meaning neighbouring graziers were less aggressive to the Dingo than in other parts of NSW (Gold and Prineas 1978). A recent study in neighbouring Yengo NP included genetic testing of animals trapped in soft-jaw traps in the centre of that park, and found trapped animals to have a high degree of Dingo heritage (up to 98 %) (T. Horwood pers. comm.). Further towards the boundaries of Yengo NP trapped animals exhibited only a 10-15 % Dingo heritage due to hybridisation with Wild Dogs (T. Horwood pers. comm.). A similar pattern is likely to occur in Wollemi National Park. The Dingo is listed as Vulnerable on the IUCN Red List of Threatened Species due to a 30 % decrease in numbers across its distribution (Corbett 2004). Populations from Sturt NP, the coastal ranges and some coastal parks have been nominated as Endangered under the TSC Act (Colong Wilderness Foundation 2002). In contrast to this, Dingoes are declared a pest animal under the Rural Lands Protection Act (1998) (RLP Act). Nevertheless, DECC recognises the expectation amongst the community that the Dingo be conserved (NPWS *et al.* 2000, Fleming *et al.* 2001, DEC 2005c). Wollemi NP is considered to be important for the conservation of the Dingo in a submission to the RLP Act by all key land management agencies (NPWS *et al.* 2000, DEC 2005c). It is recommended that research be extended to Wollemi National Park to: ascertain patterns in the level of Wild Dog/Dingo hybridisation in the area; identify key areas of Dingo purity and Wild Dog invasion; enable the formulation of a management plan that balances the need for Dingo conservation and Wild Dog control within the study area.

Conservation of the Dingo is increasingly regarded as an important conservation tool, with recent research confirming that Dingoes regulate arid-zone ecosystems. Without Dingoes, Foxes and large herbivores explode in number while lizards and, in some areas, small mammals decline almost to extinction (M. Letnic in prep.). While the forested environments of eastern Australia are yet to be similarly investigated, the Dingo is likewise the top-order predator and is certainly playing an important role in south-eastern Wollemi NP. Research in the southern Blue Mountains suggests that there is little difference in the ecological role played by Dingoes, Feral Dogs and hybrids (B. Purcell in prep.).

3.2.7 Bats

A total of nineteen species of insectivorous bat are confirmed to occur in south-eastern Wollemi NP. All of these species were recorded during the 2007-08 BSP surveys (including three for the first time): seventeen were detected by the Anabat system while a partly overlapping total of twelve species were captured in harp traps. Seven of the bat species are listed as Vulnerable on the TSC Act: the East-coast Freetail-bat, Large-eared Pied Bat, Eastern False Pipistrelle, Eastern Bentwing-bat, Large-footed Myotis, Greater Broad-nosed Bat and Eastern Cave Bat. A twentieth species of bat, the Grey-headed Flying-fox, listed as Vulnerable under both state and

Plate 17: Eastern Horse-shoe Bats were frequently recorded on the Anabat system and occasionally captured in harp traps. This individual is being released from a harp trap © E. Magarey/DECC

federal legislation, has also been recorded in the study area, though only by a single record of low spatial accuracy in the vicinity of 'Upper Colo'. As it is likely that this latter species forages within the park on occasion, it has been included in the species totals provided in this report. Each of the threatened bats will be discussed further in Section 4.

The composition of the microbat fauna is largely typical of Sydney Basin hinterland plateaux, with a few additions reflecting the influences of the dry Hunter Valley and the north coast. As expected for Sydney sandstone environments, the most frequently recorded species is the Little Forest Bat (42 % of Anabat sites and 69 % of Harp trap sites). Other species frequently captured in harp traps are Gould's Long-eared Bat (52 % of sites), Chocolate Wattled Bat (31 %) and Gould's Wattled Bat (29 %). The latter two of these species are also frequently detected from their ultrasonic calls (50 % and 42 % of Anabat sites respectively), as are the Eastern Horseshoe-bat (38 %) (Plate 17), White-striped Freetail-bat (27 % of sites), Eastern Freetail-bat (21 %) and Large Forest Bat (21 %).

The occurrence of three of the microbat species is worthy of comment. The Eastern Cave Bat (Plate 18) was recorded for the first time in south-eastern Wollemi NP during the BSP surveys, when four individuals (three male and one of unknown sex) were found roosting in the honeycomb weathering of an overhang along the cliffs of the Colo River in November 2007. The Eastern Cave Bat primarily occurs in northern NSW and Queensland, with the records collected in south-eastern Wollemi NP, and in northern Wollemi and northern Yengo NPs during BSP surveys in recent years, amongst the most southerly records of the species. The Eastern Cave Bat remains a poorly understood species, but recent surveys suggest that the northern escarpments of the Sydney Basin are somewhat of a stronghold for the species and likely to play a pivotal role in its conservation in the region. It is likely that the Capertee and Colo Rivers act as a conduit for the occurrence of this species from further north in Wollemi NP. The Southern Freetail-bat (long penis form) is restricted to the drier environments of the study area, namely from along the Putty Road near Angorawa Creek through the Mellong Plateau and across to Wollemi Creek. This species is more common in western NSW, typically inhabiting dry or semi-arid areas inland of the Great Dividing Range (Churchill 1998). It also occurs in northern Yengo and parts of northern Wollemi NP, within areas influenced by the rainshadow of the Hunter Valley (DEC 2007a). In contrast, the Eastern Forest Bat is primarily a coastal species, generally occurring in moister forest types but also in wet and dry sclerophyll forest (Churchill 1998). This species was recorded by a consultant on the Mellong Plateau in 2003, which is rather unusual habitat. During the BSP surveys the species was detected by its ultrasonic call on Wheeny Creek, an area that supports more typical habitat. This bat is expected to occur elsewhere in the south of the study area where average annual rainfall is relatively high.

Plate 18: The Eastern Cave Bat is a cave-roosting species that was observed for the first time in the study area in November 2007, along the clifflines of the Colo River © N. Williams/DECC

3.3 INTRODUCED SPECIES

3.3.1 Introduced mammals

Ten species of introduced ground mammal have been recorded in south-eastern Wollemi NP. This includes two species that are known to be common and widespread (Fox, Wild Dog), one species that is likely to be widespread but is very cryptic (Feral Cat) and several species which currently appear to be only limited in extent (House Mouse, Black Rat, Rabbit, Horse, Pig, European Cattle, Goat and Fallow Deer). The House Mouse and Black Rat have each only been recorded with low spatial accuracy, including through old records that may be incorrectly spatially referenced, and from remains in predator scats. These species are likely to only occur on the periphery of the park and unlikely to pose a significant threat to native fauna. Similarly, Rabbits have only been recorded immediately adjacent to the park boundary, or from predator scats further inside the park (Map 12), apparently currently restricted to disturbed areas, and have negligible impact on native fauna. The Rabbit has therefore not been afforded a species profile in Section 4.

Cattle have been recorded in three broad locations in south-eastern Wollemi NP. East of the property 'Itchenstoke' Cattle tracks and scats were detected just within the boundary of the park, likely to be roaming or escaped domestic Cattle from the neighbouring property. Though this practice should be strongly discouraged, the Cattle appear unlikely to become problematic at this stage. Cattle have been recorded on many more occasions in the north-eastern corner of the study area, including on the Mellong Plateau between Mellong Creek and Howes Swamp Creek, along Wollemi Creek and along Long Weeney Creek. The animals in this area would also have originated from wild-roaming or escaped farm animals, however there is a strong possibility that these animals are, or will become, feral. Whether feral or farm animals, the Cattle in the north-eastern section of the study area would still be having an impact on the bush, particularly along major creek lines. Depending on its intensity, Cattle grazing is likely to be affecting the regeneration of some plants, spreading weeds, fouling waterholes and causing harm by trampling and compacting the soil. These impacts would have flow-on effects for the native fauna that rely on these creek-line or diatreme habitats.

The other feral species will be individually discussed in Section 4, together with a map of their known locations.

3.3.2 Predator scat analysis

A total of ten Fox scats have been collected from south-eastern Wollemi NP and analysed for their content, revealing the following prey species: Common Dunnart, Bush Rat, Long-nosed Bandicoot, Common Ringtail Possum, Sugar Glider, Brush-tailed Possum, Swamp Wallaby and unidentified reptile remains. Thirty-nine Wild Dog/Dingo scats were also analysed, of which 59 % contained remains of Swamp Wallaby, 18 % contained Common Wombat and 15 % contained Brush-tailed Possum. Also represented in the Wild Dog/Dingo scats were Rabbit (5 % of scats), Short-beaked Echidna (5 %), Greater Glider (3 %) and Bush Rat (3 %).

3.3.3 Introduced birds

The only species of introduced bird recorded within the boundaries of south-eastern Wollemi NP is Eurasian Blackbird, and though this has been recorded on several occasions in developed lands adjacent to the park, the only place it has been detected therein is just north of Bilpin rest area where two individuals were seen in October 2007. This does not currently occur in the reserve proper, but has the potential to invade further into the park in the future, as will be discussed further in Section 4.

Several additional species of introduced bird have been recorded outside the boundaries but within five kilometres of south-eastern Wollemi NP (Map 11), most notably the Common Myna and Spotted Turtledove. Of these species the Common Myna has the greatest potential to impact on native wildlife, as though it is usually closely associated with human habitation it will occupy open grassy woodlands supporting hollow-bearing trees (Pell and Tidemann 1997). The Common Myna is infamous for its aggressive nature and has been known to evict native birds from their nests and threaten the local survival of hollow-dependant mammals such as the Sugar Glider (Environment ACT 2004). Barrett *et al*. (2003) listed the Common Myna as a species that had increased in the frequency of recordings across their distribution between 1984 and 2002. Thus any sightings or reports of Common Myna within the park should trigger management actions, and warrant study into the feasibility of removing the population.

Plate 19: Evidence of Feral Pig activity is obvious on the Mellong sands © E. Magarey/DECC

3.4 ADDITIONAL SPECIES THAT HAVE THE POTENTIAL TO OCCUR

An examination of records occurring within five kilometres of the study area provides some insight into species that may occur within the study area, but gone undetected to date. Table 7 lists such species that are considered highly likely to occur within south-eastern Wollemi NP. A full list of species detected within five kilometres of the reserve, but not therein, is provided in Appendix C. In addition, there is a possibility that the Green Catbird (*Ailuroedus crassirostris*) occurs, as though the species has not been recorded within or adjacent to the study area on the Atlas of NSW Wildlife its call was thought to be heard on Wollemi Creek in November 2008 (C. Isaacs pers. comm.).

Table 7: Additional species that have been recorded within five kilometres and have the potential to occur in the study area

Scientific name	Common name	Reason it is considered likely to occur
Delma plebeia	Leaden Delma	Recorded in southern Yengo NP in Howes Swamp just two kilometres east of study area. Similar habitat occurs within study area.
Cyclodomorphus michaeli	Mainland She-oak Skink	Cryptic species that is widely scattered and easily missed. Has been recorded near Mount Irvine 1.7 km west of study area.
Glossopsitta concinna	Musk Lorikeet	Recorded immediately adjacent to the park. This species moves through the landscape in response to flowering events and is likely to visit the study area during periods of heavy eucalypt flower.
Pyrrholaemus saggitatus	Speckled Warbler	Speckled Warbler was removed from the fauna totals provided in this report as it has never been accurately recorded on the Atlas of NSW Wildlife. Habitat for the species does occur in the far north of the study area particularly at the interface between cleared and forested lands along Long Weeney Creek. The species is likely to only persist in low numbers.
Stipiturus malachurus	Southern Emu-wren	Potentially occurs in the hanging swamps which are scattered through the southern half of the study area.
Cercartetus nanus	Eastern Pygmy-possum	This species is difficult to detect without pitfall trapping and/or Elliott trapping, but is likely to occur in areas of heath and heathy woodland where Heath Banksia (*Banksia ericifolia*) occurs such as north of Mount Tootie.
Miniopterus australis	Little Bentwing-bat	Primarily a coastal species, this bat may travel along the Colo River to forage and potentially roost in the adjacent escarpment lines. Likely to only occur in the higher rainfall sections of the study area.

4 PROFILES OF THREATENED AND PEST SPECIES

This section provides a profile of each of the threatened fauna species and key pest species that are known or considered highly likely to occur within south-eastern Wollemi NP. 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 (as at 1st July 2008); and an appraisal of the distribution and status of the species in south-eastern Wollemi NP and the surrounding area. Due to the spatial inaccuracy of records from the first Birds Australia atlas, these records have not been included on the species distribution maps contained herein. Similarly, records with a low reliability of identification have not been included on the maps.

4.1 THREATENED SPECIES

GIANT BURROWING FROG

Species Profile

The Giant Burrowing Frog (*Heleioporus australiacus*) is a large rotund ground-dwelling frog. Its powerful limbs are used to excavate burrows where it can stay 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 2001a). It has been suggested that this disjunct distribution may reflect two separate species, though at present evidence is inconclusive (Penman *et al.* 2004).

Plate 20: Giant Burrowing Frog © N. Williams/DECC

Threats

The primary threat to the Giant Burrowing Frog in NSW is development of its preferred habitat for housing and agriculture (NPWS 2001a). Other threats are not well known but may include alteration of drainage patterns, infection by Chytrid fungus, road mortality, water pollution, frequent fire, forestry operations (DEC 2006a), and predation by Foxes and Feral Cats. Long wall mining may be a significant future threat (NSW Scientific Committee 2005a).

Local and Regional Conservation Status

The Giant Burrowing Frog is listed as Vulnerable under the TSC Act and the EPBC Act. 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 NPs and across the Woronora Plateau. Fewer records have been obtained in Blue Mountains, Nattai, Wollemi and Yengo NPs and Bargo SCA. Penman *et al.* (2004) consider the Giant Burrowing Frog to be well represented within the reserve system in the Sydney Basin Bioregion.

The Giant Burrowing Frog has long been known from south-eastern Wollemi National Park, with specimens first collected by the Australian Museum from the Culoul Range area in the late 1970s (DECC 2008b). The BSP surveys located the species at several new locations in the park, including both breeding and non-breeding sites. Tadpoles were located at a single location, near the headwaters of a tributary of Bowen Creek, while males were heard calling along a sandy tributary of Tootie Creek in October 2007. Such breeding locations are likely to be widespread across the study area, particularly near the shallow headwaters of minor drainage channels where sandy soils have accumulated, or on larger creek lines with alluvial sand and rocky pools. In addition to the breeding locations individuals have been sighted on roads along several ridgelines and creek lines, including Angorawa Creek Track, Grassy Hill Track, and between Little Tootie and Bowen Hill (Map 3). The frogs would disperse in similar areas extensively during and after rainy periods, and thus a large proportion of the reserve can be considered potential habitat for this species.

The Giant Burrowing Frog currently appears to be secure in the northern Blue Mountains/Hunter Range reserve system, and no specific management actions are required in the study area at this stage. Management may be required in the future if Chytrid fungus is discovered to be affecting populations, or if scientific research confirms that feral predators and/or frequent fire pose a significant threat to the species in wilderness areas.

STUTTERING FROG

Species Profile

The Stuttering Frog (*Mixophyes balbus*) is a large frog that becomes highly camouflaged in the wet leaf litter of the forest floor. After summer rains the males make a call that includes a soft stuttering. The thin barring on the limbs in combination with the blue crescent above the iris distinguishes it from other *Mixophyes* in NSW (Barker *et al.* 1995). It is usually associated with small flowing streams in rainforest or wet sclerophyll forest (Anstis 2002), where it feeds on insects and smaller frogs (Gilmore and Parnaby 1994). It breeds in spring and summer and has very long-lived tadpoles that are capable of surviving over winter (Anstis 2002). It was once found along the coast and ranges between northern NSW and Victoria, though it is now found only patchily through its former distribution (Daly 1998).

Plate 21: Stuttering Frog © N. Williams/DECC

Threats

The main threats to the species are thought to be habitat fragmentation and degradation, which can lead to the isolation of sub-populations, increased vulnerability to other threats, and to local extinction (NSW Scientific Committee 2002a). The Stuttering Frog is threatened by the introduced pathogen, Chytrid fungus (Hunter and Gillespie 2006). The disease is known to have seriously affected populations of the closely related Fleay's Barred Frog (*M. fleayi*) (Berger *et al.* 1998), and has been recorded in Stuttering Frog tadpoles and metamorphs in the southern Blue Mountains (DEC 2004b) and Macquarie Pass (Gaia Research 2006a). This frog is also potentially threatened by predation by exotic fish including Plague Minnow (*Gambusia holbrooki*) (NSW Scientific Committee 1999a) and Brown Trout (*Salmo trutta*) (Daly *et al.* 2002). Climate change is likely to have a negative impact on the Stuttering Frog in the future (Hunter and Gillespie 2006).

Local and Regional Conservation Status

The Stuttering Frog is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. Within NSW, nearly all records are within the three eastern Bioregions (DECC 2008b). Within the southern portion of its range, particularly south of Sydney, the frog has declined dramatically in recent times (Daly *et al.* 2002, Gaia Research 2006b) and within the greater southern Sydney region only two localities are known to continue to support the species (DECC 2007a). North of Sydney the species is more widely distributed, but still with only very patchy occurrence (NSW Scientific Committee 2002a). Between the Hunter River and Sydney, known populations are concentrated between Gosford and the Watagan Mountains, with the closest site north of the Hunter being in Barrington Tops (NSW Scientific Committee 2002a). In the Sydney Basin Bioregion this frog is known to persist within a few public lands including Watagan, Blue Mountains and Wollemi National Parks, as well as within Olney, Strickland and Awaba State Forests (DECC 2008b).

The Stuttering Frog has only been recorded once from south-eastern Wollemi NP, from an undated specimen collected by the Australian Museum in the vicinity of 'Kurrajong Heights' (DECC 2008b). The targeted surveys that were undertaken between November 1999 and March 2000 failed to locate the species, and despite a very limited amount of targeted survey the species was not observed during the 2007-08 BSP surveys. There is sadly a chance that the Stuttering Frog is now extinct from south-eastern Wollemi NP. However, much potential habitat occurs in remote sections of the park, and only further comprehensive surveys would confirm whether the species persists or not. The discovery of Stuttering Frog in two locations in north-western Wollemi NP in December 2005 (DEC 2007a) lends hope to the feasibility of the species persisting in rarely visited wilderness areas.

Further surveys of sheltered creek headwaters and associated rock pools within coastal and hinterland warm temperate rainforest are recommended. Higher rainfall areas in the south of the park should be targeted, particularly the upper tributaries of Wheeny and Tootie Creeks, Cabbage Tree Creek and Lagoon Creek. The vegetation mapping currently being undertaken in Wollemi NP (DECC in prep.) will assist with the selection of survey sites. Surveys should be undertaken in spring or summer, particularly after rain, when individuals are most vocal and active. Any targeted frog surveys must be undertaken with strict adherence to frog hygiene protocols to ensure diseases are not spread between populations or catchments. Should a population(s) be discovered it would hold extremely high conservation significance. The greatest threat to the survival of the Stuttering Frog in the reserve system is infection by Chytrid fungus. Testing for Chytrid fungus should therefore be incorporated into any targeted surveys for the species.

RED-CROWNED TOADLET

Species Profile

The Red-crowned Toadlet (*Pseudophryne australis*) is a small, strikingly coloured, litter-dwelling frog. It is restricted in its distribution, generally only occurring on the Hawkesbury and Narrabeen sandstone geologies of the Sydney Basin. The Red-crowned Toadlet lays its eggs in moist leaf litter, relying on rain to wash the eggs into ephemeral ponds where they can complete their development (NPWS 2001b). The species is gregarious, being found in colonies of up to 30 individuals (Barker *et al.* 1995). It will breed at any time of year in order to take advantage of unpredictable rainfall events (Thumm and Mahony 2002). The Red-crowned Toadlet has a high level of reproductive failure (Thumm and Mahony 2002) and due to its size and morphology, has only a limited ability to disperse.

Plate 22: Red-crowned Toadlet © N. Williams

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 frequent fire, bush rock removal, water pollution and Chytrid fungus (NPWS 2001b). The species may also be impacted upon by the removal of dead wood and trees and by habitat alteration due to longwall mining (NSW Scientific Committee 2003a, 2005a).

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 major populations occurring in the upper Blue Mountains, around the mouth of the Hawkesbury River and on the Woronora Plateau extending to Royal National Park. Throughout its range it has been recorded in numerous reserves, from Yengo and Wollemi National Parks in the north to Barren Grounds Nature Reserve in the south (DECC 2008b), including some within the Sydney urban area, such as Lane Cove National Park (DEC 2004a).

Red-crowned Toadlet specimens were collected by the Australian Museum from the vicinity of Grassy Hill and Bilpin during the late 1960s and 70s and were also observed along the Culoul Range in the late 1970s (DECC 2008b). The records collected during the BSP surveys were the first observations recorded on the Atlas of NSW Wildlife since this time, and include eleven new locations for the species. All of the records for the species are south of the Culoul Range, with individuals primarily being detected by their calls. During the 2007 surveys Red-crowned Toadlets were heard calling in upper drainage channels and roadside pools north and south of Mount Tootie, along tributaries of Tootie Creek, and from upper headwaters of tributaries of Dooli Creek (Map 3). The species would be widespread through the southern half of the study area, occurring underneath leaf litter at the edge of pools or seepage areas on first and second order creeks and drainage channels.

The Red-crowned Toadlet is restricted to the sandstone geologies of the Sydney Basin Bioregion, with the large reserves, particularly Blue Mountains, Wollemi and Yengo NPs playing a vital role in the conservation of this species over the long term. As the threatening processes known for this species are not present throughout the majority of these reserves, the Red-crowned Toadlet appears to currently be secure within the area and does not require any immediate management action. Management may be required in the future if Chytrid fungus is discovered to be affecting populations or if scientific research confirms that frequent fire imposes a significant threat to the species in wilderness areas.

BOOROOLONG FROG

Species Profile

Plate 23: Booroolong Frog © M. Pennay

The Booroolong Frog (*Litoria booroolongensis*) is a medium-sized frog that is similar to others in the *lesueurii* group (*L. lesueurii, L. wilcoxi and L. jungguy*) (Donnellan and Mahony 2004). The Booroolong Frog may be reliably distinguished by the extension of the webbing to the base of the first inner toe pad on the hind foot, a mottled dorsum with a scattering of salmon-coloured flecks, and an indistinct black stripe passing through the eye and over the tympanum to the shoulder (Gillespie 1999); and by its call. The species was formerly known from the tablelands and slopes of New South Wales, from catchments draining the Northern Tablelands to the Tumut River in the Southern Highlands and other tributaries of the Murrumbidgee River, and has recently been discovered in Victoria (Gillespie 1999). This frog typically inhabits rocky western-flowing creeks and their headwaters, although a small number of animals have also been recorded in eastern-flowing streams (NSW Scientific Committee 1998a). Adults are typically found sheltering under boulders or cobbles near riffles along the stream bank, in both forested areas and open pasture (Gillespie 1999). In spring, eggs are deposited in rock crevices in the stream or in isolated streamside pools and tadpoles metamorphose in January and February (Gillespie 1999).

Threats

Tadpoles of the Booroolong Frog are vulnerable to predation by exotic fish species including Brown Trout, Rainbow Trout (*Oncorhynchus mykiss*) and European Carp (*Cyprinus carpio*) (NSW Scientific Committee 1998a, DEH 2004a). Nearly all streams occupied by the Booroolong Frog are also inhabited by introduced fish, particularly Trout, which may be stocked in very high numbers (DEH 2004a). Land and water degradation, flow modification and weed invasion of riparian areas (particularly by Willow (*Salix* spp.)) each pose a threat to the species across its range (DEH 2004a). Another significant threat is infection by Chytrid fungus (DEH 2004a), listed as a Key Threatening Process on the TSC Act and the EPBC Act.

Local and Regional Conservation Status

The Booroolong Frog is classified as Endangered under the TSC Act and under the EPBC Act. Formerly, the species was present in three main concentrations: the New England Tablelands, the Central Tablelands and the western side of Kosciusko National Park (DECC 2008b, DEH 2004a). Aside from two locations near Tamworth, Booroolong Frog have not been found in the northern part of their range since 1994 (Anstis 2002, DEH 2004a) and it is suspected that the species is virtually extinct in this area (NSW Scientific Committee 1998a, DEH 2004a). The Booroolong Frog has also declined severely across the remainder of its range (DEH 2004a), with only a handful of recent records from the Central Tablelands area. The species is not well represented within conservation reserves, though it is known from Abercrombie River, Turon, Kosciusko and Woomargama National Parks. There are historical records from within Blue Mountains National Park and northern Wollemi National Park, though populations in these areas appear to have been lost (NSW Scientific Committee 1998a).

The Booroolong Frog has not been recorded within the study area since 1979, when an Australian Museum specimen was collected from Wollemi Creek (Map 3). Extensive surveys for the Booroolong Frog were not undertaken during the CRA or BSP surveys, however no evidence of the frog was detected. The nearest known extant population is located on the Turon River, approximately seventy kilometres west of the study area.

It is highly likely that the Booroolong Frog is extinct from south-eastern Wollemi National Park, as well as from the surrounding region. However, further targeted survey work would be required to definitively determine this, involving nocturnal surveys adjacent to permanent creek lines in late spring/summer, particularly after heavy rain. There is most chance that the species persists in more remote parts of the drier northern section of the study area, and where exotic fish species are not known to occur, such as along Wollemi Creek and the lower Capertee River. Given the drastic decline of this species across its range, the discovery of an extant population, though highly unlikely, would have extremely high conservation significance and warrant immediate management action.

LITTLEJOHN'S TREE FROG

Species Profile

Plate 24: Littlejohn's Tree Frog © H. Jessup

Littlejohn's Tree Frog is a poorly-known species that was only recently taxonomically separated from the Jervis Bay Tree Frog (*L. jervisiensis*) (White *et al.* 1994). It is confined to coastal environs at scattered locations from the Watagan Range west of Gosford to eastern Victoria (Barker *et al.* 1995). Littlejohn's Tree Frog is also known as the Heath Frog, though it may associate with a number of environments, including sedgelands, wet and dry sclerophyll forests and woodlands (Lemckert 2005). Males have been found to call at any month of the year, with a recent review of records from NSW suggesting a peak around February (Lemckert 2005). Males will call from elevated positions beside ponds and creeks (Anstis 2002) with breeding habitat not restricted to any particular type of water body, having been found in streams, temporary pools and dams (Lemckert 2005).

Threats

Littlejohn's Tree Frog is one of the most infrequently recorded frogs in NSW (Lemckert 2005) and consequently, very little is known about the threats operating on this species. The NSW Scientific Committee (2000a) listed the following as potential threats: limited dispersal from small populations, which increases the risk of local extinction; clearing of native vegetation and reduced habitat availability; and inappropriate fire practices (including pre- and post-logging burns and control burning) that disturb breeding habitat. It is possible that this species is another that is particularly susceptible to frog Chytrid fungus. Lemckert (2005) states that although the species will definitely tolerate some degree of disturbance, it has never been found in fully cleared areas. The NSW Scientific Committee (2005a) listed this species as one that is likely to have habitat affected by subsidence due to longwall mining. Predation by introduced fish and yabbies is another potential threat to this frog (G. Daly pers. comm.).

Local and Regional Conservation Status

Littlejohn's Tree Frog is listed as Vulnerable under the TSC Act and under the EPBC Act. Scattered records occur within the Sydney Basin and South East Corner Bioregions, where it is thought that Littlejohn's Tree Frog has declined significantly over the past 20 years. The paucity of records would suggest that it is extremely rare, though Lemckert (2005) cautions that the species is likely to be under-recorded due to the lack of information available on which to base targeted surveys. Within the Sydney Basin Bioregion they are currently known from the Watagans and Blue Mountains NPs and the Woronora Plateau, and they are regularly recorded at Barren Grounds NR.

Littlejohn's Tree Frog was recorded for the first time in the whole of Wollemi National Park during the BSP surveys in October 2007 when a tadpole was located near the headwaters of a tributary of Bowens Creek (Map 3). The identity of the tadpole was confirmed by A. White and M. Anstis through photos. The tadpole was located in a deep pool of water on the creek line, in dry sclerophyll forest dominated by Smooth-barked Apple and Sydney Peppermint. The ground layer adjacent to the waterway included many sedges, such as Saw-sedge (*Gahnia sieberiana*) and *Schoenus melanostachys*, as well as shrubs such as Tantoon (*Leptospermum polygalifolium*). Such habitats occur elsewhere in that area, as do patches of Upland Swamp, a habitat in which the species is regularly recorded elsewhere in the Sydney Basin (DECC 2007a). It is therefore possible that the species occurs in further locations in the study area, most likely in creek headwaters and Upland Swamps south of the Colo River where rainfall is higher.

The status of Littlejohn's Tree Frog in the study area, and indeed through the remainder of Wollemi National Park is currently unknown. The species is known to occur in Blue Mountains NP to the south. However records of Littlejohn's Tree Frog remain rare within the region and the species is considered a high conservation priority, particularly at known breeding sites. It is recommended that further surveys for Littlejohn's Tree Frog be undertaken in creek headwaters and Upland Swamps south of the Colo River, to establish the extent of the population(s) in the study area and make an assessment of the current risks to their ongoing survival. The greatest threat to the survival of Littlejohn's Tree Frog in the reserve system is likely to be infection by Chytrid fungus. Testing for Chytrid fungus should therefore be incorporated into any targeted surveys for the species.

ROSENBERG'S GOANNA

Species Profile

Rosenberg's Goanna (*Varanus rosenbergi*) (also known as Heath Monitor) is a large, powerful lizard that occurs in the greater Sydney Basin and the Southern Highlands, but then discontiguously through Victoria, South Australia and south-western Western Australia (King and Green 1999). It is superficially similar to the commonly encountered Lace Monitor though morphologically and taxonomically it is closer to the Sand Monitor. It can be distinguished from the Lace Monitor by the fine barring on its lips and tail and the spots on front and back legs, and from the Sand Monitor by the lack of a distinctive plain yellow tail tip. This goanna is known to be associated with sandstone environments, but is relatively cryptic and can be difficult to detect. It is usually found in heath and woodlands where it shelters in burrows, hollow logs and rock crevices (Cogger 2000).

Plate 25: Rosenberg's Goanna © N. Corkish/DECC

Threats

Rosenberg's Goanna is particularly threatened in urban fringes, due to development of the flat sandstone ridge tops that are its preferred habitat as well as road mortality (NPWS 2002a). Goannas have been identified as taking poison 1080 baits (Thomson and Kok 2002) and thus may be impacted upon by Wild Dog and Fox control programs. Eggs and juveniles may also be vulnerable to predation by Feral Cats and Dogs (DEC 2005d). Rosenberg's Goanna is listed as a species adversely affected by the Key Threatening Process removal of dead wood and dead trees (NSW Scientific Committee 2003a).

Local and Regional Conservation Status

Rosenberg's Goanna is listed as Vulnerable under the TSC Act. The NSW population was once thought to be restricted to the Hawkesbury and Narrabeen sandstones (particularly coastal areas such as Ku-ring-gai Chase NP, Woronora Plateau and Morton NP), but survey work conducted by DECC over the last few years has confirmed it to be present elsewhere in the region, with confirmed sightings from Abercrombie River and Turon NPs. In addition, there are anecdotal records of this species from the south-western slopes as far west as Bathurst and for the region around Goulburn (R. Wells pers. comm.), Braidwood and parts of the ACT (M. Schulz pers. comm.). The species is moderately well represented in conservation reserves in the Sydney Basin, including in Wollemi, Yengo and Blue Mountains NPs (DECC 2008b).

Rosenberg's Goanna has been recorded on just two occasions in the study area, once on the Mellong Plateau during CRA surveys and once on Grassy Hill track during BSP surveys (Map 3). Habitat for the species is widespread, however, and it is likely to be more frequently occurring than records indicate. Records of Rosenberg's Goanna are sparsely scattered across Yengo and northern Wollemi NPs and Parr SCA, and in the study area the species is also likely to be patchily distributed right across the sandstone plateau, particularly on ridgelines and upper slopes.

Within the system of reserves that run around the western rim of the Sydney Basin, there are few threats to the species, and its habitat is relatively well conserved in the region. Predation by introduced carnivores is likely to be the most significant threat currently acting upon the species, a factor which should be considered in ongoing feral management control programs. Besides this, no immediate management actions are currently required for the species in the study area.

BROAD-HEADED SNAKE

Species Profile

Plate 26: Broad-headed Snake © A. Dudley

The Broad-headed Snake (*Hoplocephalus bungaroides*) is a semi-arboreal species that spends the cooler part the year under sandstone exfoliations and around rock outcrops, and the summer sheltering in tree hollows in woodland (Webb and Shine 1997). It averages about 60 centimetres in length and is recognisable by its black and yellow patterning. It is restricted to the sandstone environments of the Sydney Basin between Wollemi National Park and the Clyde River catchment, south west of Nowra. Within this range it has disappeared from such areas as Port Jackson and Middle Harbour, and on the western edge of its distribution around Bathurst. It is primarily a nocturnal ambush predator (NPWS 1999a) and is known to prey on Lesueur's Velvet Gecko (*Oedura lesueurii*).

Threats

Known key threats to the Broad-headed Snake include removal and disturbance of bush rock (Shine and Fitzgerald 1989) and collection of specimens from the wild by snake-collectors (NPWS 1999a). Other potential threats include: urbanisation of sandstone ridge tops; logging operations; and altered fire regimes including an increase in vegetation density due to long term fire suppression that results in a reduction in winter habitat (Pringle *et al.* 2003). Feral animals may threaten the species through both predation and disturbance (NPWS 1999a), in particular the disturbance of rock outcrops by Feral Goats (Murphy 1996). Habitat alteration by longwall mining and the removal of dead wood and dead trees are other Key Threatening Processes thought to impact upon this snake (NSW Scientific Committee 2005a, 2003a).

Local and Regional Conservation Status

The Broad-headed Snake is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. It is restricted to the Hawkesbury and Narrabeen sandstones of the Sydney Basin Bioregion and has disappeared from many locations where it was once well-known to occur. Remaining strongholds appear to be the upper Blue Mountains, southern Wollemi and Royal National Parks extending on to the Woronora Plateau. There is also a population in eastern Morton National Park, west of Nowra, where recent targeted surveys in high quality habitat detected two individuals in approximately 27 hours of searching by expert herpetologists (P. Craven pers. comm.).

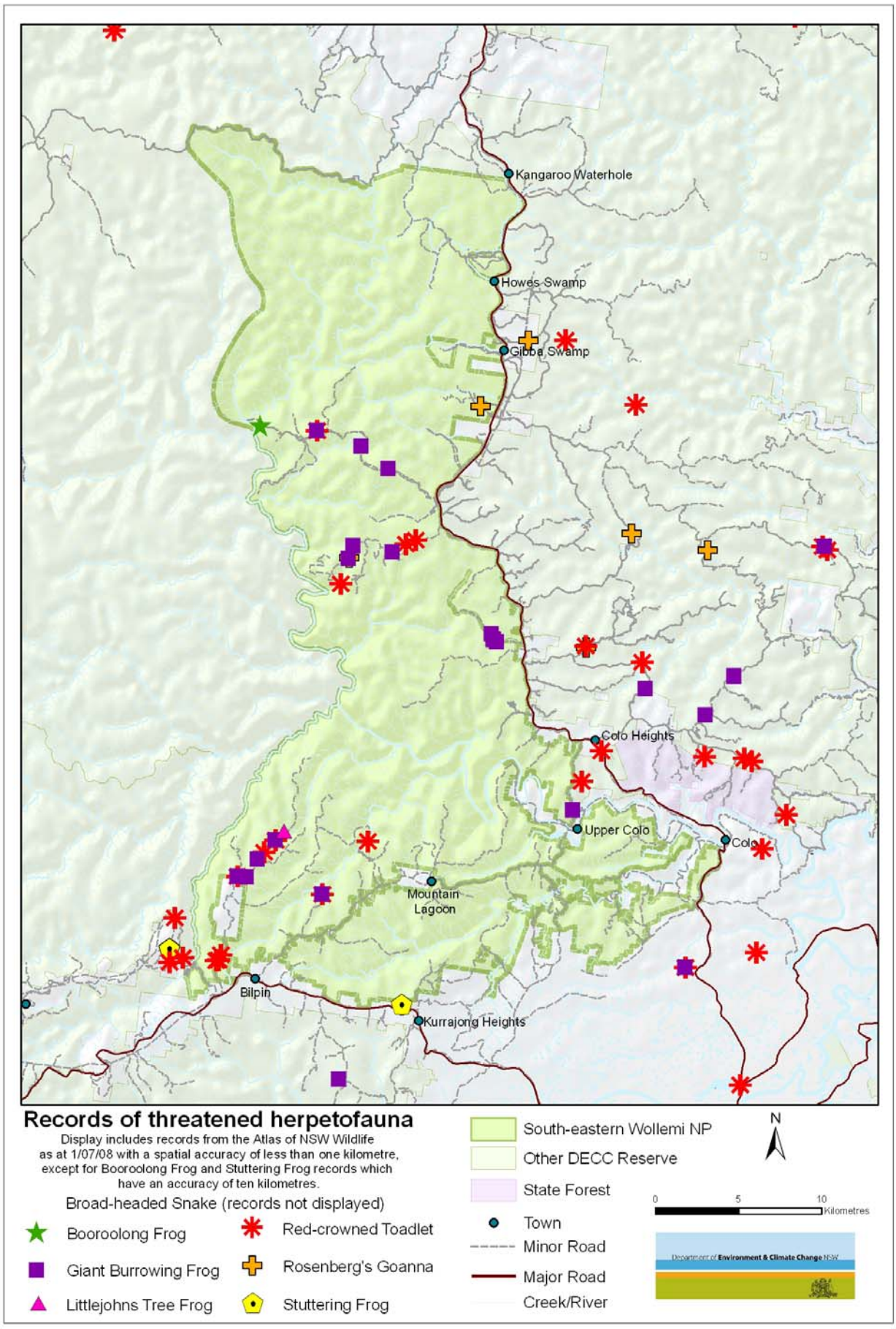
Broad-headed Snake have been recorded on six occasions in south-eastern Wollemi NP on the Atlas of NSW Wildlife, though only four of these records are associated with accurate spatial information. The records range from the late 1970s to 2007 when two individuals were seen during the BSP surveys. Both of these latter observations were made in November, including one individual observed at night on Angorawa Creek track and one snake found coiled in the honeycomb weathering of a dark sandstone overhang along the Colo River. The other two spatially accurate records originate from the Mellong Plateau.

Targeted searches for Broad-headed Snake in the last decade suggest the species to be very rare in reserves in the northern half of the Sydney Basin (Newell 1998 in Baker 2003). Over 540 systematic reptile searches (and hours of opportunistic survey) undertaken in Yengo and northern Wollemi NPs between 2004 and 2007 located just one individual (in north-western Wollemi NP see DEC 2007a). The sighting of two individuals in south-eastern Wollemi NP during the BSP surveys this year, and a further two individuals in neighbouring north-eastern Blue Mountains NP (DECC 2008c), suggests these two areas are important for the Broad-headed Snake. The reason for this higher rate of sightings is not known, but likely to relate to either a greater abundance of Broad-headed Snakes in these areas, or to some climatic variation that made the snakes more visible this season than during the previous three years. In either case, south-eastern Wollemi NP clearly holds high significance to the conservation of the Broad-headed Snake in the Sydney Basin. The species is likely to also persist in other parts of the Hawkesbury Sandstone plateau where suitable habitat features abound, particularly remote sections located far from roads and access points. Further survey would be

required to accurately determine the current status of the Broad-headed Snake in the study area. The species is known to still occur in other parts of the greater Blue Mountains, particularly to the south-west of the study area.

Postulated threats to the species in south-eastern Wollemi NP include: previous and current disturbance to and removal of bush rock leading to low availability of winter shelter sites; previous removal of hollows during logging operations leading to reduced availability of summer shelter sites; frequent high intensity wildfire; and possibly predation by introduced carnivores and disturbance by Feral Goats. The relative importance and degree of impact of these threats is unknown.

Management actions for the Broad-headed Snake in south-eastern Wollemi NP would ideally commence with gaining a better understanding of the species current distribution and status. However, due to the notorious difficulty in surveying this species, further surveys would be very expensive and likely to provide little, if any, return. Until more efficient survey protocols are identified for this species, further surveys are therefore not recommended. Management should instead focus on mitigating key threats to the species, including ensuring that access to mapped areas of extensive outcropping and exfoliating rock is highly restricted and that natural maturation and senescence of forest and woodland is enabled to allow the re-establishment of hollows in previously logged and cleared areas. The study area is also being incorporated into a research programme currently underway trialling the introduction of replacement rocks to potential habitat areas, with the aim that this could be used to augment habitat where natural rock has been removed (M. Ewings pers. comm.). Active management of the Broad-headed Snake in the park should be undertaken in consultation with the species recovery team. In the absence of more data, any potential Broad-headed Snake habitat located in south-eastern Wollemi NP, particularly extensive areas of outcropping and exfoliating rock and adjacent wooded areas supporting hollows, should be considered of high conservation significance.



Map 3: Threatened herpetofauna records within five kilometres of south-eastern Wollemi NP

GANG-GANG COCKATOO

Species Profile

Plate 27: Gang-gang Cockatoo © K. Madden/DECC

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, with the males crest and head being 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 understorey or on the ground (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 2001a, 2005b). An important threat 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 2001a), while Psittacine Circoviral (Beak and Feather) Disease may threaten small populations that are already stressed (DEH 2004b). Climate change may alter the extent and nature of the cool temperate vegetation that the species utilises (Olsen *et al.* 2003, NSW Scientific Committee 2005b).

Local and Regional Conservation Status

The Gang-gang Cockatoo is listed as a Vulnerable Species under the TSC Act. 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 relatively few records in the Sydney and Wollongong urban areas. Numerous records of the species occur within many reserves, including Kanangra-Boyd, Blue Mountains, Nattai, Wollemi and Yengo National Parks.

Records of Gang-gang Cockatoo are widely scattered across south-eastern Wollemi NP, from Wollemi Creek in the north to Wheeny Creek and the Mount Tootie area in the south (Map 4). The bird has been seen and heard in a wide range of habitat types, including sandstone ridgetop woodland, basalt cap forest, *Melaleuca* swamp forest, sheltered gully forest and rainforest. 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 the known potential threats to this species, the only ones relevant to the study area are reduced availability of tree hollows from previous logging operations, and potentially climate change.

The study area is clearly important to the local protection of the Gang-gang Cockatoo and contributes significantly to its regional conservation. However, the species is widespread across the sandstone reserves of the Sydney Basin, and is currently considered to be relatively secure in the region. No management actions are currently required for the Gang-gang Cockatoo in south-eastern Wollemi NP.

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).

Plate 28: Glossy Black-cockatoo © N. Williams/DECC

Threats

The major threat appears to be habitat destruction for agricultural or residential development, causing the removal of nesting and feeding sites and also increased competition from more open habitat species such as Galahs. Because many *Allocasuarina* species are fire sensitive, inappropriate burning regimes may affect food supplies (NSW Scientific Committee 2000b). In addition, the removal of dead wood and dead trees is a Key Threatening Process that may impact on this species (NSW Scientific Committee 2003a), as is competition from Feral Honeybees (*Apis mellifora*) (NSW Scientific Committee 2002b). In addition, DEH (2004b) 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 TSC Act. 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 1999b). Relatively large areas of the Sydney Basin provide suitable habitat for the species and there are a large number of records throughout the Bioregion (DECC 2008b). Feeding habitat is well protected, occurring in numerous DECC reserves, including Morton, Nattai, Blue Mountains, Ku-ring-gai Chase, Yengo and Wollemi NPs.

The Glossy Black-cockatoo has been seen or heard on sixteen occasions in south-eastern Wollemi NP, though only twelve of the records are associated with accurate spatial referencing (Map 4). In addition to this, evidence of feeding activity in the form of chewed *Allocasuarina* cones has been recorded at a further eleven locations in the park (also included in Map 4). The species has primarily been recorded in gully lines and sheltered slopes, as this is where Forest Oak (*Allocasuarina torulosa*) often occurs, though it is also infrequently recorded in more exposed locations, such as where Black She-oak (*Allocasuarina littoralis*) grows.

The Glossy Black-cockatoo was not been recorded as frequently in south-eastern Wollemi NP as in the adjacent southern Yengo, Parr and northern Wollemi reserves, but the area nevertheless contributes significantly to the regional conservation of the species. The Glossy Black-cockatoo is well protected across the sandstone environments of the Sydney Basin, and appears to have few threats acting upon it within the reserve system. No management actions are currently required for the Glossy Black-cockatoo in south-eastern Wollemi NP. Fire management may be necessary in the future if research indicates that burning regimes are reducing the abundance or distribution of *Allocasuarina* species.

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).

Plate 29: Turquoise Parrot © DECC

Threats

Garnett and Crowley (2000) summarise the main threats as: 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. The species is listed as potentially threatened by the removal of dead wood and dead trees (NSW Scientific Committee 2003a). Psittacine Circoviral (Beak and Feather) Disease is not known from this species, but has been recorded in the congeneric Orange-bellied Parrot (*N. chrysogaster*) (DEH 2004b). The species may also be threatened by competition for nesting sites with introduced birds, such as the Common Myna, as well as Feral Honeybees.

Local and Regional Conservation Status

The Turquoise Parrot is listed as Vulnerable under the TSC Act. Within NSW the number of records is highest along the western slopes (Nandewar, Brigalow Belt South and NSW South West Slopes Bioregions) and in the Sydney Basin Bioregion (DECC 2008b). In the latter, the species is most commonly found within dry grassy woodland environments in the Hunter and Capertee Valleys and to a lesser extent the Cumberland Plain. Important conservation reserves for this species in this Bioregion include Wollemi, Yengo and Goulburn River NPs, Munghorn Gap Nature Reserve and Yerranderie SCA.

Turquoise Parrot has been recorded at eleven locations in south-eastern Wollemi NP (Map 4) as well as several times during the first Birds Australia survey (not presented in Map 4 due to low spatial accuracy). The most recent sighting was made during the BSP surveys when an individual was seen on Angorawa Creek in November 2007. Turquoise Parrot records are concentrated along the eastern edge of the park, particularly north of Colo Heights to Angorawa Creek, and on the Mellong Plateau. In the last decade the Turquoise Parrot has been recorded most frequently on the Mellong Plateau, within the grassy woodlands and woodlands on perched sands, as was found to be the case in adjacent southern Yengo NP (DECC 2008a). The species is also likely to visit Ironbark-dominated woodlands during periods of flowering, while further potential habitat exists in the far north of the study area in the more open woodlands along Wollemi and Long Weeney Creeks. The Turquoise Parrot has not been recorded in higher rainfall areas in the south of the park, and is particularly unlikely to occur in the south-east corner.

South-eastern Wollemi NP supports relatively peripheral habitat for the Turquoise Parrot, with only the Mellong Plateau being frequently used by the species. The majority of the study area does not provide suitable habitat. However, due to the fact that large amounts of Turquoise Parrot habitat in the Goulburn, Capertee, Hunter and Howes Valleys, and on the Cumberland Plain, have been cleared in the past for agriculture, or are still under threat from urban development and expansion of mining activities, all habitat that is conserved in reserves has high conservation value. The study area therefore provides a small yet significant contribution to the regional conservation of the species. The greatest threat to the species within the study area is likely to be predation by Fox and Feral Cat, both of which have been recorded in Turquoise Parrot habitat areas. High frequency fire on the Mellong Plateau may also affect the species.

BROWN TREECREEPER (EASTERN SUBSPECIES)

Species Profile

The Brown Treecreeper (*Climacteris picumnus*) is a medium-sized brown bird that is similar in appearance to the Red-browed and White-throated Treecreepers. It is distinguished from both by its slightly larger size, distinctive pale 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, it 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).

Plate 30: Brown Treecreeper © M. Schulz

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). Studies have shown that populations cannot persist in habitat fragments smaller than 300 hectares, mostly because females either disperse or suffer from preferential mortality. As with most treecreepers, once extinction occurs in a remnant, natural recolonisation is unlikely (Garnett and Crowley 2000). Competition for tree hollows from introduced species such as the Common Starling and Feral Honeybee is also problematic (Higgins *et al.* 2001; NSW Scientific Committee 2001a). Further processes that are thought to impact on this species are the removal of dead wood and dead trees (NSW Scientific Committee 2003a) and grazing, which reduces the diversity of ground-dwelling invertebrates and hence food availability (NSW Scientific Committee 2001a).

Local and Regional Conservation Status

The eastern subspecies of the Brown Treecreeper is listed as Vulnerable under the TSC Act. It is found through all the eastern Bioregions in NSW, though 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 (DECC 2008b). These environments are all characterised by agricultural and urban clearing with scattered small isolated fragments of native vegetation. The species is very close to extinction from the Cumberland Plain, with recent sightings consisting of only a small isolated population in the south (DECC 2007a). Habitat for the species is contained within a limited number of reserves within the Sydney Basin Bioregion, including Yerranderie SCA, Nattai NP (Burragorang and Nattai Valleys), Wollemi, Yengo, Blue Mountains and Goulburn River NPs and Manobalai NR.

There are historic records of Brown Treecreeper from the study area collected during the late 1970s and early 1980s, however the exact locations of these sightings are not known. The species was confirmed to still occur in December 2006 (C. Barker pers. comm.), and again during the BSP surveys, when birds were observed along Wollemi Creek and one of its tributaries (Map 4). The occurrence of the species here is due to the presence of drier open woodland. Brown Treecreeper is known to occur on the Mellong Plateau in Yengo NP (DECC 2008a) and potentially uses these open woodland habitats in the Wollemi NP side of the Mellong Plateau also.

South-eastern Wollemi NP supports only a relatively small amount of peripheral habitat for the Brown Treecreeper (eastern subspecies) and the majority of the study area does not provide suitable habitat. However, due to the fact that only small amounts of Brown Treecreeper habitat in the Goulburn, Capertee, Hunter and Howes Valleys and on the Cumberland Plain are located in public lands or reserves, all habitat that is conserved has high conservation value. South-eastern Wollemi NP therefore provides a very small yet significant contribution to the regional conservation of the species. Potential threats to the species within the study area are not known, but may include grazing by introduced herbivores (including wild Cattle along Wollemi Creek and Fallow Deer on the Mellong Plateau) and competition for hollows from the Feral Honeybee. The Mellong Plateau and the Wollemi Creek catchment should therefore be included in Deer and Cattle eradication programmes to aid abatement of these potential threats.

BLACK-CHINNED HONEYEATER (EASTERN SUBSPECIES)

Species Profile

Plate 31: Black-chinned Honeyeater © P. Mahoney

The Black-chinned Honeyeater (*Melithreptus gularis*) is a small, rather stocky and short-tailed honeyeater. It is distinguished from other related honeyeaters by its relatively larger size, bright blue or jade green eye-wattle and distinctive call. The species is nomadic, moving within and between drier eucalypt woodlands that feature Ironbark and/or Box species. It is usually found in pairs or small groups of up to twelve and feeds on insects, nectar and lerp usually in the upper canopy and outermost flowers and leaves. There are two subspecies, which 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 fragmentation of woodland habitat and do not 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). The species is 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 the Pied Currawong (NSW Scientific Committee 2001c).

Local and Regional Conservation Status

The eastern subspecies of the Black-chinned Honeyeater is listed as Vulnerable under the TSC Act. Scattered records occur in the eastern half of the state, with the highest number in the Nandewar, Sydney Basin and NSW South West Slopes Bioregions (DECC 2008b). In the Sydney Basin region most records come from drier areas with fertile soils such as the Capertee and Hunter Valleys and western Sydney, where it is often associated with winter-flowering tree species such as White Box (*Eucalyptus albens*) and Spotted Gum (*Corymbia maculata*). All of these areas have been heavily cleared in the past and remain subject to numerous ongoing threatening processes. Most of the records for the species are outside of conservation areas. However, it has been recorded in a small number of DECC reserves, notably Goulburn River and Werakata NPs and Munghorn Gap Nature Reserve, as well as Yengo and northern Wollemi NPs (DECC 2008b).

Though Black-chinned Honeyeater were recorded during the first Birds Australia atlas, accurate records of the species in south-eastern Wollemi NP were not collected until the CRA surveys, when an individual was heard along Dooli Creek, and again during the BSP surveys when two birds were observed along Wollemi Creek and two along Long Weeney Creek in November 2007 (Map 4). Both of these latter observations were made in forest supporting Ironbark species, as was found to most often be the case in Yengo NP (DECC 2008a). The Black-chinned Honeyeater is likely to visit other areas of Ironbark-dominated woodlands during periods of flowering, and may occasionally use the Mellong Plateau. The Black-chinned Honeyeater is unlikely to occur in the higher elevation areas in the far south of the park.

The Black-chinned Honeyeater is a mobile species that moves around the landscape in response to local flowering events. The species is therefore likely to utilise the extent of vegetation communities in the park that contain Ironbark species in the canopy, which most frequently occur on lower Narrabeen sandstone slopes in lower rainfall areas, such as on the slopes of Wollemi Creek in the north of the study area. The amount of high quality habitat available to the Black-chinned Honeyeater in south-eastern Wollemi NP is limited in extent, yet the area still plays a significant role in the regional conservation of the species. Potential threats to the species from within the study area are not known and hence no management actions can currently be recommended in the park.

REGENT HONEYEATER

Species Profile

The Regent Honeyeater (*Xanthomyza phrygia*) is a medium-sized honeyeater with striking black and yellow plumage. It typically favours Box-Ironbark woodland, though it also utilises River Oak 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 on nectar, lerps and insects and nests in the crown of eucalypts where it usually lays two or three eggs. It is endemic to south-eastern Australia, formerly occurring between central Queensland and South Australia. 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 1500 individuals remaining, with numbers considered to be still decreasing (Garnett and Crowley 2000).

Plate 32: Regent Honeyeater © DECC

Threats

Land clearance for agriculture has removed about three-quarters of habitat that was suitable for the Regent Honeyeater across its range. The remaining habitat is highly fragmented, and continues to be degraded by the removal of larger trees as well as grazing by domestic stock and Rabbits (NPWS 1999b). Habitat alteration may also advantage more aggressive honeyeaters, such as miners (*Manorina* spp.) and friarbirds (*Philemon* spp.), which may displace the Regent Honeyeater.

Local and Regional Conservation Status

The Regent Honeyeater is listed as Endangered under the TSC Act and under the EPBC Act. Within NSW the greatest numbers occur in the Sydney Basin, Nandewar and New England Tableland Bioregions (DECC 2008b). Important areas in the Sydney Basin are 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 NPs, Munghorn Gap Nature Reserve, and occasionally Wollemi NP (DECC 2008b).

The Regent Honeyeater was frequently recorded on the periphery of the study area during the 1980s, including at Colo Heights and at Upper Colo on the Colo River (Map 4). The species were only recorded in low numbers, being two to four individuals on any one occasion. However, the species has not been recorded in either of these areas since 1987. This is of great concern and part of an observed massive decrease in abundance and reduction in range for the entire species. During the 1980s the species would have utilised the River Oak that grows along the Colo River and the grassy Ironbark forest around Colo Heights for foraging. In the vicinity of the study area in the last decade the Regent Honeyeater has most frequently been sighted on the Cumberland Plain between Castlereagh NR and Blue Mountains NP, in the Capertee Valley including along the Capertee River in western Wollemi NP and occasionally in the Putty Valley (DECC 2008b). The species may also occasionally utilise the small patches of Swamp Mahogany forest that have recently been mapped in alluvial areas to the south-east of Wollemi NP (DECC 2008d).

South-eastern Wollemi NP contains only a very small fraction of marginal habitat for this Endangered species. The Regent Honeyeater favours creek lines and valley flats that support River Oak with mistletoe, Red Gum, Swamp Mahogany or Rough-barked Apple, as well as vegetation communities that are dominated by Box and Ironbark species. A small amount of such habitat occurs along the Colo River, along the northern section of Wollemi Creek and Long Weeney Creek, around Colo Heights, and small patches along Angorawa Creek and on the Mellong Plateau. It is possible that the Regent Honeyeater still visits such areas on rare occasions when trees are in heavy flower or food is limited elsewhere.

Clearing has reduced the available habitat in the region, with the greater extent of quality habitat located on private lands. Much of the remaining high quality habitat within the region is fragmented and continues to be degraded or under pressure from development. Any habitat that is preserved within the reserve system therefore has high conservation significance. Though the study area contains only a small amount of peripheral habitat, it may none-the-less contribute to the network of foraging resources available to the Regent Honeyeater in the region. Management actions should be focussed on targeted surveys during peak flowering periods of favoured food trees, over several years, in order to ascertain the extent to which the species currently utilises the study area, if at all.

GREY-CROWNED BABBLER (EASTERN SUBSPECIES)

Species Profile

Plate 33: Grey-crowned Babbler © N. Williams

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. The Grey-crowned Babbler lives 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 (Garnett and Crowley 2000). The species feeds on invertebrates gleaned from vegetation or the ground (Garnett and Crowley 2000). The birds form family parties which are thought to be vital for predator avoidance and co-operative feeding of the young (King 1980).

Threats

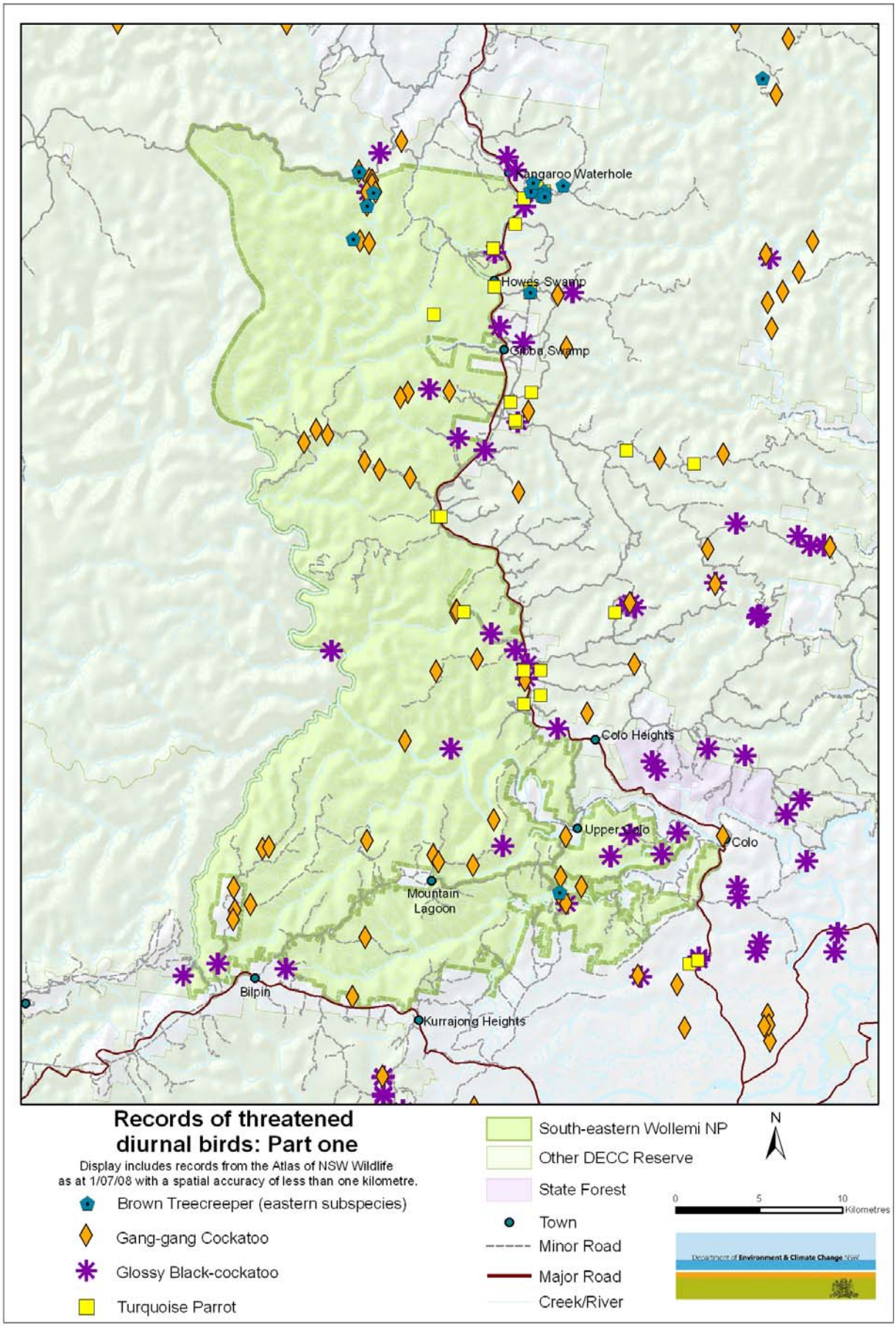
The Grey-crowned Babbler has been identified as one of a number of birds that have declined significantly in range and population in the sheep-wheat belt of central west NSW due to the degradation and fragmentation of woodland habitats (Reid 1999). Much remaining Babbler habitat occurs in isolated fragments, from which the species has gradually disappeared (Garnett and Crowley 2000). 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 (NSW Scientific Committee 2003b), as does increased competitor abundance in disturbed habitats (NSW Scientific Committee 2004a), removal of important feeding sites in the form of dead wood and dead trees and possibly predation by Feral Cats.

Local and Regional Conservation Status

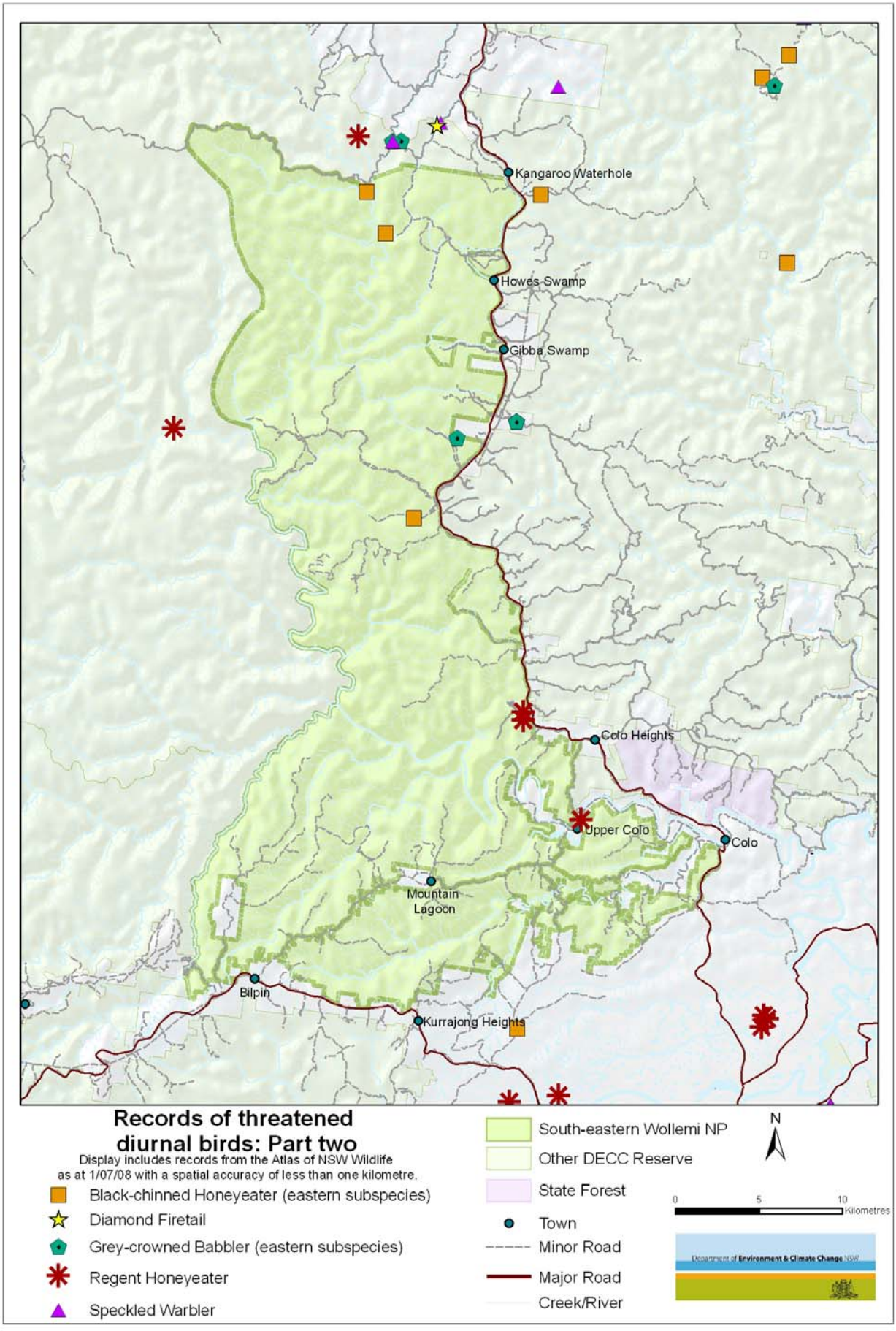
The eastern subspecies of the Grey-crowned Babbler is listed as Vulnerable under the TSC Act. It is most common in the central western Bioregions of NSW, particularly the NSW South Western Slopes and Brigalow Belt South, but also occurs in the NSW North Coast Bioregion in areas such as in the Clarence River Valley (DECC 2008b). 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 associated with the drier woodland habitats. Within the Bioregion it is poorly represented in reserves, but has been detected within Wollemi, Goulburn River, Yengo and Werakata National Parks and Munghorn Gap Nature Reserve (DECC 2008b).

The Grey-crowned Babbler has been recorded on just one occasion on the extreme periphery of the study area near Tari Creek in 2003 (Map 4). Potential habitat for this species is very limited, confined to the lower rainfall areas in the north-east where open woodland occurs. In addition to the Mellong Plateau, potential habitat occurs along the wider creek flats of Wollemi and Long Weeney Creeks, and in fact the species was recorded just north of the study area on Putty Creek flats in late 2007 (Map 4). In the last decade in the vicinity of south-eastern Wollemi NP the Grey-crowned Babbler has most frequently been sighted in Putty and Howes Valleys and further afield through the Hunter and Capertee Valleys including along the boundaries of northern Wollemi NP (DECC 2008b). The species is highly unlikely to occur in the southern half of the study area as the habitat and average rainfall patterns are not suitable.

South-eastern Wollemi NP supports only a very small fraction of marginal habitat for the Grey-crowned Babbler. However, as much of the little remaining habitat for this species east of the Great Dividing Range is still under threat from further fragmentation and development, all habitat contained within the reserve system makes a significant contribution to the species long term conservation in eastern central NSW. The species is subject to ongoing threats even within the reserve system, including grazing by introduced herbivores, weed invasion and possibly predation by introduced carnivores. Ongoing management of these threats on the Mellong Plateau and Putty, Wollemi and Long Weeney Creeks may be important to the long term survival of Grey-crowned Babbler in the study area.



Map 4: Part one of threatened diurnal bird records within five kilometres of south-eastern Wollemi NP



Map 5: Part two of threatened diurnal bird records within five kilometres of south-eastern Wollemi NP

BARKING OWL

Species Profile

The Barking Owl (*Ninox connivens*) is of intermediate size between the larger Powerful Owl and the Southern 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 or Dog 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 (Higgins 1999).

Plate 34: Barking Owl © S. Cottrell/DECC

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 often subject to degradation through grazing or forestry operations that fell old-growth and over-mature trees, thus reducing available nest sites (NPWS 2003c). 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). Other threats include predation (particularly of fledglings), mortality from collisions with fences and vehicles, secondary poisoning from rodenticides, collection of firewood and removal of dead wood and trees and competition from Feral Honeybees (Garnet and Crowley 2000, NSW Scientific Committee 1998b). The long generation time of this species (ten years) is a further issue, as it compromises the ability to recover after suffering population declines (NSW Scientific Committee 1998b).

Local and Regional Conservation Status

The Barking Owl is listed as Vulnerable under the TSC Act. Records occur throughout NSW, though it is rarer in the far west and at higher altitudes in the south-east (DECC 2008b). Records are scattered throughout the Sydney Basin Bioregion, the most important locations appearing to be the Capertee and Hunter Valleys. Within this Bioregion very few records are located on conservation reserves, with most being on private lands (DECC 2008b). However, recent DECC surveys have obtained a small number of records from the dry woodlands in Yengo and northern Wollemi National Parks as well as Manobalai Nature Reserve and Crown Lands.

There is a high degree of uncertainty regarding the occurrence of Barking Owl in south-eastern Wollemi NP, as the species has only been recorded during the first Birds Australia Atlas (low spatially accuracy records prior to 1981) and once by a member of the public somewhere within a ten kilometre radius of Wheeny Creek campground. Due to the low spatial accuracy of these records they have not been presented on Map 6. In the last decade within the vicinity of the study area the Barking Owl has been recorded to the south on the Cumberland Plain, to the west elsewhere in Wollemi NP, to the north in the Putty Valley and to the east in Yengo NP, particularly around Big Yango Station where a population is known to still occur (DECC 2008a). Habitat for the Barking Owl occurs along creek lines and lower slopes in the drier parts of the study area, namely along Putty, Wollemi and Long Weeney Creeks. Only three nocturnal call playback censuses have been undertaken along Wollemi Creek, and one along Long Weeney Creek. The species thus has the potential to have gone undetected in this area, though it is likely to be low in abundance and restricted in extent.

Though it is not known whether habitat for the Barking Owl in south-eastern Wollemi NP is currently occupied, the inclusion of potential habitat in the park has conservation significance as much of the preferred habitat in the Capertee, Goulburn and Hunter Valleys and on the Cumberland Plain has been widely depleted by clearing for agriculture, industry and settlements and much remaining habitat is under continued pressure from these threats. South-eastern Wollemi NP is likely to only contribute a small amount to regional conservation of the species, but if the species does occur this contribution should not be discounted. It is recommended that further call playback surveys be undertaken for this species to assess its conservation status in the park. Current threats to the Barking Owl within Wollemi NP are not known, but likely to be few within the study area. Management of the owl if it is found to occur should be undertaken in accordance with the state-wide recovery plan (NPWS 2003c).

POWERFUL OWL

Species Profile

Plate 35: Powerful Owl © N. Williams

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 and Greater Gliders (Kavanagh 2002a). This species usually nests in a hollow in a eucalypt within or below the canopy, and normally lays two eggs. It usually maintains 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).

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 bushland areas of Brisbane, Sydney and Melbourne (Garnett and Crowley 2000, DECC 2008e). Two of the determining factors for the species persistence in disturbed areas are the presence and suitable abundance of prey species (Chafer 1992) and suitable nesting/roosting sites (Debus and Chafer 1994). Other factors that may affect this species include predation of fledglings by Foxes and secondary poisoning, though neither is thought to be a significant cause of mortality (DEC 2006b). In addition, the foliage roosts of the Powerful Owl are vulnerable to regular hazard reduction burning (DEC 2006b).

Local and Regional Conservation Status

The Powerful Owl is listed as Vulnerable under the TSC Act. Within NSW, 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 is regularly recorded throughout the Sydney Basin Bioregion, from the rural-urban fringes of the Sydney Metropolitan area to west of the Dividing Range onto the Central Tablelands. 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 (DECC 2007a). Most reserves within the Sydney Basin Bioregion support known territories of this species, though they are at lower densities in the drier environments of the north-west.

The Powerful Owl has been recorded at 10 locations within south-eastern Wollemi NP, including four times during CRA surveys and six times during the recent BSP surveys (Map 6). The species responded to ten percent of the nocturnal call playback censuses undertaken in 1997-98 and 2007-08. Records of the Powerful Owl are scattered through the southern two-thirds of the study area, primarily heard calling from creek lines including Culoul Creek, Dooli Creek, Angorawa Creek, Tootie Creek, Blacksmiths Creek, Cabbage Tree Creek, Wheeny Creek, Lagoon Creek and a tributary of the Colo River (Map 6). These observations reflect the species preference for tall sheltered forests, where hollow-bearing trees and preferred prey species are more abundant. Though habitat is widespread in the park, it is most well developed and of highest quality in the higher rainfall areas south of the Culoul Range.

The study area appears to support a moderate density of the Powerful Owl, providing an expanse of suitable habitat that is largely contiguous with that in the wider system of reserves that connect coastal habitats and populations to those on the Great Dividing Range. The Powerful Owl is considered to be relatively secure when located in protected areas. However, known locations and habitats should be considered during fire management planning, to ensure that the quality of canopy foliage is not altered by regular hazard reduction burning. Management of the owl across the region should be undertaken in accordance with the state-wide recovery plan (DEC 2006b).

MASKED OWL

Species Profile

Plate 36: Masked Owl © R. Jackson

The Masked Owl (*Tyto novaehollandiae*) is a large owl that is distinguished from the similar Barn Owl by its larger size, more thickset and hunchbacked appearance, fully feathered legs and larger feet (Higgins 1999). It inhabits a wide range of open forest and woodland habitats, requiring large hollows for roosting and nesting and open areas for hunting. It feeds mostly on ground-dwelling mammals such as rats and Antechinus, and occasionally on diurnal birds, Sugar Gliders and insects (Kavanagh 2002a). It appears to forage near ecotones, either at the boundary of forests of different structural composition or at the forest edge, and may thus benefit from the mosaic of burnt-unburnt patches in the landscape after fire (DEC 2006b). The owl has a home range of 800 to 1200 hectares (Kavanagh 2002b). 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).

Threats

Clearance of native forest for agriculture and urban development, and the resulting fragmentation of habitat, is the primary threat to the Masked Owl (Garnett and Crowley 2000). The species does not persist within fragments of forest smaller than 200 hectares (Kavanagh 2002b). The core areas of the species distribution in NSW are located on the Central Coast and Lower Hunter Valley where much habitat is not reserved and therefore under continued pressure from urban and industrial development. The owl may be affected by logging, through removal of hollows or reduction in foraging habitat due to vigorous regrowth (Garnett and Crowley 2000). However it has been suggested that modern mosaic logging operations do not cause major changes to the abundance of the species (Kavanagh 2002b). The removal of dead wood and dead trees is considered to be a Key Threatening Process affecting this species (NSW Scientific Committee 2003a).

Local and Regional Conservation Status

The Masked Owl is listed as Vulnerable under the TSC Act. Most records for the species in NSW are located within the three coastal bioregions (NSW North Coast, Sydney Basin and South East Corner), with a few scattered records west of the Divide (DECC 2008b). Within the Sydney Basin Bioregion, the woodlands of the coastal plains between Wyong and Port Stephens support high numbers of this species, with concentrations of records also occurring in the south and to a lesser extent across the southern Blue Mountains. Records of the Masked Owl are scattered within a number of DECC reserves, including Royal, Blue Mountains, Nattai, Kanangra-Boyd, Brisbane Water, Wollemi and Dharug NPs and Berowra Valley Regional Park (DECC 2008b).

The Masked Owl has been recorded on a single occasion in the study area, observed on the Culoul Range during CRA surveys (Map 6). The species did not respond to any of the 61 nocturnal call playback censuses undertaken in 1997-98 or 2007-08, indicating that it only occurs at very low abundance. This low call playback response is consistent with surveys of other sandstone reserves, including Yengo and northern Wollemi NPs and reserves south of Sydney (DECC 2008a and DECC 2007a). In the last decade the species has more commonly been recorded to the south-east of the study area on the Cumberland Plain, reflecting its preference for dry open forests and woodlands on soils of mild to high fertility (DECC 2007a). Following this pattern the species has also been recorded in the Putty Valley to the north, and is well known from the Lower Hunter Valley. Given this, limited potential habitat for the species occurs in the far north of the study area, such as along Long Weeney Creek. The species is considered unlikely to occur at the higher elevations in the south-west of the study area.

The majority of Masked Owl records in the region occur outside DECC reserves. Thus, though the habitat within south-eastern Wollemi NP is probably only of marginal quality, and the current status of the species is unknown, it never-the-less provides a small yet significant contribution to the regional conservation of the species. It is recommended that further call playback surveys be undertaken in the far north and south-east of the study area to assess the species current status. Management of the owl in the region should be undertaken in accordance with the state-wide recovery plan (DEC 2006b).

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 tree hollows (often located in old emergent trees) as well as in deep sandstone overhangs or dark caves (DEC 2006b). It is usually located within 100 metres of a stream (Kavanagh 1997). Pairs probably maintain permanent territories that are between 200 and 800 hectares in area, depending on the availability of prey (Higgins 1999). The species feeds on a wide range of arboreal and terrestrial mammals (Kavanagh 2002a). In Australia the subspecies *tenebricosa* is distributed along the east coast between Queensland and Victoria. A smaller subspecies (*arfaki*) occurs in New Guinea (Higgins 1999).

Plate 37: Sooty Owl © R. Jackson

Threats

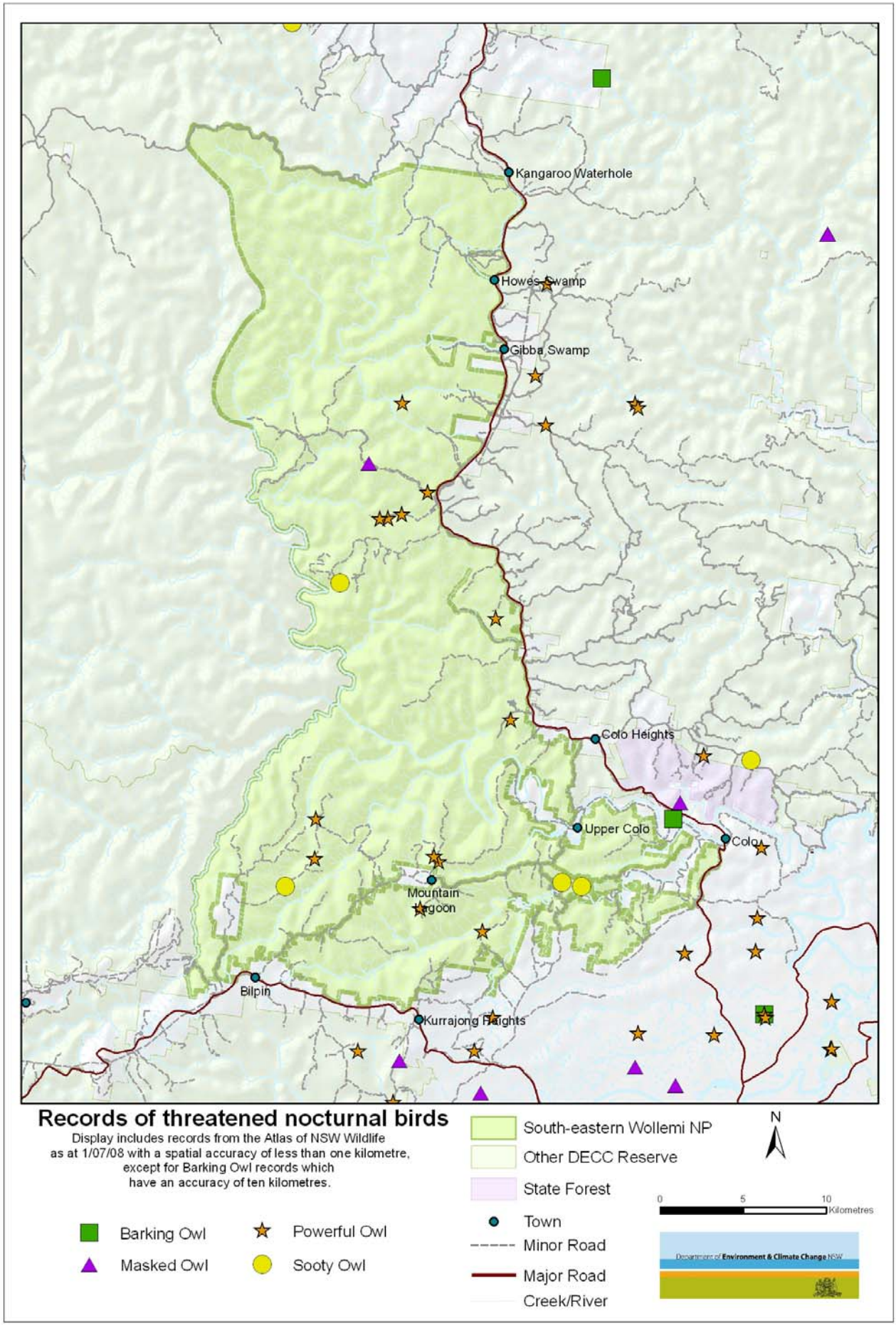
Garnett and Crowley (2000) list the main threat as habitat clearance for agriculture and urban development, along with additional fragmentation or degradation caused by logging, burning and dieback. The exact impacts of logging remain unclear (Higgins 1999). Where the species is at the margins of its 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. The Sooty Owl is a highly specialised species occupying a narrow range of habitats, which makes it particularly vulnerable to climate change (NSW Scientific Committee 2000c).

Local and Regional Conservation Status

The Sooty Owl is listed as Vulnerable under the TSC Act. Within NSW it is largely 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 (DECC 2008b).

The Sooty Owl was recorded for the first time on the Atlas of NSW Wildlife during the BSP surveys, responding to three (5 %) of nocturnal call playback censuses and detected on a fourth occasion during a spotlighting survey. The records are scattered through the southern half of the study area (south of Grassy Hill Firetrail) (Map 6), where environmental conditions such as higher average rainfall, encourage the growth of mesic forests and rainforests, the species preferred habitat. Further habitat for the Sooty Owl occurs in gully lines that support coastal and hinterland warm temperate rainforest such as Lagoon Creek, tributaries on the north side of Wheeny Creek, Gospers Creek, Cabbage Tree Creek, and tributaries of Tootie Creek, amongst others. The Sooty Owl has only been recorded in areas where average annual rainfall is greater than 800 millimetres per annum, while the rainforests primarily occur where average rainfall is greater than 1000 millimetres per annum.

The study area is considered to play a significant role in the conservation of the Sooty Owl in the northern half of the Sydney Basin. The species has also been recorded to the north-west elsewhere in Wollemi NP and to the south in Blue Mountains NP, and habitat is currently considered relatively well reserved in the region. The greatest threat to the Sooty Owl in the reserve system is likely to be changes in vegetation characteristic resulting from frequent fire and climate change, leading to a reduction in the availability of suitable mesic habitat. To reduce the potential for this to occur, fire management practices should aim to ensure at least some sections of mesic and rainforest vegetation are always left in a long unburnt state. In general, management of the owl in the region should be undertaken in accordance with the state-wide recovery plan (DEC 2006b).



Map 6: Threatened nocturnal bird records within five kilometres of south-eastern Wollemi NP

SPOTTED-TAILED QUOLL

Species Profile

Plate 38: Spotted-tailed Quoll © N. Fenton/DECC

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 1999c). Juveniles are more dependent on invertebrates, small mammals and birds; while 70 per cent of the adult's diet is comprised of medium-sized mammals, such as small macropods, possums, gliders, Rabbits and bandicoots (Belcher *et al.* 2008). 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 1999c). Habitat requirements include suitable den sites, an abundance of food and large areas of intact vegetation (NPWS 1999c).

Threats

Key threats to the Spotted-tailed Quoll are habitat loss, degradation and fragmentation (Belcher 2004). Other threats include: predation and competition by introduced mammals such as Feral Pigs, Feral Cats, Foxes and Dogs; disease such as toxoplasmosis; road mortality; and direct mortality at the hands of humans (Mansergh 1984). Dingo and Feral Dog control, through the competitive release of Foxes and Feral Cats, also has the potential to impact on the Spotted-tailed Quoll (Glen and Dickman 2005). Quolls have been persecuted as killers of domestic fowl, and have been hunted and trapped to extinction in many parts of the country. In recent years evidence has been collected showing aerial, ground and mound baiting using 1080 (sodium monofluoroacetate) poses a risk to Quoll populations (Belcher 2004; Murray and Poore 2004; Claridge *et al.* 2006), however other research contradicts this (e.g. Kortner and Watson 2005). The Spotted-tailed Quoll has been listed as a species affected by the following Key Threatening Processes: removal of dead wood and dead trees (NSW Scientific Committee 2003a); high frequency fire (NSW Scientific Committee 2000b); and removal of bushrock (NSW Scientific Committee 1999c).

Local and Regional Conservation Status

The Spotted-tailed Quoll is listed as Vulnerable under the TSC Act and as Endangered under the EPBC Act. 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 (DECC 2008b). There are few recent records for the Sydney Basin Bioregion, though it is still seen with some regularity on the Central Coast between Hornsby and Newcastle, in the Blue Mountains and to a lesser extent in the Kangaroo Valley (DECC 2008b). It 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 (DECC 2008b).

The Spotted-tailed Quoll has been observed at two locations in south-eastern Wollemi NP including south of Mountain Lagoon (during CRA surveys in 1997) and along D'Arcy Range (during BSP surveys in October 2007) (Map 8). Sightings have also been made on several occasions just outside the park boundary at Colo Heights (1981), at Upper Colo (in 1992), near Bilpin (twice in 1991 and once in 1994), on the Putty Road near Colo (1994) and near Mountain Lagoon township (2004) (Map 8). In the vicinity of south-eastern Wollemi NP the Spotted-tailed Quoll has most commonly been recorded in the upper Blue Mountains particularly in the vicinity of townships along the Great Western Highway and to a lesser extent the Bells Line of Road (DECC 2008b).

The sighting of a Spotted-tailed Quoll during both the CRA and BSP systematic surveys was very exciting as this is a very cryptic species which, where it occurs in low density, is difficult to trap and can require an immense effort to detect using standard survey techniques (Lunney and Matthews 2001). In contrast, quolls have not been sighted during any other BSP surveys in the northern Sydney Basin in the previous three years including through north-east Wollemi, north-west Wollemi and Yengo NPs or Parr SCA. The sighting of Spotted-tailed Quoll within the study area may indicate a greater abundance of the species here than further north in the Yengo-Wollemi reserve system, which is likely to relate to greater habitat availability in the higher rainfall areas in the south-west of the park. Potential habitat for the species is widespread in moist vegetation types in the south of the study area. However, the current status of Spotted-tailed Quoll in south-eastern Wollemi NP remains unknown.

Management actions for the Spotted-tailed Quoll would ideally commence with gaining a better understanding of the species current distribution and status. However, due to the difficulty in surveying this species, further surveys would be expensive and likely to provide little return. Until more efficient survey protocols are identified for this species, further surveys are therefore not recommended. Management should instead focus on mitigation of threatening processes that continue to act within the reserve system including competition and predation from Foxes and Feral Cats and potentially high intensity or high frequency fire. Management of the species in the reserves should consider interactions between Quolls, Dingoes and Foxes and the potential impact of 1080 baiting, with the results of latest research incorporated into any feral animal control programmes. Priority should be given to increasing public awareness of the Spotted-tailed Quoll, its identification and conservation status, and to encouraging neighbours and park visitors to report any sightings, together with accurate location information.

KOALA

Species Profile

The Koala (*Phascolarctos cinereus*) is a distinctive, iconic arboreal mammal of eucalypt forests and woodlands. 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. Historic records and recent research (DECC 2007a) suggest that the Koala generally has a preference for higher fertility soils. Individuals spend most of the day resting in dense foliage or the forks of trees, and are most active following sunset (NPWS 1999d). Home range varies depending on the density of food trees and population size. In coastal areas of NSW home ranges vary between 15 and 100 hectares, with individuals, particularly dispersing juveniles, known to travel up to 50 kilometres (Martin and Handasyde 1995; NPWS 1999d). During the breeding season (spring and summer) adult males have a distinctive carrying bellowing call that often is the first indication of this species' presence.

Plate 39: Koala © P. Madden

Threats

Throughout its entire range loss, fragmentation and degradation of habitat for urban development, agriculture and mining pose the greatest threat to Koala (NPWS 2003d; Martin *et al*. 2008). Reed *et al.* (1990) reported on a survey in 1986-87 which found that the Koala had disappeared from 50 to 75 percent of its known range in NSW and populations had been lost from many localities, particularly on the southern and western edges of their distribution. Other threats to the Koala include: disturbance by fire; mortality from Dogs and motor vehicles; and infection by *Chlamydia* which causes *keratoconjunctivitis* (an infection of the eyes) and infertility (NPWS 1999d; 2003d). In NSW, *Chlamydia* mostly afflicts animals that are already stressed and it is not considered to be a major problem (Menkhorst 1995, NPWS 2003d).

Local and Regional Conservation Status

The Koala is listed as Vulnerable under the TSC Act. The species is widespread across the eastern third of the state, with a number of records throughout the Sydney Basin Bioregion. In this Bioregion, concentrations of records occur around the Central Coast, Blue Mountains, the fringes of the Cumberland Plain and the Woronora Plateau (DECC 2008b). Records from reserves within the Sydney Basin are uncommon, though sightings have been made in Morton, Dharug, Nattai, Blue Mountains, Brisbane Water, Wollemi and Yengo National Parks (DECC 2008b). Recent surveys found that southern Yengo NP and Parr SCA together support the greatest collection of Koala records on DECC estate in the northern half of the Sydney Basin (DECC 2008a).

Prior to the 2007-08 BSP surveys a total of eighteen records of Koala existed for the study area, concentrated along the Culoul Range and around the peripheries of the park including along the Putty Road and Mountain Lagoon Road (Map 7). Thirty-four new records of the species were collected during the BSP surveys, including along Angorawa Creek, Wheeny Creek and surrounds, Culoul Creek, Long Weeney Creek, Mellong Creek and Grassy Hill track (Map 7). Records of the species within south-eastern Wollemi NP connect with those in Parr SCA and southern Yengo NP (Map 7), which are likely to be part of the same population. Records also extend south-west through northern Blue Mountains NP. No estimate of population size was made during the 2007-08 surveys, but animals in the study area appeared to be healthy and widespread at low to moderate density. Vegetation formations from which the species has been recorded include *Melaleuca* swamp forest, sandstone ridgetop woodland, Mellong sandmass woodland, sheltered gully forest and basalt cap forest.

Though Koala appear to occur in greater numbers to the east through southern Yengo NP and Parr SCA, south-eastern Wollemi NP supports a significant amount of occupied habitat for the species and is likely to also play a critical role in the regional conservation of the Koala. Of the known threats to the species, two which occur in the study area are predation (from Fox and Feral Cat) and fire. However, no direct evidence of predation from feral species has been collected to date, and the population(s) appears to have remained healthy despite the recent wildfire history. Road mortality on the Putty Road and Bells Line of Road, which has the potential to inhibit connectivity with populations to the east and south-west, may be an issue, and DECC staff and members of the public should be encouraged to report sightings of living or dead animals on roads in the local area to enable an assessment of this threat.

YELLOW-BELLIED GLIDER

Species Profile

Plate 40: Yellow-bellied Glider © J. Winter/DECC

The Yellow-bellied Glider (*Petaurus australis*) is a medium-sized nocturnal marsupial found in tall open sclerophyll forests 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 1999e). It is characterised by grey fur above and a whitish to orange fur beneath 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 (Goldingay 2008). It feeds on eucalypt nectar, sap, manna and invertebrates found under shedding bark. Its feeding habits can leave V-notched incisions in the bark of eucalypts, with individuals and family groups demonstrating a preference for individual trees within their territory (Mackowski 1988). Across the Sydney Basin there appears to be a preference for Grey Gum as a sap feeding tree. The glider utilises a home range of between 30 and 65 hectares (Goldingay and Kavanagh 1991).

Threats

Yellow-bellied Gliders are known to be greatly affected by the reduction of nesting resources when the availability of hollow-bearing trees is lost through clearing, fragmentation or timber extraction (NPWS 1999e). In particular, logging of high-productivity forests is thought to be the major threat to the species across its range (NPWS 2003e). Another important threat is habitat fragmentation, with greater than 15 000 hectares required to conserve viable populations of the species (Goldingay 2008). Predation by Feral Cats and Foxes is also thought to contribute to the species' vulnerability. Impacts of fire regimes are poorly understood, although some studies suggest that high-intensity fire reduces populations and the availability of food resources (NPWS 1999e, 2003e). This species is occasionally entangled on barbwire fences, including a record in 2000 in forest north of Werakata SCA (DECC 2008f). The Yellow-bellied Glider is also listed as negatively affected by the Key Threatening Process of competition from Feral Honeybees (NSW Scientific Committee 2002b).

Local and Regional Conservation Status

The Yellow-bellied Glider is listed as Vulnerable under the TSC Act. Within NSW, records are largely concentrated within the coastal Bioregions, being NSW North Coast, Sydney Basin and South East Corner, as well as parts of the South East Highlands Bioregion (DECC 2008b). Recent surveys have significantly expanded the knowledge of its distribution and habitat preferences in the Sydney Basin. For example, as little as ten years ago the species was thought to be uncommon in the greater southern Sydney region, however, the converse has been found to be the case (DECC 2007a). 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 (DECC 2008b). In fact, the large number and wide distribution of records of Yellow-bellied Glider that have been collected in the past decade, together with 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 should be reviewed and possibly down-listed (Kavanagh 2004).

The Yellow-bellied Glider has been recorded on only six occasions outside the systematic fauna surveys, but on three times that many occasions during the CRA and BSP surveys combined (Map 7). This highlights the need for dedicated survey to estimate the current distribution and abundance of the species. The Yellow-bellied Glider has not been directly seen within the study area, with approximately half of the records deriving from the distinctive 'V'-shaped feeding notches on trunks, and half deriving from hearing the species call. The species has most commonly been recorded in taller open forests in gullies and sheltered slopes through the central incised sandstone plateaux, but also on the Mellong Plateau (Map 7). The species does not appear to be as common in the study area as further north through central Wollemi NP and Putty State Forest, but never-the-less it is likely to be present in the majority of well developed wet sclerophyll forests.

Recent surveys on reserves in the northern half of the Sydney Basin concur with findings in the greater southern Sydney region, that Yellow-bellied Gliders are widespread and common throughout the moderate to high rainfall areas in the large sandstone reserves of the Sydney Basin. Most threats outlined in the species recovery plan are not present within large sections of these reserves. The Yellow-bellied Glider can thus be considered relatively secure in the Sydney Basin Bioregion, and does not currently require any specific management actions in south-eastern Wollemi NP.

SQUIRREL GLIDER

Species Profile

The Squirrel Glider (*Petaurus norfolcensis*) is a nocturnal marsupial 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. However, the Squirrel Glider is generally larger, has a longer more pointed face, longer and narrower ears, a bushier tail and lacks the persistent yapping call of the Sugar Glider. It has a varied diet, including insects, nectar, pollen, seeds, *Acacia* gum and sap from eucalypts (van der Ree and Suckling 2008). It usually occurs in family groups consisting of one male, one or more females and their dependant young. Home ranges are thought to vary between 0.65 and 8.55 hectares, depending on habitat quality. The Squirrel Glider is a hollow dependent species that is patchily distributed along the east coast and inland slopes from north Queensland to Victoria (NPWS 1999f) in habitats that comprise sufficient numbers of hollow-bearing trees for shelter and winter flowering plant species for food (Quin 1995).

Plate 41: Squirrel Glider © N. Williams

Threats

The greatest threat to the Squirrel Glider is loss of habitat by broad scale clearing for agriculture (Kavanagh 2004). Most clearing in NSW has occurred in open forests and woodlands growing on relatively fertile soils on gentle topography, especially in river valleys (Lunney and Leary 1988), which comprises the prime habitat of the Squirrel Glider. NPWS (1999f) lists further threats to the Squirrel Glider as: loss of nesting resources when the availability of hollow bearing trees are lost through fragmentation or timber extraction; predation by Feral Cats and Foxes; and the entanglement of individuals on barbed-wire fences. The species is also listed as susceptible to the following Key Threatening Processes: removal of dead wood and trees (NSW Scientific Committee 2003a); ecological consequences of high frequency fire (NSW Scientific Committee 2000b); and competition for tree hollows with Feral Honeybees (NSW Scientific Committee 2002b).

Local and Regional Conservation Status

The Squirrel Glider is listed as Vulnerable under the TSC Act. It occurs patchily throughout the eastern Bioregions of NSW, and is only recorded regularly in the NSW North Coast, Nandewar and Sydney Basin (DECC 2008b). Across its range, habitat for the Squirrel Glider occurs primarily outside of public lands (Kavanagh 2004). In the Sydney Basin Bioregion the dry woodlands of the Central Coast are 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 in a small number of reserves such as Yengo, Wollemi, Blue Mountains, Dharug, Goulburn River and Werakata NPs (DECC 2008b).

The Squirrel Glider has been recorded on two occasions in the study area: one Australian Museum specimen collected in 1998 from the vicinity of 'Colo'; and one sighting made during CRA surveys on the Mellong Plateau adjacent to the Putty Road between Gibba and Howes Swamps (Map 7). The location of the first site is not specific enough to assess habitat, but the location of the CRA sighting was in open Scribbly Gum woodland right on the eastern boundary of the study area. Through the Sydney Basin the Squirrel Glider is most often found within drier woodlands on somewhat enriched soils, particularly in alluvial valleys. Based on this, potential Squirrel Glider habitat is also considered to occur in the far north of the study area in the open alluvial areas and Ironbark-dominated woodlands along Long Weeney Creek, as well as lower slopes of Putty and Wollemi Creeks. It is possible that the species occurs at low density through these northern valleys, though past land use practices may have caused local extinction through removal of tree hollows. The current status of the Squirrel Glider in the study area is unknown.

South-eastern Wollemi NP supports only a small amount of marginal habitat for the Squirrel Glider. However, as much of the remaining habitat in the Hunter Valley, Central Coast and Cumberland Plain is still under threat from further fragmentation and development, all habitat that is conserved has high conservation value. South-eastern Wollemi NP may therefore provide a small yet significant contribution to the regional conservation of the species. The Squirrel Glider is subject to ongoing threats even within the reserve system, including low density of hollows due to past land use, and predation by Fox and Feral Cat. Management of the Squirrel Glider in south-eastern Wollemi NP will require further survey to determine the species current extent, and potentially targeted management of introduced predators in areas where the Glider is confirmed to occur. In addition, adjoining landholders in the Putty Valley should be encouraged to maintain paddock trees near the park boundaries, even if dead, in order to ensure a sufficient supply of tree hollows.

BRUSH-TAILED ROCK-WALLABY

Species Profile

Plate 42: Brush-tailed Rock-wallaby © E. Holland/DECC

The Brush-tailed Rock-wallaby (*Petrogale penicillata*) is a medium-sized macropod, characterised by its distinctive facial markings, black paws, and long thickly furred tail which has a distinctive brush-like appearance near the tip (NSW Scientific Committee 2003c, 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). Most sites where it still occurs have a northerly aspect (Eldridge and Close 2008). Vegetation forms a vital component of the habitat, especially as refugia near major rock outcrops. 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). This wallaby has declined significantly in the west and south of its former range, and populations have become more fragmented throughout (NSW Scientific Committee 2003c).

Threats

Historically the greatest contributor to the decline of the Brush-tailed Rock-wallaby was hunting for skins and as alleged agricultural pests ((Eldridge and Close 2008). Today the greatest threats are thought to be predation by introduced predators, competition with introduced herbivores (especially Feral Goat, Rabbit and domestic stock), habitat modification by fire, vegetation clearing, disease transmission (toxoplasmosis and hydatosis) by feral carnivores (NSW Scientific Committee 2003c) and inbreeding (Environment ACT 1999). The species typically exhibits low migration rates between colonies, impeding persistence and recovery of populations affected by these threatening processes.

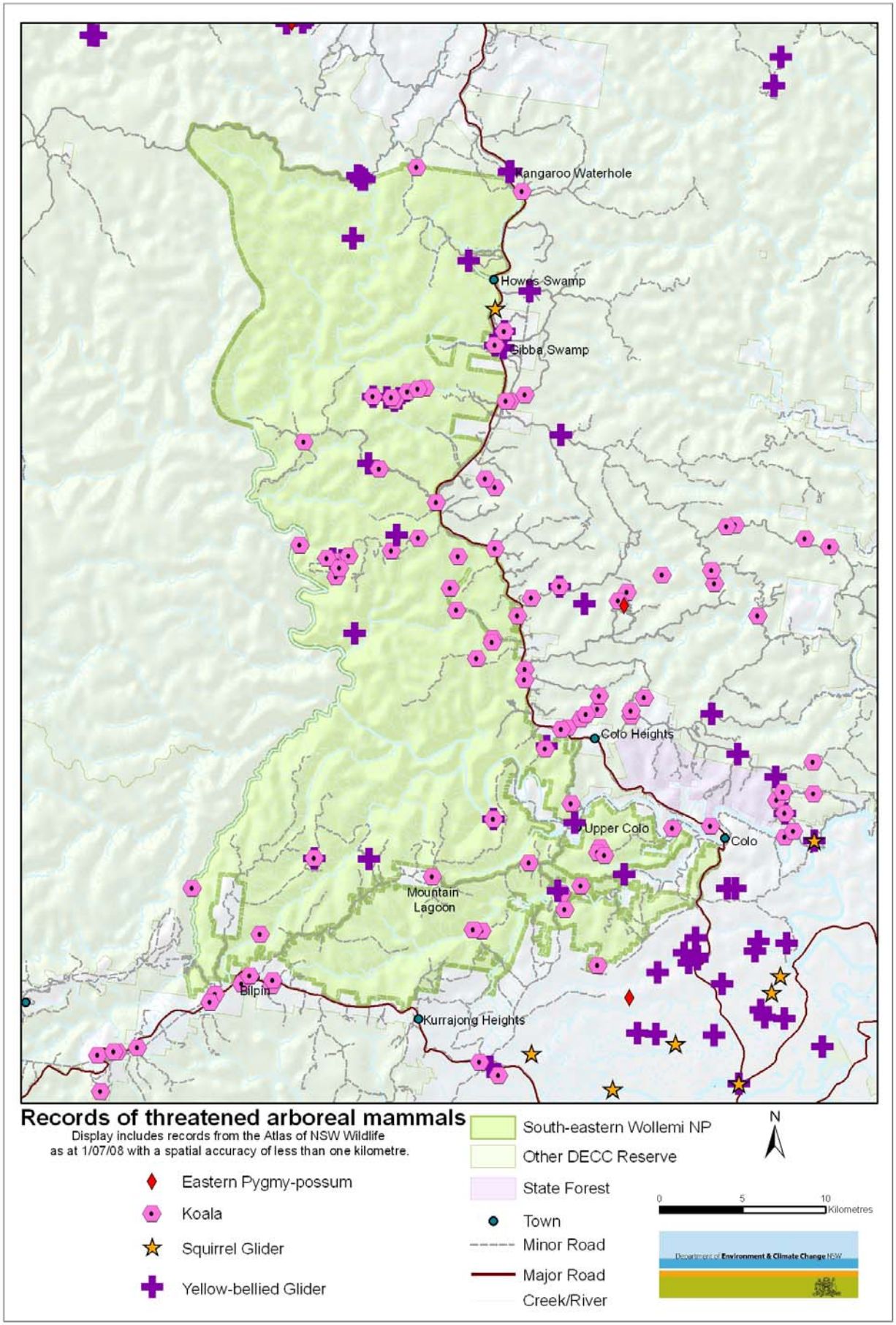
Local and Regional Conservation Status

The Brush-tailed Rock-wallaby is listed as Endangered under the TSC Act and as Vulnerable under the EPBC Act. 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 2003c). Recent records from reserves within the Sydney Basin are mostly confined to Yengo, Wollemi, the Watagans and Morton NPs and Parr SCA as well as a recently discovered colony in Nattai National Park (DEC 2004b).

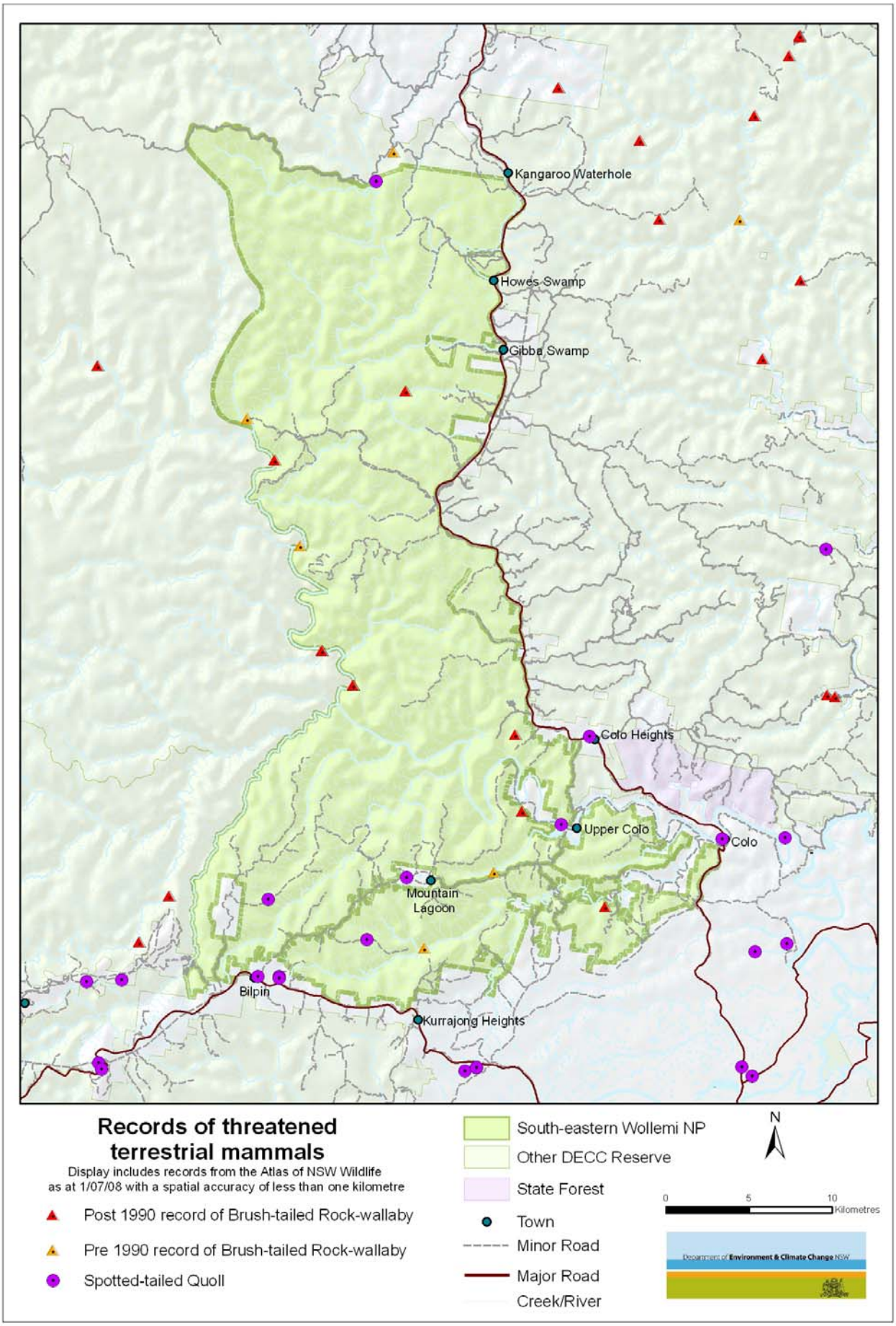
Specimens of the Brush-tailed Rock-wallaby were first collected by the Australian Museum (date unknown) from the 'Colo River' and 'Wheeny Creek', though the exact origin of these animals is not known. Three animals were observed in the 1970s and early 1980s further upstream along the Colo River and on Gospers and Wheeny Creeks. Since the 1990s the species has only been directly observed on one occasion, but again the exact location of this sighting is unknown. Where spatial accuracy is less than one kilometre these records have been presented in Map 8 as historic locations. Since the 1990s the species has more accurately been recorded from scats including behind Brawdy Farm on the Colo River (scats identified by expert Cath Rummery), south-west of Bob Turners Track, and again on the Colo River (between Wollemi and Boorai Creeks) (Map 8). The BSP surveys located Brush-tailed Rock-wallaby scats at three locations: just north of Culoul Creek along a small rocky escarpment line with numerous ledges and boulders; and in two locations adjacent to the Colo River (between Tambo Crown and Clews Cave) again in rocky escarpment lines featuring ledges and overhangs (Map 8). In early November 2008 fresh Brush-tailed Rock-wallaby scats were collected adjacent to Wollemi Creek, including north of Long Weeney Creek junction and north of Mellong Creek junction (A. Macqueen pers. comm.). All of these scats were moderately fresh suggesting Brush-tailed Rock-wallaby still occupy these locations, though the size and condition of the colonies was not estimated.

Potential habitat for the Brush-tailed Rock-wallaby is widespread and it is expected that the species persists undetected at several more remote locations in the study area, particularly along the Colo River and its major tributaries where they feature rocky escarpment lines in the vicinity of water, with boulders, ledges that receive the morning sun, overhangs and adjacent vegetation. Despite the extent of suitable habitat, the status of Brush-tailed Rock-wallaby in south-eastern Wollemi NP is currently not well understood. More colonies are known from the adjacent Yengo NP, with many of these subject to regular monitoring (DECC 2008a), and elsewhere in the greater northern Sydney region colonies are known from Wollemi NP (e.g. Myrtle Creek and the Wolgan River), further east in Watagans National Park, and various locations in Blue Mountains NP (though again the current status of some of these latter colonies is unknown). 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. Any extant colonies of Brush-tailed Rock-wallaby in south-eastern Wollemi NP, together with those in northern Wollemi and Yengo NPs, are therefore highly significant as they encompass one of the few remaining strongholds for the species, not only within the region but also within the central ESU. Such colonies are important to the conservation of the species across the state.

It is recommended that further surveys be undertaken for Brush-tailed Rock-wallaby in south-eastern Wollemi NP in order to obtain a better understanding of the current size and condition of the colonies, and the threats acting upon them. At a minimum, locations where scats have reliably been recorded since the 1990s (namely Culoul Creek, Colo River, behind Brawdy Farm, and south-west of Bob Turners Track) should be revisited by experienced surveyors to determine if these sites are currently used and if so to estimate the size and condition of the colonies (see Section 6). Continued survival of the Brush-tailed Rock-wallaby in Wollemi and adjacent areas will require active targeted management and is a matter of the highest conservation priority. The primary threat to the persistence of the species is likely to be predation by Foxes. The small size and apparently scattered nature of the colonies also makes them susceptible to intense wild fire. Management of the Brush-tailed Rock-wallaby must be coordinated with management of the species across the state, the key being to maintain regular communication with the NSW Brush-tailed Rock-wallaby recovery team.



Map 7: Threatened arboreal mammal records within five kilometres of south-eastern Wollemi NP



Map 8: Threatened ground mammal records within five kilometres of south-eastern Wollemi NP

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 numbers roosting at specific camps may vary depending on season and food availability. It feeds 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. The species can travel up to twenty kilometres to a food source, and is an important pollinator and disperser of native plants. The Grey-headed Flying-fox is endemic to eastern Australia, between Melbourne, Victoria and Bundaberg, Queensland (NPWS 2001c). The species range has contracted, previously occurring as far north as Rockhampton (NPWS 2001c). It primarily occurs 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 2001c). 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 2001c).

Plate 43: Grey-headed Fliying-fox
© N. Williams

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 2001c, Duncan *et al.* 1999). This species is also commonly entangled on barbwire fences and in nets draped over fruit trees in backyards.

Local and Regional Conservation Status

The Grey-headed Flying-fox is listed as Vulnerable under the TSC Act and is also listed as Vulnerable under the EPBC Act. The species is regularly recorded in all three coastal bioregions (DECC 2008b). 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, Wollemi and Werakata National Parks (DECC 2008b). 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.

The Grey-headed Flying-fox has only been recorded on a single occasion on the Atlas of NSW Wildlife, in the vicinity of Wheeny Creek Camp. As it is the only record in the park this record has been included on Map 9 despite its low spatial accuracy. The species is known to utilise lands immediately adjacent to the park, such as Upper Colo reserve and the caravan park at Colo (Map 9), and is sure to forage within the park itself when eucalypts are in flower or fruit-bearing trees and shrubs such as figs provide feeding resources. As the species is only a visitor to the study area, it would easily go undetected. The species is more commonly recorded in populated areas, such as the Cumberland Plain (DECC 2008b). There is no indication of a Grey-headed Flying-fox camp in the study area.

South-eastern Wollemi NP contributes significantly to the regional system of large reserves that provide a natural foraging area for Grey-headed Flying-foxes in spring and summer, and therefore holds conservation significance to the species. South-eastern Wollemi NP would form a component of the foraging habitats on which Grey-headed Flying-foxes in the northern half of the Sydney Basin depend, but large numbers are likely to congregate in the study area only when an abundance of eucalypts are in heavy flower, or when food resources are limited elsewhere. The area may also play an important role during southward/northward population movements. However, no specific management actions are currently required for this species within the study area.

EAST-COAST FREETAIL-BAT

Species Profile

Plate 44: East-coast Freetail-bat © N. Williams/DECC

The East-coast Freetail-bat (*Mormopterus norfolkensis*) is a member of a group of bats that remain in a state of 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. This is a poorly known species, but it appears to be restricted to the east of the Great Dividing Range between approximately Brisbane (Queensland) and Picton (New South Wales) (Duncan *et al.* 1999, Parnaby 1992a). 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 agricultural clearing, development and logging have serious impacts (Duncan *et al.* 1999). These threats are of heightened significance because the species' entire known distribution lies within an area of concentrated human population density and increasing urban development. The East-coast Freetail-bat is listed as threatened by the Key Threatening Process removal of dead wood and trees (NSW Scientific Committee 2003a) and it has been suggested that pesticide use may also be a problem (NPWS 2002c).

Local and Regional Conservation Status

The East-coast Freetail-bat is listed as Vulnerable under the TSC Act. Most records for the species in NSW occur within the NSW North Coast, South East Corner and Sydney Basin Bioregions. Within these bioregions it appears to prefer the coastal plains and larger incised valleys of the Dividing Range, with relatively large numbers of records from the Cumberland Plain, Central Coast and Hunter Valley (DECC 2008b). 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 (DECC 2008b).

The East-coast Freetail-bat has been confidently recorded from ultrasonic call analysis at three locations, widely spaced from the very northern extremity of the study area on Wollemi Creek to the south along Wheeny and Little Wheeny Creeks (Map 9). The species was recorded to the 'probable' confidence level from a further two locations, near the junction of Wollemi and Long Weeney Creeks and just north of Bilpin rest area (these sites have not been indicated on Map 9 due to the low level of identification confidence). The East-coast Freetail-bat has not been captured in harp traps in the study area, which is typical of the species as it generally flies high or ranges widely through more open habitats where it is difficult to capture. Records for this species are only very sparsely scattered throughout the adjacent sandstone reserves and are mostly derived from ultrasonic call analysis, with a few to the north in Wollemi NP, and few to the east in Yengo NP and Parr SCA. In the vicinity of the study area the species has only been captured in harp traps on the Cumberland Plain, where the greatest number of records is concentrated (DECC 2008b).

Recent work in the southern Sydney region has found the East-coast Freetail-bat to be strongly associated with fertile valleys and plains (DECC 2007a), while in the northern half of the basin cursory examination of records shows the greatest concentrations on the flats of the Central Coast, Hunter Valley and Cumberland Plain. The low number of records within the study area itself makes it difficult to assess distribution, but extrapolating patterns elsewhere the species is likely to be most closely tied to alluvial areas, or areas with enriched soil, though also move through more open areas of the sandstone plateaux. The majority of south-eastern Wollemi NP is likely to provide only peripheral habitat for the Eastern Freetail-bat and no specific management actions are currently required in the study area for this species.

LARGE-EARED PIED BAT

Species Profile

Plate 45: Large-eared Pied Bat © N. Williams/DECC

The Large-eared Pied Bat (*Chalinolobus dwyeri*) is recognisable by its combination of large ears, overall black colour and bands of white fur along the sides of the body that join to form a V-shape on the lower belly (Parnaby 1992a; Churchill 1998). Its ultrasonic call is an alternating pattern made at a low frequency which is readily distinguishable from all other species (Reinhold *et al.* 2001). It has been recorded from scattered locations between Rockhampton and Ulladulla (Hoye and Schulz 2008) in a wide range of habitats, including wet and dry eucalypt forest, Cypress (*Callitris*) forest and sub-alpine woodland (Duncan *et al.* 1999). It is a cave-roosting species that roosts in overhangs and 'pock-holes' on vertical cliff walls. It has also been detected roosting in disused mine shafts, overhangs and in abandoned Fairy Martin (*Petrochelidon ariel*) nests (Churchill 1998; Hoye and Schulz 2008). It prefers the 'twilight' area of caves and overhangs and may be dependent on sandstone outcrops (Duncan *et al.* 1999; Hoye and Schulz 2008). The Large-eared Pied Bat is poorly understood, particularly in terms of its roosting requirements, foraging habits and other aspects of its biology.

Threats

The primary threat to this species is the destruction or interference of subterranean roosting and maternity sites (Duncan *et al.* 1999). It is possible that mining-induced subsidence (particularly coal mining in sandstone areas of NSW) may destroy roost sites. Other potential threats include habitat destruction for agriculture and urban development, impacts of forestry operations and predation by feral animals (Duncan *et al.* 1999). In addition, Feral Goats may disturb roosts in overhangs (M. Schulz pers. comm.). The impact of fire on this species is unknown.

Local and Regional Conservation Status

The Large-eared Pied Bat is listed as Vulnerable under the TSC Act and also as Vulnerable under the EPBC Act. The Sydney Basin is extremely important to the species, holding a large proportion of overall records. Only scattered records occur to the north, south and west of the Bioregion (DECC 2008b). 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 (DECC 2008b). However these concentrations are likely to reflect the locations of recent DECC survey effort. Records are scattered throughout the Bioregion, including southern Wollemi, Kanangra-Boyd, Royal, Gardens of Stone and Morton National Parks. However, despite this wide distribution the species is infrequently detected, suggesting that it only occurs at low abundance.

The Large-eared Pied Bat was captured at five harp trap locations (14 % of harp trap sites) and identified with a high degree of confidence from two (4 %) Anabat sites. It was detected with a low level of confidence from a further two Anabat sites, on D'Arcy and Culoul Range, although these have not been presented on Map 9 due to their low reliability. As can be seen from Map 9 the records of Large-eared Pied Bat are all on and south of the Culoul Range, and though most records are from ridge tops they occur in a wide range of habitat types including sandstone ridgetop woodland, sheltered gully forest, rainforest and shale cap forest. No roost sites have been located within the study area, but are sure to occur in deep sandstone overhangs and holes in cliff faces. Maternity roost requirements for the species are poorly understood, but are located within deeper cave systems, which are comparatively rare. It is however possible that a maternity roost site(s) occurs within the reserve.

Systematic surveys conducted in northern Wollemi, Yengo and Goulburn River NPs and Parr SCA since 2002 have shown the reserves of the upper Hunter Valley and Goulburn Valley region to be a stronghold for the species (DECC 2008a). Surveys conducted through north-eastern Blue Mountains NP and south-eastern Wollemi NP in 2007-08 resulted in a lower rate of detection of the Large-eared Pied Bat, though still revealed the area to play a significant role in the ongoing conservation of the species in the northern half of the Sydney Basin. The Large-eared Pied Bat is more frequently detected in these sandstone reserves than in the plains of the Hunter Valley, Central Coast or north-western edge of the Cumberland Plain (DECC 2008b) and appears to be well protected. The primary threat to the species in the study area at this stage is likely to be predation by feral animals and possibly wildfires that scorch roost and maternity caves. If any maternity caves are discovered they should become a focus of feral predator and wildfire control programmes. In the mean time, however, no immediate management action is thought to be required for this species in the study area.

EASTERN FALSE PIPISTRELLE

Species Profile

Plate 46: Eastern False Pipistrelle © L. Broome/DEC

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 (Phillips 1995, Law *et al.* 2008), 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) and buildings (Law *et al.* 2008). It may hibernate over winter and has been known to travel at least twelve kilometres from its roost site (Churchill 1998).

Threats

Threats to the species are poorly known, but appear to comprise: disturbance to winter roosting and breeding sites, including loss of hollow-bearing trees; loss of trees for foraging; and application of pesticides in or adjacent to foraging areas (DEC 2004e). The Eastern False Pipistrelle is listed as impacted by the Key Threatening Process removal of dead wood and trees (NSW Scientific Committee 2003a).

Local and Regional Conservation Status

The Eastern False Pipistrelle is listed as Vulnerable under the TSC Act. The species is known from the Sydney Basin Bioregion and the South Eastern Highlands Bioregion (DEC 2008 Atlas). The species has been relatively well reported from a number of reserves in the Sydney Basin, including Wollemi, Nattai, Blue Mountains, Kanangra-Boyd and Gardens of Stone National Parks (DEC 2008b).

The Eastern False Pipistrelle has never been captured or otherwise directly observed in south-eastern Wollemi NP, as recorded on the Atlas of NSW Wildlife. The species has been confidently identified from its ultrasonic call on just two occasions, including once during CRA surveys near the junction of Wollemi and Putty Creeks, and once during BSP surveys on Wheeny Creek (Map 9). Unless a long sequence is recorded, the ultrasonic call of this species is easily confused with that of the Eastern Broad-nosed Bat (*Scotorepens orion*) and Greater Broad-nosed Bat (*Scoteanax ruepellii*) (Pennay *et al.* 2004). This has led to the 'possible' identification of Eastern False Pipistrelle at three further locations being above Canoe Creek and on the Mellong Plateau near Mellong and Howes Swamp Creeks. The vegetation formation occurring at both of the 'definite' localities is sheltered Blue Gum forest (elevation 30 and 270 metres asl). Though the species is known to prefer tall forest such as Blue Gum forest, these elevations are relatively low for the bat, which appears to be more common above 600 metres asl (e.g. DEC 2007a). It is unfortunate that no individuals have been captured in harp traps to positively confirm their occurrence and make an assessment of habitat preferences in the study area. Within the vicinity of south-eastern Wollemi NP the Eastern False Pipistrelle has most frequently been captured further north in Wollemi NP along the Hunter Main Range, but also on occasion on the Cumberland Plain.

As with many other bat species, a better understanding of habitat preferences and further harp trapping surveys are required in order to accurately assess the distribution and conservation status of the Eastern False Pipistrelle in south-eastern Wollemi NP and the surrounding region. At this stage the low number of records suggests that the study area provides only lower quality habitat. No specific management actions can be recommended for this species within the study area at this time.

EASTERN BENTWING-BAT

Species Profile

Plate 47: Eastern Bentwing-bat © S. Eberhard

The Common Bentwing-bat (*Miniopterus schreibersii*) is the most widely distributed bat in the world, occurring through Europe, Africa and Australasia (Churchill 1998). However, research suggests there to be three taxa in Australia (Duncan *et al.* 1999). The subspecies *oceanensis* is the relevant taxa for New South Wales and extends between central Victoria and Cape York Peninsula, Queensland (Duncan *et al.* 1999) and is commonly referred to as the Eastern Bentwing-bat. This species is distinguished from other similar-sized bats by the long last bone in the third wing digit and from the Little Bentwing-bat by the longer forearm (greater than 44mm) (Parnaby 1992a). The ultrasonic call can be distinctive. However, it is often inseparable from the Large Forest Bat and Southern Forest Bat (*Vespadelus regulus*) (Reinhold *et al.* 2001). It utilises a wide variety of habitats where it usually roosts in caves, disused mines and road culverts (Churchill 1998). It is a fast flying species that usually feeds above the canopy (Churchill 1998) and has been known to travel up to 65 kilometres away from roosts in a night (Dwyer 1966). Though individuals often use numerous non-breeding roosts, they congregate en masse at 12 large maternity roosts and a number of smaller sites to breed (Hoye and Hall 2008). Individuals may travel considerable distances with juveniles travelling up to several hundred kilometres from maternity to overwintering roosts (Hoye and Hall 2008).

Threats

Damage and disturbance to roosting sites are the greatest threats to this species. Only relatively few nursery caves are used, hence significant population changes can occur if these sites are damaged (Hoye and Hall 2008). Disturbance of hibernating colonies can lead to starvation due to loss of energy reserves (Gilmore and Parnaby 1994). Modification to feeding habitat by agriculture and urban development may also be a problem (Gilmore and Parnaby 1994). Some individuals are preyed upon by Feral Cats and, less often, Foxes (Dwyer 1995).

Local and Regional Conservation Status

The Eastern Bentwing-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 (DECC 2008b). Records are widespread within the Sydney Basin Bioregion, but strong clusters 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 habitat in a number of reserves including Royal, Nattai, Kanangra-Boyd, Blue Mountains and Wollemi National Parks (DECC 2008b). However, roost sites for the species, particularly maternity roosts, are much less frequently recorded and poorly reserved.

The Eastern Bentwing-bat has been directly observed on just one occasion when an individual was captured in a harp trap on Wollemi Creek during CRA surveys (Map 10). The species has once been confidently identified from its ultrasonic call, detected on Wheeny Creek during BSP surveys (Map 10). The species has been identified to the 'probable' level of certainty at six further locations, including the Mellong Plateau, Gospers Ridge, north of Gees Arm and Mountain Lagoon Road (records not presented on Map 10). Eastern Bentwing-bats are infrequently captured in harp traps due to their habit of flying above the tree canopy, sometimes so high it is beyond the range of the Anabat detector, and hence the density of records may be an underestimate of the species actual occurrence in the area. The species is likely to forage widely throughout the study area. Evidence of roosting, in the form of scats on the floor of an overhang, was collected at a single location above the Colo River during the BSP surveys (Map 10). Many more temporary roost sites would occur in rocky overhangs throughout the study area, but no maternity roosts are known.

Though the Eastern Bentwing-bat may be more abundant than records indicate, it is clearly less common here than in other parts of the region such as north-eastern Wollemi NP (DEC 2007a). The reserve never-the-less makes up an important component of the matrix of foraging and temporary roost site habitat for the species in the region. As urban and industrial expansion continues to place pressure on off-reserve roost sites, any roost sites that are located in reserves will take on increasing conservation importance. Known roost sites, especially if any maternity or hibernation sites are discovered, should be managed to minimise disruption from fire and visitation. No other management actions appear to be required for the species in the study area at this time.

LARGE-FOOTED MYOTIS

Species Profile

Plate 48: Large-footed Myotis © Martin Schulz

The Large-footed Myotis (*Myotis adversus*) is another bat species for which the taxonomy has recently been reviewed. Australian Myotis are now considered to belong to two separate species. The Southern Myotis (*M. macropus*) is found in the coastal region and along the Murray River between South Australia and south-east Queensland. The Northern (*Myotis moluccarum*) occurs in Queensland and across the Top End (Duncan *et al.* 1999, Churchill 1998). Even though Myotis can be recorded from up to 20 metres using Anabat, its call can be difficult to distinguish from *Nyctophilus* species (Reinhold *et al.* 2001). Trapped individuals are easily distinguished from other species by their disproportionately large feet, which they use to rake prey comprising insects and small fish from the surface of water (Churchill 1998). It occurs in a wide variety of habitats as long as water is nearby. It roosts in caves, tree hollows, vegetation and artificial structures such as bridges and mines - usually over or near water (Churchill 1998).

Threats

The threats to this species are poorly known, but it is probably sensitive to changes in water quality including sedimentation (from vegetation clearing and logging), eutrophication (sewage and fertiliser run-off), pollution and altered flow regimes (Duncan *et al.* 1999). Roosting sites may be susceptible to disturbance by such activities as recreational caving, roadworks or forestry activities (Duncan *et al.* 1999, Gilmore and Parnaby 1994). Replacement or repair of bridges, road culverts or water supply tunnels is another threat to this species, which may roost in such structures in large numbers (R. Williams pers. comm.). Land subsidence due to longwall mining may also impact on sandstone caves and waterways that provide habitat for this species (NSW Scientific Committee 2005a).

Local and Regional Conservation Status

The Large-footed Myotis is listed as Vulnerable on the TSC Act. Throughout its range, it is primarily a coastal species and there are few records outside of the maritime Bioregions. In the Sydney Basin Bioregion it is strongly associated with the coastal plains and hinterland environments of the Central Coast, Cumberland Plain and Illawarra. Representation in reserves is relatively poor, however records are known from Nattai, Royal and Popran NPs and Dharawal SCA (DECC 2008b).

Large-footed Myotis has been captured on a single occasion within south-eastern Wollemi NP, near the junction of Wollemi and Putty Creeks during CRA surveys (Map 10). The species has been identified from its ultrasonic call at two further locations, and though neither of these are definite the call detected along Wheeny Creek during BSP surveys is considered '90 %' probable (N. Williams pers. comm.) and therefore has been included in Map 10. As noted above, the Large-footed Myotis is closely associated with permanent water, most commonly encountered foraging along creek lines that contain permanent pools of water. Given this, the species is sure to forage in numerous drainage systems in the study area, including the Colo River, Wollemi, Tootie, Wheeny, Mellong and Culoul Creeks. Elsewhere in the vicinity of south-eastern Wollemi NP the Large-footed Myotis has been most frequently recorded on the Cumberland Plain, where it utilises waterways in relatively disturbed environments (DECC 2008b), though the density of records here may be a bias towards areas that are most frequently surveyed.

The preservation of habitat for the Large-footed Myotis in south-eastern Wollemi NP holds conservation significance as the species is rarely recorded on neighbouring reserves. Furthermore, the fact that the Colo River catchment is largely natural, with little potential for pollution and no eutrophication or altered flow regimes, makes it particularly valuable to water-quality dependent species such as this bat. As a lot of remaining habitat for the Large-footed Myotis in the region is still under threat from further development, habitat that is preserved within the reserve system is important to regional conservation of the species. Threats acting upon this species in the study area are not known, but likely to be few if any. Hence management actions can not currently be recommended for this species.

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-eastern New South Wales and north Queensland (Atherton Tablelands). The species can readily 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). It feeds primarily on beetles and other slow-flying insects; although it has been recorded eating a variety of smaller bat species when caught in harp traps. The Greater Broad-nosed Bat utilises creeks and forest clearings for hunting below 500 metres in altitude (Churchill 1998; Hoye and Richards 2008). 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; Hoye and Richards 2008). The ultrasonic call of the Greater Broad-nosed Bat is easily confused with species of *Scotorepens* and with the Eastern False Pipistrelle (Pennay *et al.* 2004).

Plate 49: Greater Broad-nosed Bat © N. Williams/DECC

Threats

The threats to this species are poorly known, but thought to include: disturbance to roosting and breeding sites; clearing and fragmentation of foraging habitat; and application of pesticides and herbicides in foraging areas or near waterways (Duncan *et al*. 1999; DEC 2005f). Forest harvesting may remove suitable hollows and alter the availability of prey (Duncan *et al.* 1999). Urban expansion is likely to be a problem in the Sydney Basin, with the core of the species' range centred on the coastal plains of the Sydney, the Illawarra and the Central Coast (DECC 2007a).

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 (DECC 2008b). 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, and to a lesser extent the Cumberland Plain and the southern Blue Mountains. The species is reasonably well reported from DECC reserves within the Sydney Basin, including Nattai, Kanangra-Boyd, Blue Mountains and Wollemi National Parks (DECC 2008b).

The Greater Broad-nosed Bat was not reliably detected during the 2007-08 BSP surveys, with only a single call identified to the 'probable' level of accuracy north-east of Mount Tootie. However, the species was captured in harp traps at two locations during the CRA surveys, near the junction of Wollemi and Putty Creeks (where it was also detected by Anabat) and on the Mellong Plateau (Map 10). The species is rarely captured through neighbouring areas also, but has been trapped in Wollemi NP to the north and west of the study area, in Yengo NP and most frequently in areas where the most survey has been undertaken, such as the Cumberland Plain (DECC 2008b). Research in the greater southern Sydney region found the Greater Broad-nosed Bat to be closely aligned to taller forests, particularly in flatter areas (DECC 2007a). A cursory examination of records in the northern part of the Sydney Basin aligns somewhat with these findings. The recent systematic surveys between the Hawkesbury and the Hunter Rivers have found the Greater Broad-nosed Bat to be only sparsely scattered through the sandstone reserves, suggesting much of the sandstone plateaux provide only marginal habitat for the species.

The Greater Broad-nosed Bat remains a poorly understood species and is thought to be only sparsely scattered across its entire range (Parnaby 1992b). Continued scientific survey and research of the species is crucial to guiding its conservation management. Targeted management actions are not immediately required for the species within the reserve, but ongoing survey in the region, and eventually habitat modelling, will lead to a greater understanding of the conservation requirements of this species in the future.

EASTERN CAVE BAT

Species Profile

Plate 54: Eastern Cave Bat © N. Williams/DECC

The Eastern Cave Bat (*Vespadelus troughtoni*) is a small mustard yellow-brown bat with dark wings. It has a patchy distribution through much of 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 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 2005g). Although little is known about the biology and ecology of this species, general habitat preferences 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 2005f). 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 (*Petrochelidon ariel*) mud nests (Schulz 1998).

Threats

Threats to the species are poorly understood as little is known about its habitat preferences, diet and breeding requirements. As for other cave-dwelling bats destruction or disturbance of roosting and maternity sites, and the surrounding forest and woodland, is likely to be the main threat (DEC 2005f). This type of disturbance results 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 modification and from practices such as timber harvesting and grazing (DEC 2005f). Direct damage or disturbance to roosting sites can result from mining operations or recreational activities such as caving (DEC 2005h). Application of pesticides near foraging areas is also likely to impact, through reduction of invertebrate populations and accumulation of toxins within the bats' tissues (DEC 2005f). Predation by Feral Cats and Foxes also poses a threat to the species (DEC 2005f).

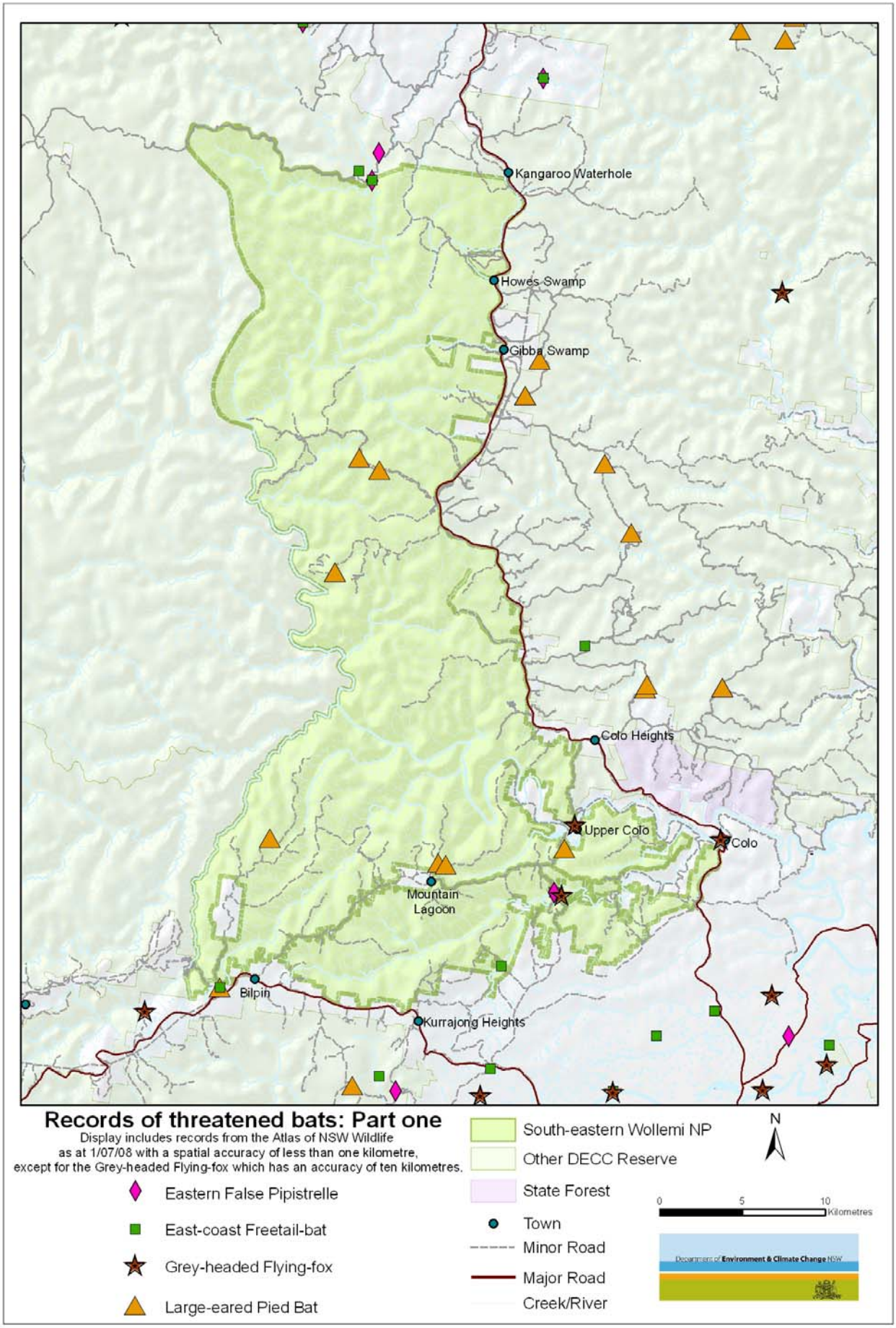
Local and Regional Conservation Status

The Eastern Cave Bat is listed as Vulnerable under the TSC Act. 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 (DECC 2008b). The species is reported in low numbers from DECC reserves including Wollemi, Yengo, Goulbourn River and Warrumbungle National Parks and Arakoola and Manobalai Nature Reserves (DECC 2008b). Extensive DECC surveys in various reserves and Sydney Catchment Authority Special Areas in the greater southern Sydney region have failed to locate this species in that area (DECC 2007b).

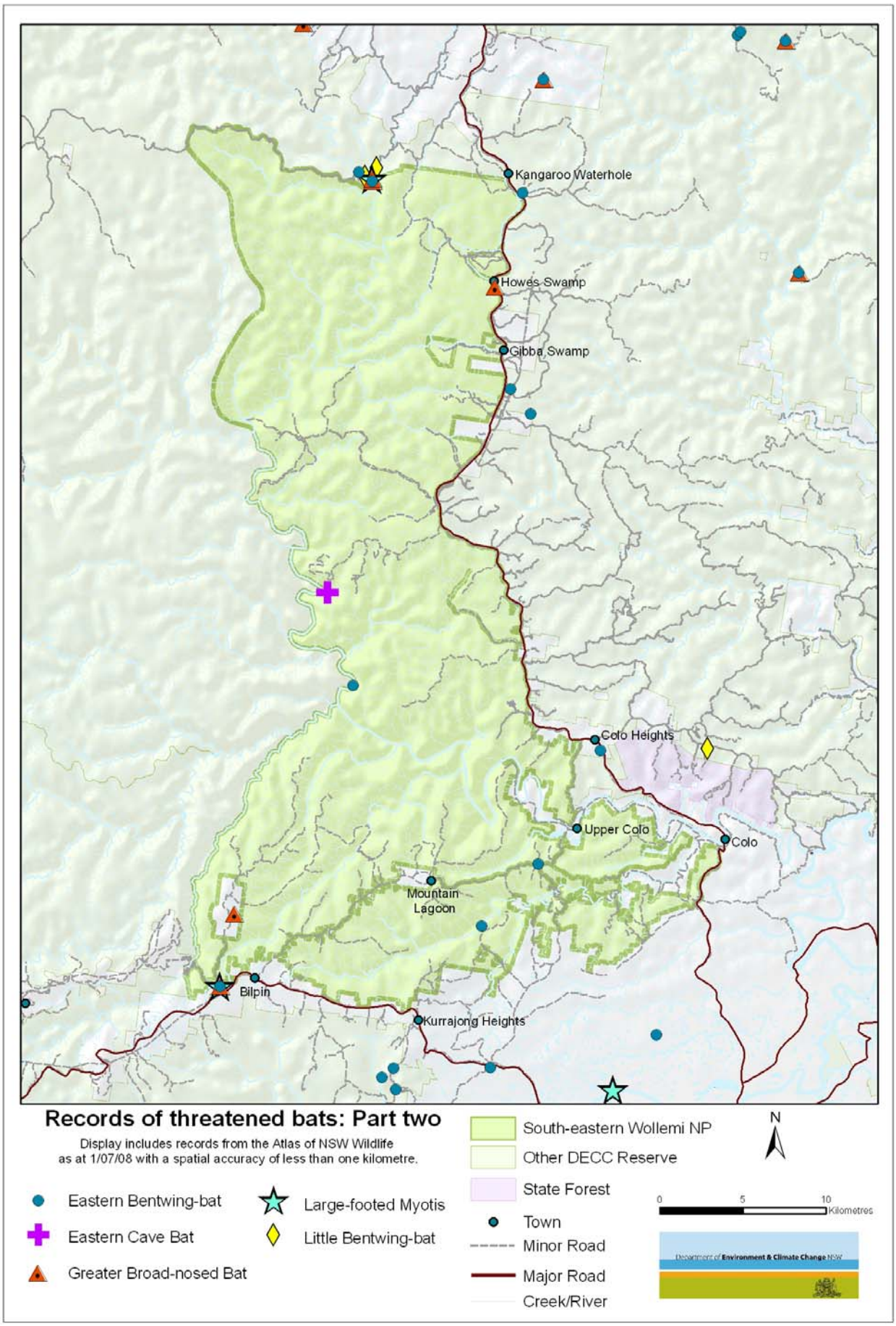
The Eastern Cave Bat was recorded for first time in south-eastern Wollemi NP during the BSP surveys, when four individuals (three male and one of unknown sex) were found roosting in the honeycomb weathering of an overhang along the cliffs of the Colo River in November 2007 (Map 10). This was a rather unexpected discovery, as the species has not previously been recorded elsewhere in the vicinity of the study area, despite recent DECC surveys having been undertaken in northern Blue Mountains and southern Yengo NPs and Parr SCA. The closest known localities for the species are in northern Yengo and northern Wollemi NPs, which (together with Goulburn River NP and Manobalai Nature Reserve) recent BSP surveys have identified to be somewhat of a stronghold for the species in the Sydney area. The record collected in south-eastern Wollemi NP is one of the most southerly records for the species on the Atlas of NSW Wildlife, indicating the species approaches the southern limit of its range within the study area. It is likely that the Capertee and Colo Rivers act as a

conduit for the occurrence of this species from further north in Wollemi NP, though Eastern Cave Bat have also sporadically been recorded closer to Sydney (N. Williams pers. comm.). The species is likely to roost in other rocky overhangs and caves along the escarpments of the Colo River, but probably only occurs in low abundance and restricted extent within the study area. To date there is no evidence of maternity roosts within the study area.

The upper Hunter and Goulburn Valley region appears to be a stronghold for the Eastern Cave Bat and is likely to play a pivotal role in its conservation within the Sydney Basin. The study area appears to lie at the southern limit of this stronghold, probably supporting only a small amount of habitat and a small number of individuals. 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. The greatest threat to the species in the study area is likely to be predation by Foxes and Feral Cats, and potentially high intensity fire in the vicinity of roost sites, but as the species remains so poorly understood specific management recommendation cannot be provided at this stage.



Map 9: Part one of threatened bat records within five kilometres of south-eastern Wollemi NP



Map 10: Part two of threatened bat records within five kilometres of south-eastern Wollemi NP

4.2 PEST SPECIES

EURASIAN BLACKBIRD

Species Profile

The Eurasian or Common Blackbird is medium sized, sexually dimorphic bird, with the male being all black with yellow-orange beak and eye-ring. The female is generally dark brown with a streaked throat and yellow-brown bill (Pizzey and Knight 1997). It is a native of Europe and India and was introduced to Australia in the 1860s and 1870s, probably for aesthetic reasons. However, it is believed the Sydney population was established from an aviary release in the 1940s (Long 1981). Though it is often associated with gardens, parks and orchards, it is a species that will extend into moist native forest; particularly where dense weed species provide cover (P. Ewin pers. obs.). They build a cup-shaped nest in which three to five eggs are laid (Pizzey and Knight 1997). Blackbirds are usually seen feeding on the ground, where they consume invertebrates and seeds but will also eat fruits and berries.

Impacts

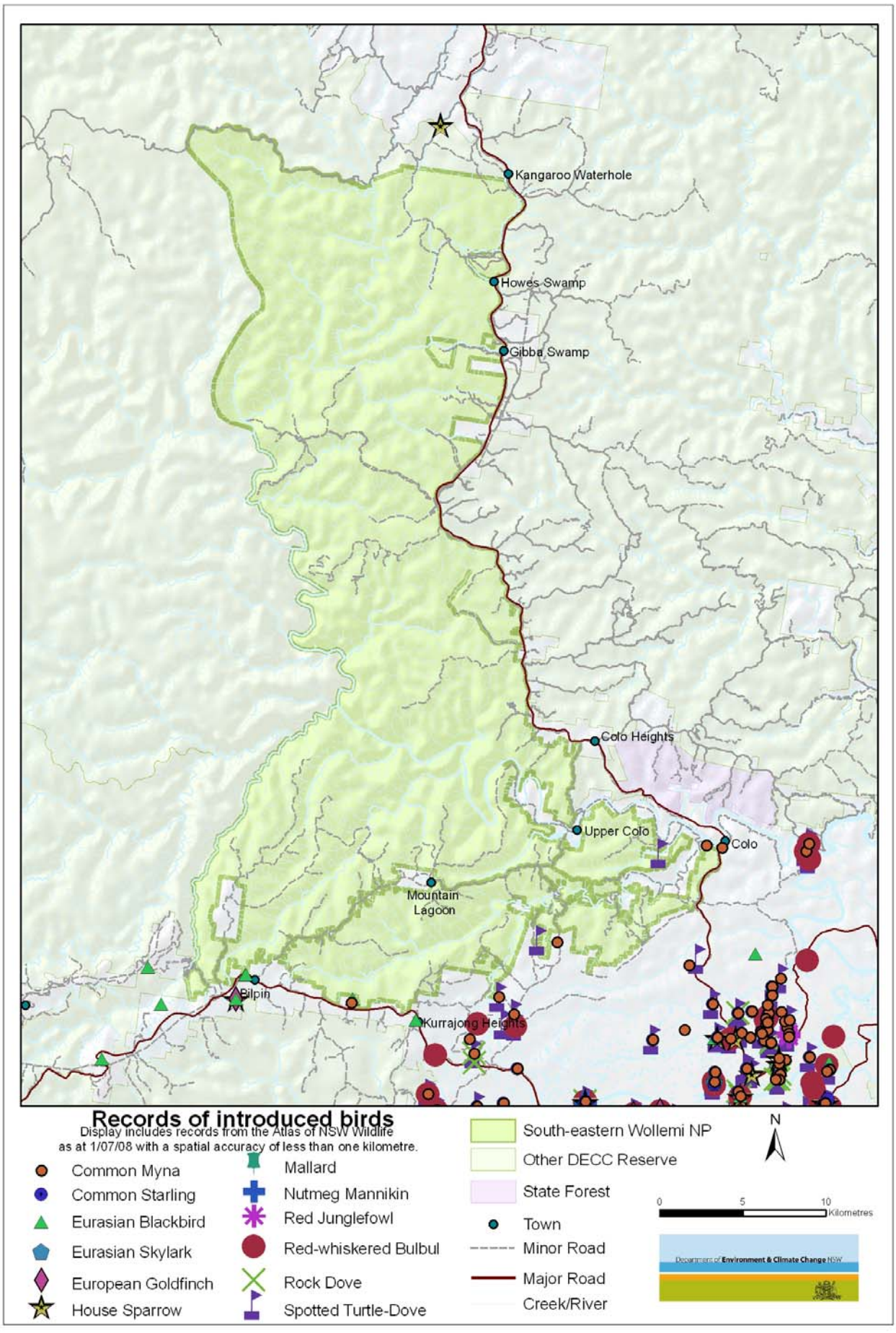
Eurasian Blackbirds have the ability to survive in relatively undisturbed areas of native vegetation, and hence may pose a significant threat to native species. This may be through direct competition with species such as Bassian Thrush (*Zoothera lunulata*), hybridisation (as may have been the case with the Norfolk Island race of the Island Thrush (*Turdus poliocephalus poliocephalus*) or through preying on native invertebrates (Garnett and Crowley 2000). It is implicated in the spread of invasive weed species such as Blackberry, Bitou Bush, Boneseed and African Olive (Cuneo and Leishman 2006, Loyn and French 1991, Dodkin and Gilmore 1984). The Blackbird has had the greatest impact in areas with a depauperate native bird fauna, such as Lord Howe Island and New Zealand; however they are continuing to expand on mainland Australia and hence impacts may not yet have been fully realised.

Local and Regional Status

The Eurasian Blackbird is listed as unprotected under the NP&W Act. There has been an increase in the frequency of recordings of this species between 1984 and 2002 (Barrett *et al.* 2003). In NSW, this bird occurs in all bioregions except in the far north-west. Currently the northern limit is about Armidale and Bourke, but it may still be expanding northward. It is widely distributed in the South Eastern Highlands Bioregion. In the Sydney Basin Bioregion there are numerous records in the Sydney Metropolitan Area, fewer records to the south and only occasional records on the Central Coast and further north. Most observations are from outside conservation reserves, though it is abundant within the smaller, urban parks, such as Lane Cove and Scheyville NPs and on the edges of larger reserves that abut urban or agricultural areas (DECC 2008b).

The Eurasian Blackbird is frequently recorded to the south of the study area in association with development along Bells Line of Road (Map 11), and further to the south-east on the Cumberland Plain (DECC 2008b). However, the species has only once been recorded within the boundary of south-eastern Wollemi NP, when one bird was heard and two were seen immediately north of the Bilpin rest area during BSP surveys (Map 11). At this stage the Eurasian Blackbird is restricted to the extremities of the park, in the vicinity of human habitation, and is likely to be having a negligible impact on native fauna. However, the species does have the potential to invade further into the park, particularly along major creek lines that run through the sandstone ranges. The Eurasian Blackbird is thought to be gradually expanding its range and increasing in number through bushland south of Sydney (DECC 2007a). Thus, though the Eurasian Blackbird has to date only been recorded on the boundary of the park, it has the potential to significantly impact on native fauna species further into the park in the future.

Active management of this species is not currently required in south-eastern Wollemi NP. However, if the species is observed to spread further into the reserve or to invade undisturbed areas of bushland, control should be considered as a moderate conservation priority.



Map 11: Introduced bird records within five kilometres of south-eastern Wollemi NP

WILD DOG

Species Profile

Plate 50: Wild Dog © G. Steenbeeke/DECC

Wild Dogs are the feral descendants of domesticated European Dogs, introduced into Australia with first British settlement. They vary in appearance and are found throughout a range of habitat types, though they are most often associated with areas that have been cleared for agriculture. Wild Dogs prey on a range of medium to large mammals, such as kangaroos and wallabies, though they will also consume reptiles, birds, insects and carrion. Prey may also include livestock, and pest species, including Rabbits and Pigs (Fleming *et al.* 2001). Wild Dogs will interbreed with the Dingo (*C. l. dingo*). Wild Dogs may not impact on native fauna as significantly as other introduced predators because the native dog, the Dingo, has been a top-order carnivore for approximately 5000 years (Savolainen *et al.* 2004). Species that survived the arrival of the Dingo should be able to co-exist with Wild Dogs, with exceptions occurring when other threatening processes are involved, such as habitat loss, disease, altered fire regimes and predation by Foxes. Wild Dogs may be a problem for isolated populations of some threatened species.

Impacts

The Wild Dog is declared a pest species throughout NSW under the RLP Act. Predation by Wild Dog is not listed as a Key Threatening Process, however Wild Dogs are known to impact on a number of threatened mammal and bird species including the Brush-tailed Rock-wallaby, Koala and Long-nosed Potoroo (NPWS 2002c, 2003d, NSW Scientific Committee 2003c). A further threat is that they have been found to carry diseases, such as Cryptosporidium and Hydatid disease, which may be transmissible to humans. Hybridisation with Dingoes is ongoing and Wild Dogs and hybrids are probably expanding into remote areas once occupied only by Dingoes.

Local and Bioregional Conservation Status

Wild Dogs are not protected under the NP&W Act. Wild Dogs are widespread throughout the Bioregions of the Dividing Range and some coastal areas. Of the 86 records of Wild Dog/Dingo in south-eastern Wollemi NP, only four derive from direct sightings, including an individual seen on Culoul Creek during the BSP surveys that was regarded to be Wild Dog (not Dingo). The remainder of the records derive from tracks and scats, from which it is impossible to determine the relative percentage of Wild Dog or Dingo heritage. Records in Map 12 are therefore presented as 'Wild Dog/Dingo' to indicate that the sightings may represent either subspecies. The Wild Dog/Dingo complex is widespread throughout the reserves, having been recorded in all major habitat types. Unsurprisingly records are concentrated tracks and major creek lines, which represents a bias in sampling effort rather than true habitat preferences. Never-the-less, Wild Dog/Dingo is known to travel along trails (J. Betteridge pers. comm.), which may increase the ease of incursion for the species into remote areas. Records of Wild Dog/Dingo are relatively evenly scattered through neighbouring reserves (DECC 2008b).

Wollemi NP is considered to be important for the conservation of the Dingo (NPWS *et al.* 2000, DEC 2005c), such that management of the Wild Dog must be balanced against the need to conserve the Dingo. It is recommended that genetic research be extended from Yengo into Wollemi National Park to: ascertain patterns in the level of Wild Dog/Dingo hybridisation in the area; identify key areas of Dingo purity and Wild Dog invasion; and inform the ongoing development and review of a management plan that balances the need for Dingo conservation and Wild Dog control. The threatened species most vulnerable to predation by the Wild Dog is thought to be Brush-tailed Rock-wallaby. Control may be deemed necessary around Brush-tailed Rock-wallaby colonies in the future, after an assessment of the size and condition of the colonies and the level of threat imposed upon them. Minimising roads, tracks and other cleared access ways into remote areas may help to control the incursion of Wild Dogs into the centre of the park. Any control of Wild Dogs in the future should focus on the peripheries of the reserve to manage impacts on adjoining landholders and protect Dingoes that may occur in more remote areas. Any control programmes must be undertaken in conjunction with Fox management and employ a cooperative cross-tenure approach. Aerial baiting is not recommended for this area due to the lack of imperative from sheep graziers, the Spotted-tailed Quoll and Dingo populations and the important role that Dingoes are likely to play in regulating the ecosystems of south-eastern Wollemi NP.

Fox

Species Profile

The European Red Fox is a small, lithe canid that occurs naturally in Europe, Asia, North America and North Africa. Foxes were successfully introduced for sport hunting in Victoria in the 1870s and since then they have spread rapidly throughout the southern two-thirds of mainland Australia and have recently been introduced to Tasmania. Foxes are generalist predators and will prey on vertebrates and invertebrates, including crayfish. Unlike Feral Cats, they will also scavenge carrion and consume plant material such as berries.

Plate 51: Fox © N. Williams

Impacts

Predation by the Fox is listed as a Key Threatening Process under the TSC Act and EPBC Act and it is also listed as a pest species under the RLP Act. It is known to impact on a range of native species by either preying on them or competing with them for food and other resources. In particular medium sized mammals, ground-dwelling and semi-arboreal mammals, ground-nesting birds and chelid tortoises are thought to be affected (Dickman 1996a, NPWS 2001d). As pests in an agricultural landscape, Foxes are known to prey on lambs and domestic fowl and can be a significant problem in some areas. Foxes have been shown to have a role in regulating the populations of some of their prey species, including Eastern Grey Kangaroo (*Macropus giganteus*) (Banks *et al.* 2000).

Local and Regional Status

Foxes are ubiquitous throughout vegetated, rural and urban areas of the eastern half of NSW, including the Sydney Basin and South Eastern Highlands Bioregions. They are an extremely common species, and even though they are under-recorded off park, there are few areas without sightings. In response to the listing of predation by this species as a Key Threatening Process, a Threat Abatement Plan (TAP) was endorsed in 2001. This Plan outlines management priorities for NSW including a research program investigating Fox control and threatened species populations (NPWS 2001d).

As elsewhere in the Sydney Basin, the Fox is widespread and common in south-eastern Wollemi NP. The species has only been seen and heard near the perimeters of the park (including on the Putty Road and near Blaxlands Ridge), but records deriving from tracks and scats are widespread, including through the centre of the study area (Map 13). Records derived from scats are most concentrated along the closed track north of Mount Tootie, however this is a sampling bias as searches for scats were specifically undertaken along this trail on at least two occasions during the BSP surveys. Scats have been collected from a range of habitat types, including sandstone ridgetop woodland, sheltered slope and gully forest and hanging swamp.

Foxes are unlikely to ever be eradicated and priority areas for control should be chosen on the basis of conservation value, particularly habitats for susceptible threatened species. Based on research elsewhere, fauna species in the study area thought to be most at risk from Fox predation are: Brush-tailed Rock-wallaby, Spotted-tailed Quoll, Turquoise Parrot, Koala, Yellow-bellied Glider and Rosenberg's Goanna. Fauna that occur in hanging swamps and sedgelands are also at risk as many species frequent the ground and low shrubs, or shelter in dense vegetation at ground level, making them highly vulnerable to predation. Minimising roads, tracks and other cleared access ways in these habitats may help to control Fox numbers. The highest priority for monitoring and potentially abatement is around extant viable Brush-tailed Rock-wallaby colonies. Hawkesbury Area should receive regular updates on the findings of Fox TAP research programs, particularly as they relate to Brush-tailed Rock-wallaby management, to enable efficient take-up of management actions as appropriate. Fox scats in the vicinity of Brush-tailed Rock-wallaby habitat should be collected and analysed to help determine the level of threat imposed. If a Fox control programme is deemed worthwhile, it will not be successful without the adoption of a multi-faceted approach including cooperative cross-tenure action and consideration of the competitive interactions with other mammalian carnivores.

FERAL CAT

Species Profile

The Cat is a medium-sized carnivore that was first domesticated in the eastern Mediterranean about 3000 years ago (IUCN 2005). The exact origin of the Cat in Australia is unknown, however they were deliberately introduced into the wild during the 19th Century to control Rabbits, Rats and Mice (Rolls 1984) and are now found in virtually all terrestrial habitats across the continent, except some of the wettest rainforests (Environment Australia 1999a). Feral Cats can survive with limited access to water, obtaining moisture from their prey (Newsome 1995). They prefer live prey and while small mammals make up the majority of their diet they will also take birds, reptiles, frogs, fish and insects (Dickman 1996b). They are capable of killing vertebrates up to two kilograms in weight but prefer smaller species weighing less than 220 grams (Dickman 1996b).

Plate 52: Feral Cat © M. Schulz

Impacts

Predation by Feral Cats is listed as a Key Threatening Process under the TSC Act and under the EPBC Act and this species has been listed by the World Conservation Union as among 100 of the 'World's Worst Invaders' (IUCN 2005). Although it is known that Feral Cats prey on native animals, the details and extent of their impact remain poorly understood. Predation by Cats has been implicated in the extinction and decline of many species of mammals and birds on islands around Australia, and in NSW has been linked to the disappearance of thirteen species of mammal and four species of birds (NSW Scientific Committee 2000d). 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 Mice) fluctuates widely (NSW Scientific Committee 2000cat). In Australia, Feral Cats are not recorded to have impacted on any species of reptiles, amphibians, fish or invertebrates (Dickman 1996b). The impact of domestic and stray Cats on native wildlife in suburbia and urban bushland remains poorly understood and controversial.

Local and Regional Status

The exact distribution of the Feral Cat in NSW is poorly known, however there are records from throughout all the Bioregions in NSW, with concentrations in the urban areas on the coast. The majority of records within the Sydney Basin Bioregion are from within 50 kilometres of the coast and to the north of the Shoalhaven River, while they are much more thinly scattered in the South Eastern Highlands Bioregion. It is highly likely that this species occurs at low densities in most environments and conservation parks from the smallest to the largest reserves such as Wollemi and Kosciusko NPs.

The distribution and abundance of the Feral Cat in south-eastern Wollemi NP remains poorly understood. The majority of records derived from the extremities of the study area, including north of 'Itchenstoke', near Upper Colo, near Blaxlands Ridge and at Kings Waterhole, but records also exist deep within the reserve such as on the D'Arcy and Culoul Ranges (Map 12). The majority of sightings of Feral Cat within the vicinity of the study area derive from areas either currently or previously inhabited by humans. However, it is not known whether this reflects a greater density of Feral Cat in these areas or is simply a sampling bias. The Feral Cat is a very elusive animal and because scats are typically buried and difficult to locate, it is much less frequently detected than Fox or Wild Dog/Dingo. It is most likely that the species occupies most habitats in the study area at a low density, with concentrations around the perimeters of the park.

DECC staff and other visitors to the reserve should be encouraged to accurately report all Feral Cat sightings, for entry in the Atlas of NSW Wildlife. The control of Feral Cats is extremely difficult, and it is not feasible to eradicate the species from the reserves, at least in the medium term; thus a control programme is therefore not recommended at this time.

FERAL PIG

Species Profile

Plate 53: Feral Pig © DECC

The Feral Pigs in Australia are descendants of various domestic breeds that were introduced by the first English settlers and transported around the country by 19th Century pastoralists (DEH 2004c). Since that time, there have been repeated escapes from domestic stock and intentional releases of animals for recreational hunting (DEH 2003). Feral Pigs are now found across Australia, reaching highest densities in eastern NSW, the ACT, Queensland and through northern Australia to the Kimberley Region (NSW Scientific Committee 2004b). They occupy a wide range of habitats, but are restricted by their requirement for shade and access to water (Choquenot *et al.* 1996). Throughout their range, Pigs show a preference for moist habitats, such as riparian zones, swamps, wet sclerophyll forests and forested gullies (NSW Scientific Committee 2004b). Feral Pigs have a varied diet that includes grasses, bulbs, tubers, roots, seeds, fruit, mushrooms, carrion, vertebrate and invertebrate prey (NSW Scientific Committee 2004b).

Impacts

Pigs have been declared a pest species throughout NSW under the RLP Act. Predation, habitat degradation, competition and disease transmission by Feral Pigs is listed as Key Threatening Processes under the TSC Act and the EPBC Act and the species has been listed by the World Conservation Union as among 100 of the 'World's Worst Invaders' (IUCN 2005). The species poses a significant threat to native species and ecological communities through its behaviour and feeding habits. The Feral Pig consumes a range of birds, reptiles, frogs, small mammals and soil invertebrates (Pavlov 1995) and competes with native fauna for food resources (NSW Scientific Committee 2004b). They cause extensive habitat alteration by wallowing, rooting and foraging, including: destruction of plants, reduced regeneration of plants, alteration of soil structure, spread of weeds, creation of drainage channels in swamps, reduction of water quality and spread of disease such as root-rot fungus (*Phytophthora cinnamomi*) (DEH 2004c).

Local and Regional Status

The Feral Pig occurs across the Sydney Basin Bioregion, especially around Goulburn River NP and the Boyd Plateau. The species has also been recorded in high numbers between Tumut and Bega in the South Eastern Highlands Bioregion, with many records from reserves such as Kosciusko NP and Tinderry NR (DECC 2008b). It is common on both private and public land, though this species is probably under-recorded outside of the reserve system.

The Feral Pig is currently fairly restricted in extent in south-eastern Wollemi NP, with the greatest density of records on the Mellong Plateau including along Mellong Creek, Gospers Creek, Howes Swamp Creek and Tinda Creek (Map 13). In this area the impact of Pigs on habitats is obvious in the form of furrows and diggings, which is disturbing natural hydrology, but direct impacts on native fauna are more difficult to assess. Disturbingly, Pig remains have also been located along Wollemi Creek, just north of the study area boundary, though the size and status of the Pig colony in this area is not known. Feral Pigs are rare within the vicinity of the study area, with the closest records on the Atlas of NSW Wildlife at Newnes Plateau and on the western rim of the Cumberland Plain (DECC 2008b). Feral Pigs have also been reported in the Putty Valley and at Bilpin and Kurrajong Heights (NPWS 2001e).

Because the population on the Mellong Plateau is so isolated and currently restricted in extent, control with the ultimate aim of eradication is feasible. The Hawkesbury Area of DECC currently control the Pigs on the Mellong Plateau as resources permit. Continuation, and escalation if possible, of this control program is a high conservation management priority. Some successful control programs have recently been implemented elsewhere in the Sydney Basin, particularly in the Murruin Wilderness and the Wollondilly River (DECC 2007a). A management program involving trapping, selected poisoning and shooting should continue to be implemented as resources permit and should include a cooperative cross-tenure and cross-PWG Area approach. It is also recommended that surveys be undertaken in the Wollemi Creek area to establish whether Feral Pigs currently occur there, and hence whether this creek system should be included in the control program.

FERAL GOAT

Species Profile

The Feral Goat is a medium-sized generalist herbivore descended from animals first domesticated in Asia (IUCN 2005). Goats were introduced to Australia by the First Fleet in 1788 and on many subsequent occasions due to their ability to thrive on tough grazing land, reproduce rapidly and provide a ready source of meat, milk and fibres (Henzell 1995). Feral Goats are descendants of various breeds of domestic stock that have escaped, were abandoned or were deliberately released (DEH 2004d). They now occur in all Australian states and offshore islands, but are most common in the rocky or hilly semi-arid to arid areas of western NSW, South Australia, Western Australia and Queensland (DEH 2004d). They have a varied diet; browsing trees and shrubs, grazing forbs and grass, and eating fruit, bark, roots and dead plant material (NSW Scientific Committee 2004c). Feral Goats are largely suppressed in areas where Dingos and/or Wild Dogs are present, but reach high densities where these predators have been controlled (Henzell 1995).

Impacts

Competition and habitat degradation by Feral Goats are listed as a Key Threatening Process under the TSC Act and the EPBC Act and has been listed by the World Conservation Union as among 100 of the 'World's Worst Invaders' (IUCN 2005). The species has 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 2004c). Feral Goats are a major contributor to soil erosion and can prevent the regeneration of palatable trees and shrubs (Henzell 1995). Feral Goats compete with native fauna for food, water and shelter and have been implicated as a threat to the endangered Brush-tailed Rock-wallaby and the Broad-headed Snake (Environment Australia 1999b, NSW Scientific Committee 2003c, 2004c).

Local and Regional Status

Feral Goats have been recorded in all Bioregions of NSW but are rare in the Australian Alps and South East Corner Bioregions (DECC 2008b). Most records are in the rocky hills and the mulga and mallee areas in western NSW, though patches of high density occur throughout the tablelands as well. In the Sydney Basin and South Eastern Highlands Bioregions, scattered records occur throughout, though the highest densities appear to be in the Southern Highlands, including Abercrombie River and Tarlo River NPs, and Bungonia SCA, and the far north, such as in eastern Goulburn River NP and Munghorn Gap NR (DECC 2008b).

Goat droppings were detected at two locations during the BSP surveys, on a small side creek adjacent to Wheeny Creek and on Culoul Creek, while Goat droppings were identified on a ridgetop between Mellong and Howes Swamp Creek by the National Parks association in 1996 (Map 13). Feral Goats have previously been reported in limited numbers on Wheeny Creek itself (NPWS 2001e). Outside of the study area Goat sightings are widely scattered, but records occur in the Putty Valley, at Bilpin and near Kurrajong (DECC 2008b).

Two known locations of Feral Goats are close to current or historic Brush-tailed Rock-wallaby colonies, and the third record is in proximity of Broad-headed Snake habitat, and thus the pest species is of high conservation concern. Given the apparent scarcity and scattered occurrence of the Goat at this stage, control is considered feasible. Initially surveys should be undertaken in the vicinity if recent scat records, to determine the current size and extent of the population(s). A management program involving shooting should then be implemented as necessary and as resources permit, and should include a cooperative cross-tenure and cross-PWG Area approach. In addition, neighbouring landholders should be made aware of the high conservation value of south-eastern Wollemi NP to the Brush-tailed Rock-wallaby and Broad-headed Snake, and of the damage that escaped Goats can cause. DECC staff and park users should be encouraged to report any sightings of Goat, together with accurate spatial information, for entry into the Atlas of NSW Wildlife.

FALLOW DEER

Species Profile

The Fallow Deer (*Dama dama*) was the first species of deer to become widely naturalised in Australia, with populations established in all States except Western Australia (Bentley 1995). It is native to the Middle East and Europe. It is smaller than other introduced deer species in the Sydney Basin, weighing between 36-97 kilograms. Most Fallow Deer are spotted to a lesser or greater degree, though variation does occur (Bentley 1995). Deer farms became popular in the 1970s and 1980s, and since this period many deer species have become established from escapees (Moriarty 2004). Between 2002 and 2004/05 Feral Deer have been reported to increase in abundance and range in NSW more than any other pest species (West and Saunders 2007) and hence are an emerging pest animal management issue.

Impacts

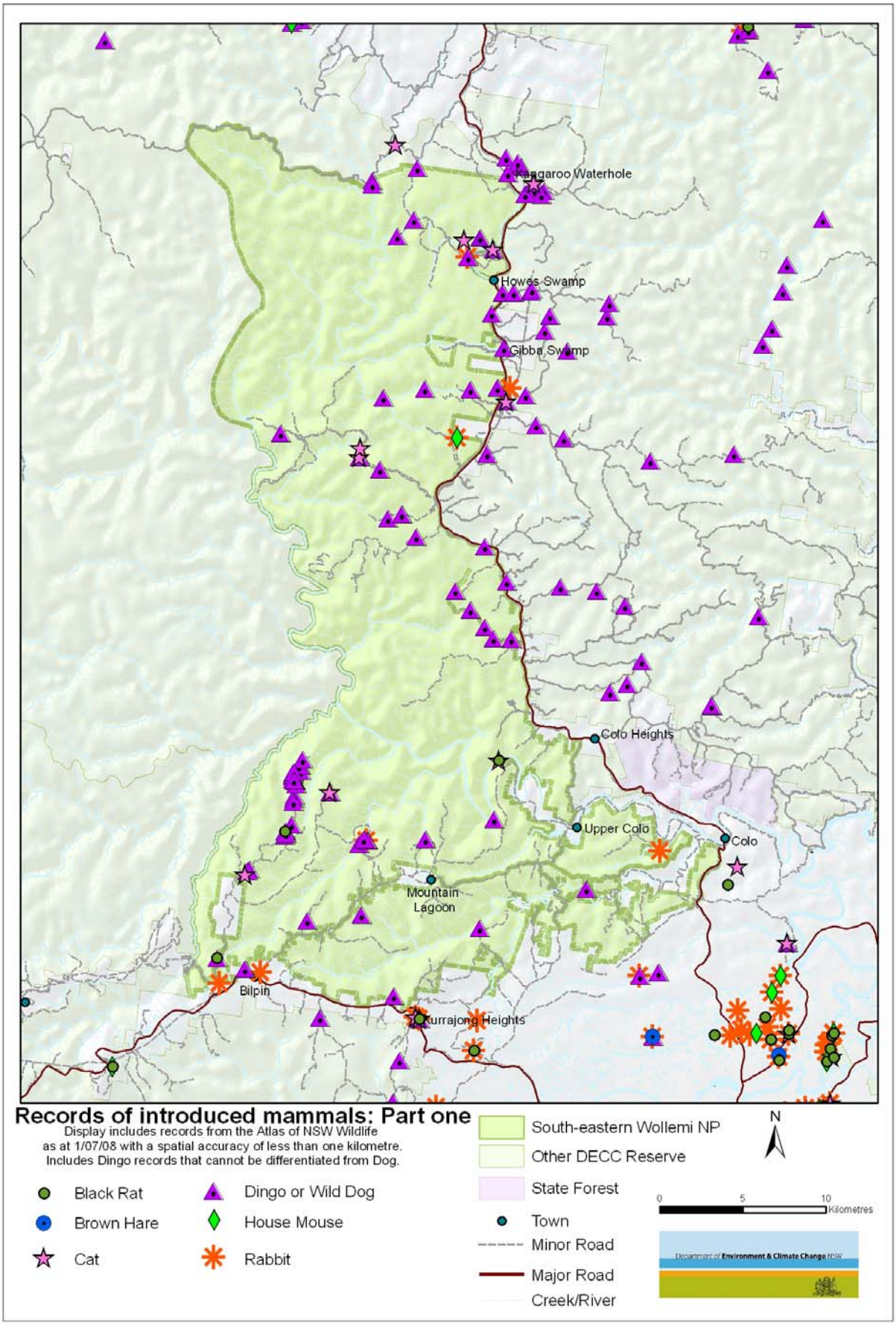
Herbivory and environmental degradation by Feral Deer has been listed as a Key Threatening Process in NSW (NSW Scientific Committee 2004d). The impacts of Fallow, Red and Sambar Deer are similar to that of the Rusa Deer, and include overgrazing, trampling, ring-barking, dispersal of weeds, acceleration of erosion, concentration of nutrients and degradation of water quality (NSW Scientific Committee 2004d). Like other species of deer, Fallow Deer can cause serious traffic accidents. There are a number of other significant socio-economic impacts of deer populations including damage to residential gardens and fences, attracting illegal hunting, carrying diseases and parasites that may be transmitted to humans and impacts on agriculture (DEC 2006c).

Local and Regional Status

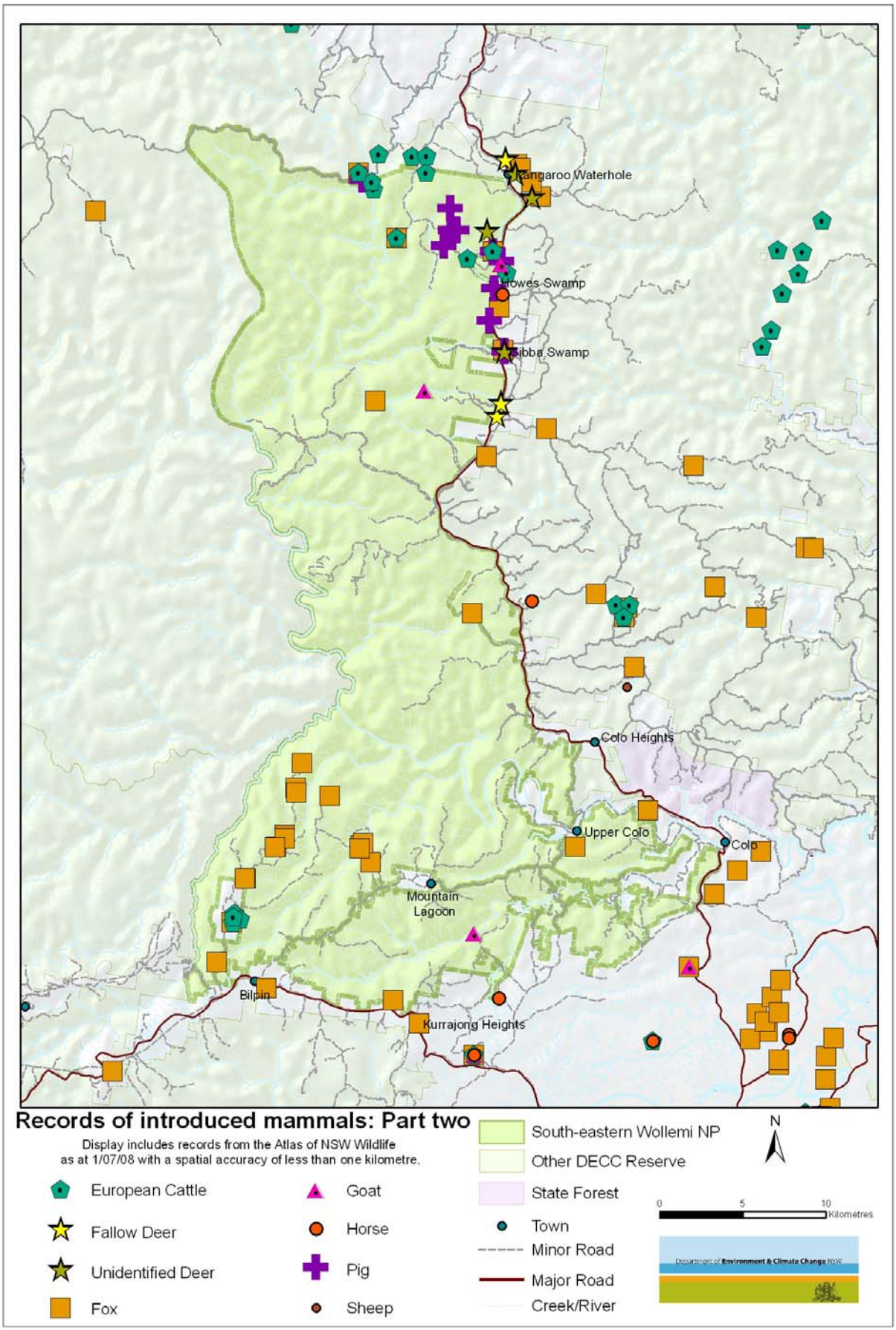
Fallow Deer are listed as unprotected under the NP&W Act. The species is not formally listed as a pest animal by the RLPB, however herbivory and land degradation caused by Feral Deer is listed as a Key Threatening Process under the TSC Act. Within NSW, the distribution of Fallow Deer is patchy and not well understood. Wild populations have established from multiple escapes and releases and the species has not reached the full extent of its potential range (Moriarty 2004).

Feral Deer currently appear to be limited in extent in south-eastern Wollemi NP, occurring on the Mellong Plateau and in the vicinity if the Putty Road from Culoul Range north to Kangaroo Waterhole (Map 13). Sightings also extend further north along Putty Creek and into the Putty and Howes Valleys and east into Yengo NP (DECC 2008b). Furthermore, there are reports of Fallow Deer being killed on the road near Bilpin (C. H. Barker pers. comm.). Fallow Deer are likely to be having a significant impact on native vegetation on the Mellong Plateau, and consequently on native fauna, particularly after fire when Deer would feed on the abundance of shoots and news leaves of trees, shrubs and grasses. Furthermore, Fallow Deer may be a significant traffic hazard on the Putty Road.

Based on recent spread of Fallow Deer in other parts of the Sydney Basin (DECC 2007a) the pest is considered to have the potential to increase in density and distribution in the north-eastern section of the study area if not addressed. At this stage control of the Fallow Deer is considered feasible, if undertaken using a cross tenure approach. The Hawkesbury Area of DECC, in co-operation with Yengo Area, currently manage the Fallow Deer in south-eastern Wollemi NP as resources permit, with several eradication methods being trialled (D. Monahan pers. comm.). Continuation of the control programme, together with monitoring of changes in Deer numbers in the park over time, is a high conservation priority. In addition members of the public, and all government staff, should be encouraged to report sightings with accurate location information for entry into the Atlas of NSW Wildlife.



Map 12: Part one of introduced mammal records within five kilometres of south-eastern Wollemi NP



Map 13: Part two of introduced mammal records within five kilometres of south-eastern Wollemi NP

5 PRIORITIES FOR FAUNA CONSERVATION AND MANAGEMENT

5.1 THREATENED SPECIES CONSERVATION MANAGEMENT PRIORITIES

Land managers are faced with an ominous list of threatened fauna species. However, not all threatened species warrant equivalent management efforts in south-eastern Wollemi NP. There are a number of threatened species within the study area which at this stage do not require any targeted management, and others that require specific management, further survey and/or monitoring to be undertaken in order to increase their chances of long term survival.

Table 8 lists all of the threatened species currently known to occur in the study area, with a rating of their priority for conservation management. These ratings are derived from expert knowledge rather than quantitative assessment, and will require review and revision in the future when comprehensive information on the regional conservation status of each species becomes available. The ratings are defined as follows.

Highest: Species that are likely to become extinct from the study area in the short to medium term without action, and for which the study area is likely to play a crucial role in the regional conservation of the species. These species require management at a site by site level. This category includes species which may already be locally extinct but would be of highest conservation priority if confirmed to be extant in the study area.

High: Species that are at risk of becoming extinct from the region without active management of remaining habitats and abatement of threats. This category includes species which are rare in the study area, or for which habitat is limited in extent, but for which the study area is never-the-less important to regional conservation, as well as species that are better represented in the study area than in other reserves in the region. This category includes species which may already be locally extinct but would be of high conservation priority if confirmed to be extant in the study area.

Moderate: Species for which the study area does not support a significant amount of habitat relative to that reserved elsewhere in the region. Though management of these species is not currently the highest priority for the reserves, an increase of pressure on these species elsewhere in the region, or the delineation of key threats within the study area, may require more active management in the future.

Low: Species for which habitat is widespread within the study area and well represented in the regional reserve system. These species do not require any specific active management in the study area at this stage, other than ongoing protection of important habitat features such as mature hollow-bearing trees.

Table 8: Threatened fauna species recorded within south-eastern Wollemi NP, their relative management priority, key locations and potential threats

Priority for management in the study area	Species	Number of records in the study area [1]	Current occurrence confirmed during BSP surveys?	Key locations in the study area	Potential key threats in the study area	Significance of the study area to regional conservation of the species
Highest Priority Require targeted management at a site level	Brush-tailed Rock-wallaby	4 pre-1990 locations 7 post-1990 locations	Yes	Rocky slopes and escarpment lines along the Colo River, particularly those with a northerly or westerly aspect. Also small rocky escarpments and boulder piles in the vicinity of water along other creek lines such as Culoul Creek and potentially Boori, lower Angorawa, Blacksmiths and Tootie Creeks.	Predation by and disease transmission from Feral carnivores, potentially hot wildfire at rocky refuge sites and competition with Feral Goat.	Moderate
	Stuttering Frog	1	No	May be locally extinct. Habitat occurs in sheltered creek headwaters with rainforest elements in the south of the park including Cabbage Tree Creek, tributaries of Wheeny Creek, Gospers Creek and Lagoon Creek.	It is not known whether Chytrid fungus occurs, but would present a highly significant threat to this species if it does.	Unknown but would be high if species is re-discovered.
High Priority Require further survey and/or management of key habitats and key threats	Booroolong Frog	1	No	Presumed to be locally extinct. Once recorded on Wollemi Creek and potential habitat also occurs on the Capertee River.	It is not known whether Chytrid fungus occurs, but would present a highly significant threat to this species if it does. Potentially Willow invasion of Wollemi Creek.	Low
	Regent Honeyeater	6	No	River Oak forest along the Colo River, grassy Ironbark forest around Colo Heights and the slopes of Wollemi, Long Weeney and Putty Creeks.	Fire (including hazard reduction burns) during nesting periods, ongoing fragmentation and development of primary habitat on the Cumberland Plain, Hunter and Capertee Valleys and elsewhere.	Low
	Broad-headed Snake	6	Yes	Rock outcrops with exfoliating sandstone on ridgelines and upper slopes and nearby forest with hollow-bearing trees.	Removal and disturbance of winter shelter sites (bush rock), collection of specimens by reptile collectors, removal of dead wood, and potentially low density of hollow-bearing trees in gully lines and disturbance of habitat by Feral	High

Priority for management in the study area	Species	Number of records in the study area [1]	Current occurrence confirmed during BSP surveys?	Key locations in the study area	Potential key threats in the study area	Significance of the study area to regional conservation of the species
					Goat.	
	Squirrel Glider	1	No	Open woodlands on the Mellong Plateau. Also potentially lower slopes of the Putty, Wollemi and Long Weeney Creek valleys in the north of the study area.	High frequency fire, predation by Fox and Feral Cat, potentially competition for hollows from Feral Honeybees.	Low
	Brown Treecreeper	4	Yes	Grassy Ironbark woodlands on the slopes of Wollemi, Putty and Long Weeney Creeks as well as adjacent open alluvial woodlands. Potentially also the Mellong Plateau.	Grazing by introduced herbivores including feral and wild-roaming domestic Cattle and Fallow Deer, removal of dead wood and dead trees, low density of hollow bearing trees due to past logging practices, potentially competition with Feral Honeybees.	Low
	Black-chinned Honeyeater	3	Yes	Ironbark woodlands on the slopes of Wollemi, Putty and Long Weeney Creeks. Potentially also the Mellong Plateau.	Unknown. Potentially competition from more aggressive honeyeater species.	Low
	Grey-crowned Babbler	1	No	Open woodlands on the Mellong Plateau and wider creek flats of Long Weeney and Putty Creeks.	Grazing and spreading of weeds by feral and wild-roaming domestic Cattle, removal of dead wood and dead trees from neighbouring lands, predation by Feral Cat.	Low
	Spotted-tailed Quoll	2	Yes	Would range through the whole park but particularly in moister vegetation types on sheltered slopes, gully lines and riparian zones in higher rainfall areas.	Predation and competition by feral carnivores, potentially high frequency fire and baiting for Foxes or Wild Dogs.	High

Priority for management in the study area	Species	Number of records in the study area [1]	Current occurrence confirmed during BSP surveys?	Key locations in the study area	Potential key threats in the study area	Significance of the study area to regional conservation of the species
	Turquoise Parrot	11	Yes	Mellong Plateau and adjacent drainage lines such as Angorawa Creek. Potentially also grassy Ironbark woodlands on slopes of Wollemi and Long Weeney Creeks, as well as more open alluvial areas on Long Weeney Creek.	Predation by Fox and Feral Cat, low density of tree hollows due to past logging practices, removal of dead wood and dead trees, potentially competition for hollows with Feral Honeybees.	Low
	Masked Owl	1	No	Not well understood but likely to be more open forests and woodlands along riparian zones in lower rainfall areas such as Long Weeney Creek.	Unknown. Potentially competition for hollows with Feral Honeybees, low density of hollow bearing trees due to past logging practices.	Unknown but likely to be low
	Koala	52	Yes	Records scattered across park particularly in centre from Angorawa to Culoul Creeks and south of the Colo River.	Widespread hot wildfire that leaves no unburnt refuge areas. Maintenance of connectivity with adjacent areas of habitat likely to be key to the species occurrence.	High
	East-coast Freetail-bat	3 definite 2 probable	Yes	Not well understood but appear to be alluvial and riparian areas particularly on more fertile soils, such as Wollemi and Wheeny Creeks.	Unknown. Potentially low density of hollow-bearing trees due to past logging practices, application of pesticides adjacent to the park, competition for hollows with Feral Honeybees, and removal of dead wood and dead trees.	Low
	Grey-headed Flying-fox	1	No	Potential foraging habitat widespread.	None known. Potentially fire during times of heavy eucalypt flowering and land use management practices on adjacent private lands.	Low

Priority for management in the study area	Species	Number of records in the study area [1]	Current occurrence confirmed during BSP surveys?	Key locations in the study area	Potential key threats in the study area	Significance of the study area to regional conservation of the species
	Large-footed Myotis	1	Single ultrasonic call collected, though identification not definite.	Permanent creek lines with open pools including the Colo River and Wollemi, Tootie, Wheeny, Mellong and Culoul Creeks.	Unknown. Potentially Willow invasion of Colo River and part of Wollemi Creek.	Moderate
	Littlejohn's Tree Frog	1	Yes	Not well understood. The single record occurs in the headwaters of a creek supporting dry sclerophyll forest with a sedgy understorey. Also potentially occur in Upland Swamps. Likely to be restricted to the south of the study area where average rainfall is higher.	Potentially small isolated populations which increases the risk of local extinction. It is not known whether Chytrid fungus occurs, but may affect this species if it does.	Unknown but likely to be moderate
Moderate Priority Require management of key habitats and key threats	Barking Owl	2 records of low spatial accuracy	No	Unknown. Potential habitat occurs along creek lines and lower slopes in lower rainfall areas including Putty, Wollemi and Long Weeney Creeks.	Low density of suitable hollow-bearing trees due to historical logging operations and clearing.	Low
	Sooty Owl	4	Yes	Higher rainfall areas in the south where mesic vegetation with rainforest elements occurs, particularly Wheeny Creek and its tributaries, Blacksmiths Creek, Canoe Creek and potentially Gospers, Lagoon and Cabbage Tree Creeks.	Possibly low density of hollow-bearing trees due to post logging practices. Potentially future changes in vegetation characteristics and prey species abundance resulting from frequent fire and climate change.	High
	Eastern Cave Bat	1	Yes	Overhangs in escarpments adjacent to the Colo River.	Species approaches southern extremity of its range in the park and may be at the limit of its ecological tolerance. Threats are not known but may include high intensity fire in the vicinity of roost sites, predation by feral carnivores and climate change.	Low

Priority for management in the study area	Species	Number of records in the study area [1]	Current occurrence confirmed during BSP surveys?	Key locations in the study area	Potential key threats in the study area	Significance of the study area to regional conservation of the species
	Greater Broad-nosed Bat	2 definite 1 probable	Single ultrasonic call collected, though identification not definite.	Not well understood but appear to be taller forest types particularly in flatter areas, such as near the junction of Wollemi and Putty Creeks.	Unknown. Potentially low density of hollow-bearing trees due to past logging practices, application of pesticides adjacent to the park, competition for hollows with Feral Honeybees, and removal of dead wood and dead trees.	Low
	Eastern False Pipistrelle	2 definite 3 probable	Yes	Not well understood but appear to be taller wetter forests.	Unknown. Potentially low density of hollow-bearing trees, application of pesticides adjacent to the park and hollow competition from Feral Honeybees.	Low
Lower Priority Do not currently require targeted management actions	Rosenberg's Goanna	2	Yes	Habitat widespread including along ridgelines and upper slopes.	Predation by Feral Cats, Wild Dogs and Foxes.	Moderate
	Large-eared Pied Bat	7 definite 2 probable	Yes	Widespread through a range of habitat types particularly sandstone ridge tops and escarpment lines.	Unknown. Potentially predation by feral carnivores. If roost sites occur within the study area these are vulnerable to disturbance by hot wildfire and by Feral Goat.	Moderate
	Red-crowned Toadlet	13	Yes	Habitat widespread in first and second order creek lines and sometimes pools on ridge tops, particularly south of Culoul Range.	No threats currently identified. It is not known whether Chytrid fungus occurs, but may significantly affect this species if it does break out.	Moderate
	Giant Burrowing Frog	20	Yes	Habitat widespread. Breed in the headwaters of minor drainage channels or on larger creek lines with alluvial sand and rocky pools. Records all south of Culoul Range but species also expected to occur to the north.	It is not known whether Chytrid fungus occurs, but may significantly affect this species if it does break out. Predation by feral carnivores.	High

Priority for management in the study area	Species	Number of records in the study area [1]	Current occurrence confirmed during BSP surveys?	Key locations in the study area	Potential key threats in the study area	Significance of the study area to regional conservation of the species
	Powerful Owl	10	Yes	Habitat widespread in tall sheltered forests where hollow-bearing trees occur.	Possibly low density of hollow-bearing trees due to post logging practices. Frequent fire may damage foliage roosts and alter the abundance of prey species.	Moderate
	Eastern Bentwing-bat	3 definite 6 probable	Yes	Foraging and temporary roost site habitat widespread. No maternity roost sites known.	Roost sites vulnerable to disturbance by hot wildfire and predation by Feral Cat. Potentially application of pesticides adjacent to foraging areas.	Moderate
	Gang-gang Cockatoo	55	Yes	Widespread. Primarily taller forests along gully lines and sheltered slopes.	Climate change may be a significant future threat.	Moderate
	Glossy Black-cockatoo	23	Yes	Widespread. Sheltered forest that includes Forest Oak in the small tree layer.	Climate change may be a significant future threat if it results in altered fire regimes that reduce the abundance of *Allocasuarina* species.	Moderate
	Yellow-bellied Glider	22	Yes	Widespread. Sheltered tall open forests.	Low density of suitable hollow-bearing trees due to historical logging operations.	Moderate

[1] Indicates the number of locations accurately recorded on the Atlas of NSW Wildlife

5.2 THREATENING PROCESSES

Several Key Threatening Processes (KTPs), as identified under state and federal legislation, act within the study area. Table 9 summarises the KTPs that are thought to occur within south-eastern Wollemi NP, including threats that are currently thought to be having a significant impact on native fauna (shaded red), threats that are restricted in extent or which are not well understood (shaded pink) and threats that may arise in the future (shaded orange).

Table 9: Relative priority and key locations of Key Threatening Processes

Key Threatening Process	Key current locations of threat and areas to target for abatement/management
Predation by the European Red Fox	Occurrence is widespread. Extent of impact on animal populations is not well understood. Total eradication is not feasible, but populations can be reduced. Until further information is gained, key areas for monitoring/control are known locations and habitats of Brush-tailed Rock-wallaby. Foraging efficiency seems to be maximal in habitats with an open understorey (Environment Australia 1999c), making the Mellong Plateau susceptible. The presence of Dingo may reduce Fox abundance (M. Letnic in prep.).
Bushrock removal and disturbance	Ridgelines in vicinity of tracks and trails. No evidence of recent bushrock removal or disturbance was collected during the 2007-08 surveys, but historic removal was widespread. Key areas of concern are accessible rocky ridgelines on the Mellong Plateau and potentially also Grassy Hill track.
Ecological consequences of high frequency fire	Entire area at risk, particularly the Mellong Plateau between Angorawa Creek and Putty Road and between Tari and Tinda Creeks.
Loss of hollow-bearing trees	Areas of regrowth in formerly logged gully systems, particularly north and east of the Colo River, and on formerly cleared and grazed lands in the north east such as Long Weeney Creek and gully lines running west of the Mellong Plateau.
Predation by Feral Cats	Distribution unknown and significance of impact on animal populations not well understood. Majority of records derive from the extremities of the study area. Most susceptible areas are known locations and habitats of Turquoise Parrot, particularly the Mellong Plateau.
Predation, habitat degradation, competition and disease transmission by Feral Pigs	Mellong Plateau including Mellong Creek, Gospers Creek, Howes Swamp Creek and Tinda Creek. Numerous threatened species occur in this area that could be impacted by degradation of habitat.
Herbivory and environmental degradation caused by Feral Deer	Mellong Plateau between Tari Creek and High Wollemi. Impact appears to be restricted in extent at this stage, but has the potential to spread if left unchecked. Threatened species potentially impacted include Brown Treecreeper.
Competition and land degradation caused by Feral Goats	Recorded from three locations, being Culoul Creek, Wheeny Creek and Mellong Plateau. Brush-tailed Rock-wallaby scats have been collected on Culoul Creek, and historic records occur on Wheeny Creek, a species which is highly susceptible to the impacts of Feral Goats. Broad-headed Snake is also vulnerable, as the species may overlap on the Mellong Plateau.
Infection of frogs by amphibian Chytrid fungus	Occurrence and distribution is not known. Key areas for research are: creek lines supporting rainforest; headwaters of minor drainage channels; larger creek lines with alluvial sand and rocky pools.
Competition from Feral Honeybees	Distribution and abundance not known. Potential impacts may be exaggerated in areas where logging or clearing has occurred in the past due to the reduced availability of tree hollows.
Invasion of native plant communities by exotic perennial grasses	Current severity and extent of this threat not mapped. Vegetation mapping currently being undertaken (DECC in prep.) will aid with assessment of current and potential impacts and habitats most at risk. Old grazing lands on Long Weeney Creek are likely to support exotic grasses, as may sections of the Mellong Plateau. Fauna species most

Key Threatening Process	Key current locations of threat and areas to target for abatement/management
	susceptible are Grey-crowned Babbler and Speckled Warbler.
Competition and grazing from feral European Rabbit	Rabbits have not been recorded within the study area on the Atlas of NSW Wildlife, but only on the park boundaries in grassy areas that have suffered some disturbance. Potential habitat occurs on the Mellong Plateau, but the species is not considered to be having a significant impact on native fauna at this stage.
Human-caused climate change	Potential impact on fauna species poorly understood at this stage. Several studies currently being undertaken will inform the management of this impending threat.
Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations	Not currently known from study area.

Table 10: Other threatening processes acting in south-eastern Wollemi NP

Process	Key locations of threat
Grazing by feral and wild-roaming domestic Cattle affecting the regeneration of previously cleared areas, and potentially spreading weeds, fouling waterholes and causing harm by trampling and compacting the soil, with flow-on effects for native fauna.	Creek lines and flats that support open grassy woodland, particularly Long Weeney Creek, Putty Creek, Mellong Creek and the northern Mellong Plateau. Threatened species potentially affected include Brown Treecreeper and Grey-crowned Babbler.
Predation by Wild Dogs and hybridisation between Wild Dogs and Dingoes	Records of the Wild Dog/Dingo complex are widespread across the study area. The presence of Dingo may reduce Fox and Feral Goat numbers and their impacts. The key areas of threat are the peripheries of the reserve (where Dogs may invade the park and hybridise with Dingoes) and potentially in the vicinity of Brush-tailed Rock-wallaby colonies, though the latter requires further research before any control action is taken.
Collection of individual specimens of Broad-headed Snake	Rocky outcrops on ridges and exposed slopes adjacent to trails.
Very high intensity fire	Rocky refugia of Brush-tailed Rock-wallaby, roost sites of cave-dwelling bats, and anywhere in the study area where no unburnt refugia are left, particularly near core areas for Koala.
Invasion of waterways by Willow (*Salix* spp.)	Willows are known to occur along the Colo River and Wollemi Creek, threatening riparian species such as Platypus and Large-footed Myotis. This problem is currently being actively addressed by the community group 'Willows Out Of Wollemi' in cooperation with the DECC Hawkesbury Area.
Occurrence of Eurasian Blackbirds which compete with native species and spread weeds	Recorded at a single location just north of Bilpin rest area. Impact on native fauna likely to be negligible at this stage, and would only require active management if found to spread further into the park.
Application of pesticides in neighbouring farmlands	Extent of practice and level of impact on threatened fauna is not known. Potential problem areas are the southern, and to a lesser extent the northern ends of the study area.
Firetrail and firebreak construction and maintenance that alters local hydrology, destroys road-side ditches or allows easier access for feral predators	All ridgelines and upper slopes.
Ground water extraction for the bottled water industry	Projects have been proposed in the vicinity of Bells Line of Road to extract water for bottling. The approval of such projects may alter local hydrology and threaten the occurrence of Upland Swamps and rainforests in the study area.

5.3 RELATIVE PRIORITY OF FAUNA HABITATS

The current mapping of native vegetation communities in Wollemi National Park (Bell 1998) is at a scale inappropriate for use in point-based assessment of fauna habitat preferences. The vegetation mapping of south-eastern Wollemi National is currently being revised using detailed aerial photograph interpretation (DECC in prep.). This will result in finer scale delineation of vegetation communities and production of a map that will be able to be used to cross reference vegetation patterns with distributions of fauna species and draw conclusions of threatened fauna habitat preferences. As the revised vegetation map is not complete, this report presents an interim prioritisation of habitat types, based on research elsewhere, expert knowledge and geographical occurrence of threatened fauna species and threatening processes in south-eastern Wollemi NP. The Information and Assessment Section is working towards undertaking modelling of habitat for threatened and regionally significant species across the northern half of the Sydney Basin.

Potential habitat for the largest number of high and moderate priority threatened fauna species is provided in the open grassy woodlands that occur in the far north of the study area, including along sections of Long Weeney, Putty and Wollemi Creeks, and on sections of the Mellong Plateau. These species include Brown Treecreeper, Black-chinned Honeyeater, Turquoise Parrot, Squirrel Glider, Grey-crowned Babbler, Barking Owl, Masked Owl, Koala and Regent Honeyeater. Furthermore, these grassy forests and woodlands and Mellong sands woodlands are subject to several ongoing threatening processes such as grazing by introduced herbivores and omnivores including Cattle, Deer and Pig, competition for hollows compounded by the low density of hollow-bearing trees due to past logging and clearing, high frequency fire (Mellong area), invasion by feral carnivores, and potentially removal of dead wood and dead trees. The grassy forests and alluvial woodlands in the far north of the study area and on Mellong Plateau are considered to be **high priority fauna habitats.**

It is not currently known whether Stuttering Frog is extant within south-eastern Wollemi National Park. However, high quality habitat for this species occurs in the south of the study area in creek lines that support coastal or hinterland warm temperate rainforest. The re-discovery of this species in the study area would have extremely high conservation significance. Rainforest also provides habitat for Sooty Owl, Spotted-tailed Quoll and Powerful Owl. Rainforests are limited in extent in the study area, and may be subject to threatening processes in the future including climate change, ecological consequences of high frequency fire and infection of stream-dwelling frogs with Chytrid fungus. Potential habitat for the Stuttering Frog is therefore considered to be **high priority fauna habitat**.

Habitat for the Brush-tailed Rock-wallaby and Broad-headed Snake is not well delineated by vegetation community, but rather determined by the occurrence of specific habitat features, as described for each species in Section 4. However, potential habitat for these species would also form high priority fauna habitat. In the absence of adequate habitat mapping for these species, the area around all known extant and historic Brush-tailed Rock-wallaby colonies is considered to be **high priority fauna habitat** (see Map 8), as are known and historic localities of Broad-headed Snake (see Map 3) and corresponding extensive areas of outcropping and exfoliating rock. Escarpment lines, cliff faces and associated rocky overhangs along the Colo River, which provide Brush-tailed Rock-wallaby and Broad-headed Snake habitat, also provide habitat for Eastern Cave Bat, Eastern Bentwing-bat and Large-eared Pied Bat, while the river itself provides foraging habitat for the Large-footed Myotis. These escarpment lines are thus an example of a high priority fauna habitat area.

Only minimal fauna survey of Upland Swamps was undertaken for the BSP project, which did not detect any threatened fauna species. However, research undertaken in the greater Southern Sydney Region highlighted the importance of Upland Swamps to numerous threatened fauna species, and nominated them as a high priority fauna habitat (DECC 2007a). Threatened species which may utilise Upland Swamps in the study area include Littlejohn's Tree Frog, Giant Burrowing Frog, Red-crowned Toadlet, Rosenberg's Goanna, Turquoise Parrot, Eastern Pygmy-possum, as well as the regionally significant Beautiful Firetail and Southern Emu-wren. Fauna occurring in Upland Swamps are also subject to several threatening processes including predation by feral carnivores (especially Foxes and Cats) on ground-dwelling birds and mammals, frequent fire and isolation of habitat patches leading to susceptibility to local extinction. The hanging swamps in the south of the study area fall into the Vulnerable Ecological Community 'Blue Mountains Swamps in the Sydney Basin Bioregion'. Based on these factors, Upland Swamps have also been nominated as a **high priority fauna habitat**.

6 SUMMARY OF MANAGEMENT RECOMMENDATIONS

The purpose of this section is to bring together the results of the BSP surveys and the priorities set in Section 5 to provide interim management recommendations for fauna in south-eastern Wollemi NP. These recommendations are intended to complement actions already identified in relevant threatened species Recovery Plans, Priority Action Statements (PAS), Threat Abatement Plans and in the Wollemi National Park Plan of Management. Such documents are readily available and will therefore not be duplicated here. These management recommendations should be reviewed and refined as further information becomes available.

6.1 INTRODUCED SPECIES

In order to guide management of pest species in the south-east Wollemi the following notes and recommendations are made. These recommendations are made primarily with regards to pest species impacts on fauna biodiversity and threatened fauna species.

6.1.1 Fox

- It is unlikely that Foxes will ever be eradicated from the reserves. A broad scale Fox control program is not considered worthwhile at this time. Instead, management should focus on abatement of threats to particular fauna species and building knowledge of what prey species are targeted in the study area.

- Recent research in arid areas has shown Fox numbers, and their impacts, are dramatically reduced where Dingoes are present (M. Letnic in prep). It is unknown whether Dingoes directly prey on Foxes or exclude them through competition. While further research needs to be conducted in forested environments, it is highly likely that where Dingoes can be protected, such as the Wollemi wilderness, they will be an effective and labour-free tool to control Foxes.

- The highest priority for monitoring and potentially abatement is around extant viable Brush-tailed Rock-wallaby colonies. The Brush-tailed Rock-wallaby surveys recommended below should incorporate searches for Fox scats, with any that are located sent to an expert for prey analysis. After assessment of the current size and condition of the colonies, any findings and recommendations of the state-wide Fox Threat Abatement Plan (Fox TAP) as they relate to mitigation of impacts on Brush-tailed Rock-wallabies should be implemented without delay.

- The alluvial forests and Mellong sands woodlands provide habitat for a number of threatened fauna potentially impacted by Fox predation, as do the Upland Swamps. If a Fox control programme is considered worthwhile in the future, these priority habitats should also be considered for inclusion.

- The impact of the Fox on Koala in the study area is not currently known. At this stage there is no evidence that Koala numbers have declined in the reserve. If evidence is found to suggest the impact of Fox predation is significant, then concomitant Fox control may be necessary.

- In order to improve the understanding of Fox distribution and predation in south-eastern Wollemi NP it is recommended that wherever possible predator scats be collected by DECC staff and sent to Barbara Triggs for identification and prey analysis. Results, together with accurate location information, should be entered into the Atlas of NSW Wildlife in order to build up a database of the prey composition of predators in different parts of the reserves and the impact they are likely to be having on fauna species in particular habitats.

- Use of 1080 baits for Fox in the study area should be carefully considered. Where use of 1080 is deemed necessary, 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 Spotted-tailed Quolls (Glenn and Dickman 2003).

- Foxes readily utilise roads, tracks and other cleared access ways through denser vegetation or complex topography (Environment Australia 1999c). One option to minimise Fox impacts in the study area is to reduce such access points to a minimum. Such an approach may be appropriate on the Mellong Plateau, particularly in the vicinity of Turquoise Parrot records.

6.1.2 Feral Goat

- Feral Goats do not currently appear to be well established in south-eastern Wollemi NP, with only three scattered records and no recent direct sightings. However, the species has the potential to have a highly significant impact on native fauna if left unchecked. Two known locations of Feral Goats are close to current or historic Brush-tailed Rock-wallaby colonies, and the third record is in proximity of Broad-headed Snake habitat. Thus the pest species is of high conservation concern.

- Feral Goats are another species that is reduced in number where Dingoes are present (M. Letnic in prep). Conserving Dingo populations in south-east Wollemi may help control this pest.

- Given the apparent scarcity and scattered occurrence of the Goat, active control is considered feasible. Initially surveys should be undertaken in the vicinity if recent scat records, to determine the current size and extent of the population(s). A management program involving shooting should then be implemented as necessary and as resources permit, and should include a cooperative cross-tenure and cross-PWG Area approach.

- Concomitant with the control program further surveys should be undertaken for Feral Goat, particularly in the area of any newly discovered Brush-tailed Rock-wallaby colonies and around escarpment lines and rocky slopes bounding to the Colo River.

- Neighbouring landholders should be made aware of the high conservation value of south-eastern Wollemi NP to the Brush-tailed Rock-wallaby and Broad-headed Snake, and of the damage that escaped Goats can cause. DECC staff and park users should be encouraged to report any sightings of Goat, together with accurate spatial information, for entry into the Atlas of NSW Wildlife.

6.1.3 Wild Dog

- Analysis of predator scats in the greater southern Sydney region have shown that Wild Dogs consume fewer types of species than the Fox, and generally larger, more common species such as Swamp Wallaby (DECC 2007b). Therefore, in terms of impacts on overall biodiversity Wild Dogs are potentially less important than Foxes.

- Mitigation of the impacts of Wild Dogs must be balanced against the need to conserve the Dingo. Unfortunately, due to an inability to differentiate Wild Dog from Dingo by indirect traces such as scats and tracks, the relative distribution of these subspecies is not clear from data on the Atlas of NSW Wildlife. Research undertaken in Yengo NP suggests that Dingo occur at the core of that park and that animals closer to the park boundary have a higher degree of Wild Dog heritage (T. Horwood pers. comm.). Such is also likely to be the case in Wollemi NP. It is recommended that a genetic sample be taken from any dead Dogs located in the park and sent for testing of the degree of Dingo heritage.

- Control of Wild Dogs (including Dingoes) must also be balanced against evidence that their presence confers a marked benefit to small mammals and reptiles and reduces the abundance of Foxes and large herbivores (M. Letnic in prep).

- The highest priority for monitoring of Wild Dogs is around extant viable Brush-tailed Rock-wallaby colonies. Predator scats should be collected from these areas and sent to Barbara Triggs for identification and prey analysis. Any Wild Dog/Dingo data collected in the vicinity of Brush-tailed Rock-wallaby colonies should be entered into the Atlas of NSW Wildlife. Findings should then be used to help determine the need for implementation of a Wild Dog control programme in the vicinity of Brush-tailed Rock-wallaby habitat.

- The impact of the Wild Dogs on Koala in the study area is not currently known. At this stage there is no evidence that Koala numbers have declined in the reserve. If evidence is found to suggest the impact of Wild Dog predation is significant, then control may be necessary.

- Any control of Wild Dog in south-eastern Wollemi NP should focus on the peripheries of the reserve. From a biodiversity perspective baiting (particularly aerial baiting) within the interior of the park should be avoided, except if determined to be required in the vicinity of known extant Brush-tailed Rock-wallaby colonies.

6.1.4 Feral Pig

- Because the population of Feral Pigs on the Mellong Plateau is isolated and currently restricted in extent, control with the ultimate aim of eradication is feasible. The Hawkesbury Area of DECC currently control the Pigs on the Mellong Plateau as resources permit. Continuation, and escalation if possible, of this control program is a high conservation management priority. The program could variously involve trapping, selected poisoning and shooting and should take a cooperative cross-tenure and cross-PWG Area approach.

- It is also recommended that surveys be undertaken in the Wollemi Creek area to establish whether Feral Pigs currently occur there, and hence whether this creek system should be included in the control program.

6.1.5 Feral Deer

- Feral Deer are considered to have the potential to increase in density and distribution in the north-eastern section of the study area if not addressed.

- At this stage control of the Fallow Deer is considered feasible, if undertaken using a cross tenure approach. The Hawkesbury Area of DECC, in co-operation with Yengo Area, currently manage the Fallow Deer in south-eastern Wollemi NP as resources permit, with several eradication methods being trialled (D. Monahan pers. comm.). Continuation of the control programme, together with monitoring of changers in Deer numbers in the park over time, is a high conservation priority.

- Members of the public, and all government staff, should be encouraged to report sightings with accurate location information for entry into the Atlas of NSW Wildlife.

- Deer are likely to be another species that is reduced in the presence of Dingoes.

6.1.6 European Cattle

- The highest priority areas for removal of wild and free-roaming Cattle are the grassy forests and woodlands on Long Weeney, Wollemi and Putty Creeks, and the Mellong Plateau. Even though the animals in this area may be wild-roaming Domestic Cattle, they are likely to be having a significant impact on native fauna habitats and do have the potential to become feral.

- Landholders adjacent to the northern and eastern boundaries of the study area should be made aware of the negative consequences of bush Cattle grazing on threatened fauna species, particularly in alluvial areas. Landholders should remain vigilant as to the condition of fence lines that border the park, and report breaches to the DECC Hawkesbury Area as a matter of priority. DECC Hawkesbury Area should consider bearing the cost of repair to broken fences, where resources permit, to ensure the problem is fixed swiftly.

- A survey should be undertaken to determine whether any of the Cattle grazing in the study area form a feral population. This could include interviews with neighbouring landholders, bushwalking groups and other regular park users. If a feral population(s) is found to occur it should be removed as a high priority. DECC Yango Area have had some success in controlling the Feral Cattle population at Big Yango Station in Yengo NP, and should be consulted regarding efficient removal techniques.

6.1.7 Feral Cat

- The distribution and abundance of Feral Cat with south-eastern Wollemi NP is currently not known. Survey for Feral Cat in wilderness areas in the Sydney Basin is extremely difficult and not considered to be worthwhile at this time. To help gain an understanding of Cat distribution in the park, DECC staff and other visitors should be encouraged to accurately report all Feral Cat sightings, for entry in the Atlas of NSW Wildlife. It is not feasible to eradicate the species from the reserve, at least in the medium term, and a control programme is therefore not recommended at this time.

6.1.8 Feral Honeybee

- The extent of occurrence of Feral Honeybees in the park is not currently known. In order to improve this understanding, DECC staff and visitors to the park should be encouraged to report observation of Feral Honeybee hives, together with accurate location information. These sightings should be entered into a centralised database to aid assessment of the extent and distribution of threat.

- Any Feral Honeybee hives should be destroyed or removed from the study area.

6.1.9 Eurasian Blackbird

- At this stage the Eurasian Blackbird is restricted to the extremities of the park, in the vicinity of human habitation, and is likely to be having a negligible impact on native fauna. However, the species does have the potential to invade further into the park, particularly along major creek lines that run through the sandstone ranges.

- Active management of this species is not currently required in south-eastern Wollemi NP. However, if the species is observed to spread further into the reserve or to invade undisturbed areas of bushland, control should be considered as a moderate conservation priority.

6.2 FIRE MANAGEMENT AND FAUNA

Due to characteristics of elevation, slope and aspect the study area as a whole is rated as having the greatest potential to carry fire in the whole of Wollemi National Park, though this risk is not as great as in neighbouring Yengo National Park (DEC 2005b). However, the impact of wildfire and controlled burning on fauna remains poorly understood. Research currently being undertaken by DECC is one of few studies comparing fauna composition in long unburnt vegetation to vegetation that has undergone extensive and severe wildfire. Findings of that study will aid in understanding the impacts of severe wildfire on fauna in south-eastern Wollemi NP.

Preliminary examination of data collected during the DECC study (DEC 2004c) suggests that fauna groups particularly susceptible to high intensity fire are the arboreal mammals, shrub-frequenting birds and litter-dwelling skinks. The study highlights the importance of unburnt refugia in the recolonisation of burnt areas. Unburnt refugia remain important for many years after the fire, as a population source for recolonisation and by augmenting food and habitat for individuals occupying burnt areas. When few unburnt refugia remain, maintaining these in an unburnt state for many years is particularly important. It is worth noting that despite the recent history of wildfires across south-eastern Wollemi NP the suite of fauna expected to occur in Sydney hinterland sandstone environments remains present. The mechanism for species survival was not examined as part of this study, but suggests that species such as Koala and Red-crowned Toadlet can survive in frequently burnt reserves where large interconnected areas of habitat exist.

Though listed as a Key Threatening Process, the ecological impacts of frequent fire on the suite of fauna in an ecosystem remain poorly studied, and hence it is difficult to make informed management recommendations in this regard. The completion of detailed vegetation mapping across Wollemi NP will enable the delineation of fire sensitive vegetation communities. The DECC Metro Information and Assessment Section is working towards undertaking fauna habitat modelling across the northern Blue Mountains and Wollemi reserves to delineate high conservation value areas and aid in the identification of fire sensitive fauna habitats. That work would enable formulation of more prescriptive fire management strategies for biodiversity conservation. In the mean time the following generic recommendations are made.

Strategies to reduce the impact of hazard reduction burns on fauna include:

- Fire management should always maintain a mosaic of fire regimes. Mosaic burning should retain some examples of all vegetation communities in a long unburnt state, especially representatives of the priority fauna habitat types.

- Fire planning should recognise the crucial role that unburnt refugia play in the recolonisation of burnt landscapes, particularly after extensive and intense wildfire. When only small areas are left unburnt these should remain in an unburnt state for as long as possible, at the very least for five years.

- Avoid burning areas that provide habitat for declining woodland birds during the nesting season, namely the grassy forests and woodlands in the north and the Mellong Plateau. For most species this is primarily between the months of July and January (Higgins *et al.* 2001; Higgins and Peter 2002).

- Avoid burning areas when key eucalypt and *Corymbia* species are in heavy flower, to minimise impact on feeding resources for nectivorous species such as Black-chinned Honeyeater and Grey-headed Flying-fox. Key eucalypt species are Ironbarks (*E. fibrosa* and *E. crebra*) and Grey Gum.

- Fuel reduction burning should be conducted outside of the spring/summer period when Koalas are breeding, and crown scorch and crown burns should be avoided.

- If active nests or roosts of threatened owls or threatened bats are located, avoid burning these sites and the immediately surrounding area. Too frequent hazard reduction burning, using low intensity fire with short burn intervals, should also be avoided in the creek lines and gorges that support Sooty or Powerful Owl territories.

- Fire regimes in the grassy forests and alluvial woodlands in the north of the study area and on the Mellong Plateau should be managed to ensure key habitat features are maintained and enhanced, including: diversity of native grasses; fallen logs and standing or fallen dead trees; hollow-bearing trees. This is particularly important for the Mellong Plateau, parts of which have been subject to four or more fires in the last 20 years.

- The patchy distribution of Upland Swamps makes recolonisation difficult in the event of local extinction from fire. Fire management regimes should always aim to leave some of this habitat type in a long unburnt state, with a plan to create a mosaic of fire histories.

Strategies to reduce the impact of wildfire management on fauna include:

- As for control burns, management of wildfire should, where possible, aim to maintain a mosaic of fire regimes, keeping examples of all vegetation communities in a long unburnt state, especially representatives of the priority fauna habitat vegetation types.

- Where possible, fire management should aim to protect hollow-bearing trees and assist the establishment of new hollows in areas that have previously been cleared or logged. Broad scale wildfire may temporarily disrupt the age structure of previously logged forests, but can also promote hollow formation in standing trees (Lindenmayer *et al.* 1991b in NSW Scientific Committee 2007).

- Wherever possible hollow-bearing dead or living trees should not be felled during mop-up operations or during construction or upgrading of fire breaks and trails.

- During construction and maintenance of firetrails care should be taken to maintain the natural hydrology of ridge tops and upper slopes, and to avoid destruction roadside ditches and pools that provide breeding habitat for Red-crowned Toadlet and Giant Burrowing Frog.

- High intensity wildlife should be excluded from the rocky refugia of known extant Brush-tailed Rock-wallaby colonies.

- During a wildfire it is critical to attempt to ensure that a proportion of Koala habitat is left unburnt. Preferred feed trees, including Red Gums and Grey Gum should not be felled during mop-up operations or construction of fire breaks in areas that are known to be used by Koala. Introduced predator control, especially for Foxes should be undertaken in initial years following wildfire, as Koalas spend more time on the ground travelling between feeding areas.

- High intensity wildfire should be excluded, where possible, from creek lines and gorges that support habitat for the Sooty and Powerful Owls, in particular where territories of these species are currently known to occur.

- High intensity wildfire should be excluded, where possible, from cave roost sites of Eastern Cave Bat, Large-eared Pied Bat or Eastern Bentwing-bat, particularly if any maternity roosts are discovered.

- Fire intensity mapping should be carried out following all major wildfire events.

6.3 HABITAT MANAGEMENT

A number of threats identified in Table 9 warrant active management, as summarised below.

- Bushrock removal and disturbance, and collection of specimens, is an ongoing threat to frogs and reptiles, particularly in accessible and well known areas. DECC Hawkesbury Area should work cooperatively with the Metro Biodiversity Conservation Section to mitigate these threats. Approaches being trialled in other areas include: placement of signage along major highways in the region to notify the public of the illegality and sensitivity of bush rock disturbance and specimen collection; use of artificial rock as alternative shelter sites; and education of the local public regarding the importance of undisturbed bushrock in natural systems.

- Habitat types most affected by historical clearing, grazing and logging activities before the establishment of Wollemi NP include the grassy alluvial forests and woodlands and taller forest on sheltered slopes and gully lines from where hardwoods such as Ironbark species, Sydney Blue Gum, Turpentine and Stringybark species were logged. The most appropriate restoration for the latter logged forests is natural regeneration, as few if any weed species occur and the areas are subject to few, if any, ongoing threatening processes. Grassy alluvial forests and woodlands, however, could best be restored by assisted regeneration, with the main focus being the control of weed species. It is recommended that a survey of weeds be commissioned for the north of the study area around Long Weeney Creek, Wollemi and Putty Creek area, as well as previously logged or cleared areas of the Mellong Plateau. A weed management plan could then be established for these areas, particularly targeting any perennial grass species that are listed under the determination of *invasion of native plant communities by exotic perennial grasses* as a Key Threatening Process, and/or weed species that are most likely to inhibit natural regeneration of the native plant community.

- Management of the open grasslands in the vicinity of Long Weeney Creek should also take into account the habitat usage patterns of high priority threatened species, particularly Grey-crowned Babbler and potentially Speckled Warbler. These species are known to occur on wider creek flats at the interface of cleared and lightly timbered country and it is possible that their occurrence in the study area depends on the maintenance of this grassland/woodland interface. It is therefore recommended that the open grasslands around Long Weeney Creek be retained at their current extent, at least until further research provides alternative recommendations.

- Removal of dead wood and dead hollow-bearing trees is a potential threat to the ecological integrity of vegetation communities near the peripheries of the park, particularly the Mellong Plateau, as it dramatically reduces the value of the habitat to numerous fauna species including several high and moderate priority species. Illegal collection of firewood from the park should be actively discouraged at every opportunity.

6.4 OFF-RESERVE CONSERVATION

6.4.1 Co-operative pest management

Management of pests in the study area will not be successful without the adoption of a cooperative cross-tenure approach. This is particularly pertinent for successful control of Feral Goat, Feral Pig, Feral Deer, Feral Dog and Cattle.

6.4.2 Community awareness and involvement

Private lands adjacent to the park, particularly in the Putty Valley, on the Mellong Plateau, and around the Mount Tootie area, play an important role in the ongoing conservation of fauna in the area. Landholders should therefore be encouraged to participate in conservation programs and/or minimise the undertaking of activities that would decrease the value of habitats to native fauna. The 2007-08 BSP project could be used as a platform to launch a community awareness program for neighbouring landholders. Such a program could include the following:

- Helping the community to become aware of the conservation value of particular habitats within and adjacent to south-eastern Wollemi NP. High conservation value habitats include: Brush-tailed Rock-wallaby colonies; grassy forests and woodlands; Mellong sandmass woodland; rocky ridgelines and upper slopes that support Broad-headed Snake winter habitat; Upland Swamps; gully lines supporting rainforest; Koala habitat on the fringes of Wollemi and Yengo NPs; any creek lines and valley flats adjacent to the park that support River Oak, Red Gums, Swamp Mahogany, Thin-leaved Stringybark or Rough-barked Apple.

- Helping the community become aware of the threat that actions they take can pose to fauna both on and off reserve. Landholders should be encouraged to prevent the progress of relevant threatening processes, which entails: in situ retention of fallen wood, dead trees, live hollow-bearing trees and bush rock; preventing domestic Cattle from grazing in the reserve; avoiding planting of exotic plant species, particularly exotic grasses; avoiding the use of pesticides in lands adjacent to the park boundary wherever possible; and adequately protecting domestic chickens from predators to avoid the killing of Spotted-tailed Quolls.

- Encouraging landholders to accurately report any sightings of the following species in or adjacent to the park to the DECC Hawkesbury Area or the Atlas of NSW Wildlife. Species include Feral Cat, Feral Goat, Feral Deer, Feral Pig, Common Starling, Common Myna, Eurasian Blackbird, wild-roaming Cattle, Brush-tailed Rock-wallaby, Spotted-tailed Quoll and Regent Honeyeater.

- Alerting landholders, particularly those along Bells Line of Road and Mountain Lagoon Road, of the impact that their activities can have on the park, particularly the negative consequences that alteration of local hydrology and extraction of ground water can have on Upland Swamps and rainforests.

- Landholders could also be made aware of the possibilities available to them to develop conservation partnerships, such as through voluntary conservation agreements.

6.5 LAND ACQUISITION PRIORITIES FOR FAUNA

In terms of vertebrate fauna, priorities for land acquisition are areas that contain significant intact amounts of the high priority fauna habitats described in Section 5.3. Grassy forests and woodlands are generally poorly represented in the reserve system and are the highest priority for addition to Wollemi National Park, particularly where remnant vegetation is present and contiguous with larger areas of native vegetation. Previously disturbed lands remain worthy of addition to the reserve system if they hold enough ecological integrity to naturally regenerate in the long term.

Habitats occurring on shale-derived soils are poorly represented in the reserve system. Though such habitats were not highlighted as a priority for threatened fauna in this report, tall forest growing on shale soils would make a worthwhile addition to south-eastern Wollemi National Park by increasing the diversity of fauna habitats reserved therein and enabling the abatement of threatening processes acting on these lands such as loss of hollow-bearing trees and removal of dead wood and dead trees.

6.6 FURTHER SURVEY AND MONITORING

The systematic fauna surveys undertaken over the last decade have resulted in an adequate level of understanding of the occurrence of most fauna species, and there is now comprehensive documentation of the fauna characteristics of south-eastern Wollemi NP, together with north-eastern and north-western Wollemi (DEC 2005a, 2007a). The key priorities for further survey and analysis now lie in gaining a more detailed understanding of particular species not well sampled during the systematic survey process, as well as developing information systems that detail the relative quality of habitats and areas for particular threatened species and hence help guide the assessment of habitats sensitive to threatening processes such as fire and feral pests.

6.6.1 Individual species projects

Brush-tailed Rock-wallaby – High Priority

Despite the extent of suitable habitat, the status of Brush-tailed Rock-wallaby in south-eastern Wollemi NP is currently not well understood. The discovery of Brush-tailed Rock-wallaby scats at three locations during the BSP surveys suggests that extant colonies survive in more remote sections of the park, however the size and health of these colonies is not known. It is highly recommended that further surveys be undertaken for Brush-tailed Rock-wallaby in south-eastern Wollemi NP in order to obtain a better understanding of the current size and condition of the population(s), and the threats acting upon them. This recommendation aligns with that provided in the Fox Threat Abatement Plan, which identified the need for further assessment of the colony at Lower Colo (NPWS 2001d). At a minimum, locations where scats have reliably been recorded since the 1990s (namely Culoul Creek, Colo River, behind Brawdy Farm, and south-west of Bob Turners Track) should be revisited. The easiest technique to employ would be searches for fresh scats. The surveys should be undertaken by personnel experienced in identifying potential Brush-tailed Rock-wallaby habitat on the ground, and identifying scats and individuals. Extant colonies should then be subject to a broad scale assessment of threats, particularly search and collection of predator scats, and search for Feral Goat scats. The surveys should be undertaken in consultation with the species recovery coordinator.

Habitat modelling to be completed by the Information and Assessment Section will aim to identify areas of high quality Brush-tailed Rock-wallaby habitat in the park. Survey in remote areas is labour intensive and expensive, but considered worthwhile particularly if the more accessible colonies are found to be active or subject to threatening processes.

Following the above, colonies and habitats should be prioritised and ranked in terms of their importance to the long-term survival of the species in the region. High priority sites should be the first target for feral animal control and abatement of any other threatening processes that are identified during the study, in consultation with the species recovery team.

Stuttering Frog – High Priority

The Stuttering Frog is known to have disappeared from numerous protected areas, and reservation of habitat alone will not guarantee its survival. Though high quality habitat is present it is not currently known whether the species persists within south-eastern Wollemi NP, and therefore the extent to which the study area contributes to conservation of this Endangered species. The following programs are highly recommended:

- Targeted survey of sheltered creek headwaters and associated rock pools and sheltered slopes within coastal and hinterland warm temperate rainforest. Surveys should be undertaken in spring or summer, particularly after rain, when individuals are most vocal and active and should include visitation to remote sheltered gorges and canyons, where the species is most likely to persist undiscovered. The surveys should include passive listening, call playback and searches for tadpoles, and follow the standard techniques being developed by the species recovery team when they are finalised. Surveys must be undertaken by personnel experienced in the identification of adult frogs (including the call), identification of tadpoles, and assessment of habitat value. Additionally the surveyors must be willing to access remote and difficult terrain, possibly with the assistance of climbing equipment. Suggested locations for survey are Cabbage Tree Creek, tributaries of Wheeny Creek, Gospers Creek and Lagoon Creek.
- Survey for Chytrid fungus in potential habitat areas. This should involve swabbing of adults and tadpoles, of Stuttering Frog or other frog species, by experienced personnel. The swabs are placed in sterilised containers and then sent for testing. If both Chytrid fungus and Stuttering

Frogs are located, an assessment of the level of infection and the impact on the populations should follow. In particular, it would be vital to assess whether Chytrid infection is significantly suppressing recruitment of frogs to the adult stage.

- These surveys must be undertaken with strict adherence to frog hygiene protocols to ensure diseases are not spread between populations or catchments.

Masked Owl and Barking Owl – Moderate Priority

While the Masked Owl has positively been recorded on a single occasion, the two records for Barking Owl have very low spatial reliability, leaving doubt about the ongoing occurrence of both species in the study area. Potential habitat for these owls occurs in the north of the study area, in the vicinity of Wollemi, Long Weeney and Putty Creeks, as well as lower elevations in the south-east, yet only limited nocturnal call playback surveys have been undertaken in these areas. It is recommended that further survey be undertaken for these owls, using the systematic nocturnal call playback technique described in Section 2.3.1. Such surveys should be undertaken by experienced observers familiar with the range of calls of both species and by identifying the owls from sight.

Squirrel Glider – Moderate Priority

Potential habitat for the Squirrel Glider is restricted in extent, occurring on the Mellong Plateau and in the far north of the study area in the open alluvial areas and Ironbark-dominated woodlands along Long Weeney Creek, as well as lower slopes of Putty and Wollemi Creeks. Management of the Squirrel Glider will require further survey to determine the species current extent, and potentially targeted management of introduced predators in areas where the Glider is confirmed to occur. Surveys should involve systematic spotlighting in potential habitat areas, by surveyors highly experienced in differentiating Squirrel and Sugar Gliders in the field.

Regent Honeyeater – Moderate Priority on an opportunistic basis

Targeted survey work is required to determine the relative importance of south-eastern Wollemi NP to conservation of the Regent Honeyeater. The species was once regularly sighted around Colo Heights and Upper Colo, but has not been recorded in either area since 1987. This is of great concern and part of an observed massive decrease in abundance and reduction in range for the entire species. South-eastern Wollemi NP contains only a very small fraction of marginal habitat, primarily along the Colo River, along the northern section of Wollemi Creek and Long Weeney Creek, around Colo Heights, and very small patches along Angorawa Creek. It is recommended that surveys be undertaken in these areas during peak flowering periods over several years, in order to ascertain the extent to which this bird continues to utilise the study area, if at all. Such surveys would need to be undertaken by experienced observers familiar with the species call, and could be coordinated as part of the national Regent Honeyeater and Swift Parrot surveys.

Littlejohn's Tree Frog – Moderate Priority

It is recommended that further surveys for Littlejohn's Tree Frog be undertaken in creek headwaters and Upland Swamps south of the Colo River, to establish the extent of the population(s) in the study area and determine the current contribution Wollemi NP makes to the species regional conservation. Surveys should be undertaken after rain in early spring and late summer by personnel experienced in the identification of adult frogs (including the call), identification of tadpoles, and assessment of habitat value. Such surveys must be undertaken with strict adherence to frog hygiene protocols to ensure diseases are not spread between populations or catchments.

Dingo – Low Priority on an opportunistic basis

Currently there is very limited understanding of the distribution of Dingoes in the study area and their degree of hybridisation with Wild Dogs. Wollemi National Park is listed as a Schedule 2 area for Dingo conservation (NPWS *et al.* 2000). In order to slowly improve the understanding of the relationship between Dingo and Wild Dog in the park it is recommended that a genetic sample be taken from any Dogs or Dingoes killed or found dead in the park and sent for testing of the degree of Dingo heritage. The results should be entered into a centralised database that is built upon over time and made accessible to any government bodies or individuals researching this issue. If funds allow, a programme similar to that undertaken by Yango Area in southern Yengo NP could also be implemented in south-eastern Wollemi NP and other areas managed by Hawkesbury Area.

6.6.2 Other future work

Modelling of habitat for priority fauna species across reserves in the northern half of the Sydney Basin – High Priority

Modelling of habitat for threatened and regionally significant species has recently been completed across the Greater Southern Sydney region (DECC 2007a, b), leading to the setting of fauna species conservation priorities, identification of high priority fauna habitat, mapping of important fauna corridors and linkages and associated management recommendations. DECC Metro Information and Assessment Section is working towards implementing a similar project across the northern half of the Greater Sydney Region, including Yengo, Wollemi and northern Blue Mountains NPs. Systematic fauna data collected in these parks during the last five years, and continuing to be collected in Wollemi NP over the next year, will feed directly into this process, in combination with the detailed vegetation mapping recently completed in Yengo and Parr and currently being undertaken across Wollemi NP and neighbouring lands. Such work will enable more detailed and robust setting of fauna conservation priorities for the reserves in a regional context, as well as identification of high priority and highly sensitive habitats.

Ongoing collection and analysis of predator scats, particularly Fox scats – Moderate Priority

The analysis of predator scats yields important information on the distribution and relative abundance of predator species as well as the composition of predator diets. The development of a database on predator locations and prey species will over time help to quantify and locate the threats posed to native fauna by Wild Dogs and Foxes. It is therefore highly recommended that predator scats, particularly Fox scats, be collected by DECC staff whenever they are encountered, placed in a paper envelope with accurate location information and date, and sent to a recognised expert such as Barbara Triggs for analysis. Results should be entered into the Atlas of NSW Wildlife using the Biodiversity Subsystem so that they are available not only to park managers but a wide range of audiences.

Further feral animal surveys

As outlined above further surveys are required for Feral Goat, Feral Pig and Cattle.

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APPENDIX A – LOCATION OF SURVEY SITES

Tabulated below is the location of systematic fauna survey sites in south-eastern Wollemi National Park and the techniques undertaken at each site. In addition to this nine transect spotlighting censuses were undertaken during the CRA surveys. All sites are located in Zone 56, using Australian Geodatum 66.

Survey program	Site number	Easting	Northing	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Hair tube detection
BSP Fauna Survey	CLH002O	286168	6309396	1	1	1						
BSP Fauna Survey	CLH008W	274189	6313747		1							
BSP Fauna Survey	CLH009W	273202	6312720	1	1	1			1			
BSP Fauna Survey	CLH010W	272018	6311310	1								
BSP Fauna Survey	CLH011R	273749	6310281	1								
BSP Fauna Survey	CLH012H	274364	6310178	1		1			1			
BSP Fauna Survey	CLH013W	275718	6308091		1							
BSP Fauna Survey	CLH014O	278837	6304726	1	1	1			1			
BSP Fauna Survey	CLH015O	273718	6315956	1								
BSP Fauna Survey	CLH016W	275223	6315708	1	1			1				
BSP Fauna Survey	CLH017W	282106	6312339		1							
BSP Fauna Survey	CLH018W	279677	6316926	1		1		1				
BSP Fauna Survey	CLH019O	278047	6316443	1	1	1						
BSP Fauna Survey	CLH020O	284005	6310612	1	1							
BSP Fauna Survey	CLH021W	285649	6312249	1	1	1		1				
BSP Fauna Survey	CLH022O	281873	6313768	1	1	1					1	
BSP Fauna Survey	CLH023O	283654	6311583	1	1	1		1				
BSP Fauna Survey	CLH024O	282754	6315255	1	1	1				1		
BSP Fauna Survey	CLH025O	284304	6313845	1	1	1						
BSP Fauna Survey	CLH026O	282065	6315812	1	1	1		1				
BSP Fauna Survey	CLH027O	274707	6314602	1		2						
BSP Fauna Survey	CLH028O	282432	6314447	1			1					
BSP Fauna Survey	CLH029O	282747	6312602				1			1		
BSP Fauna Survey	CLH030O	284180	6310895			1	1					
BSP Fauna Survey	CLH031O	285161	6310837				1					
BSP Fauna Survey	CLH032O	274284	6314945				1					
BSP Fauna Survey	CLH033O	274206	6314456				1					
BSP Fauna Survey	CLH034O	274626	6314939				1					
BSP Fauna Survey	CLH035W	275485	6315837				1					

Survey program	Site number	Easting	Northing	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Hair tube detection
BSP Fauna Survey	CLH036O	278969	6316713				1					
BSP Fauna Survey	CLH0370	274454	6314466								1	
BSP Fauna Survey	CLH038W	280712	6308928	1	1							
BSP Fauna Survey	CLH039O	285448	6310211	1	1	1		1				
BSP Fauna Survey	CLH040O	281102	6309850	1	1	1		1				
BSP Fauna Survey	CLH041W	280455	6307648		1							
BSP Fauna Survey	CLH042O	284274	6309620	1								
BSP Fauna Survey	CLH043W	283191	6309649				1			1		
BSP Fauna Survey	CLH044O	281194	6309711				1					
BSP Fauna Survey	CLH045W	284907	6310119				1					
BSP Fauna Survey	CLH046M	278999	6306890	1	1	1		1				
BSP Fauna Survey	CLH047R	274910	6314252							1		
BSP Fauna Survey	CLH048O	274251	6314365			1		1		1		
BSP Fauna Survey	CLH049O	277059	6315824							1		
BSP Fauna Survey	CLH050W	284631	6305433							1		
BSP Fauna Survey	CLH051W	285669	6310718							1		
BSP Fauna Survey	CLH052W	278291	6307535							1		
BSP Fauna Survey	CLH053O	281610	6313132							1		
BSP Fauna Survey	CLH054W	280387	6309851							1		
BSP Fauna Survey	KRR013S	278141	6289295	1	1							
BSP Fauna Survey	LPR009W	292253	6299135		1							
BSP Fauna Survey	LPR010O	293588	6298517	1	1							
BSP Fauna Survey	LPR011O	291150	6297671	1	1							
BSP Fauna Survey	LPR012W	293279	6299654	1	1	1	1			1		
BSP Fauna Survey	LPR013W	290907	6297763				1					
BSP Fauna Survey	LPR014W	291547	6296055							1		
BSP Fauna Survey	LPR015W	293051	6294627							1		
BSP Fauna Survey	MLG002W	278330	6304471	1								
BSP Fauna Survey	MLG003W	282358	6302981		1							
BSP Fauna Survey	MLG004O	284203	6299974	1								
BSP Fauna Survey	MLG005W	286370	6297330	1	1	1						
BSP Fauna Survey	MLG006W	288034	6297104	1	1	1						
BSP Fauna Survey	MLG007O	289495	6295926	1	1	1						
BSP Fauna Survey	MLG008W	290226	6294718	1	1							
BSP Fauna Survey	MLG009C	282986	6293276	1	1	1						
BSP Fauna Survey	MLG010W	288918	6298092	1	1	1		1				

Survey program	Site number	Easting	Northing	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Hair tube detection
BSP Fauna Survey	MLG011W	290470	6298198	1	1	1				1		
BSP Fauna Survey	MLG012H	290671	6296364			1		1				
BSP Fauna Survey	MLG013W	283497	6293221							1		
BSP Fauna Survey	MLG014W	288488	6298304				1					
BSP Fauna Survey	MLG015O	285674	6297099				1					
BSP Fauna Survey	MLG016O	289544	6295918					1				
BSP Fauna Survey	MLG017O	286886	6297305					1				
BSP Fauna Survey	MLG018O	284653	6291211					1				
BSP Fauna Survey	MLG019W	283474	6293557		1			1				
BSP Fauna Survey	MLG020O	276549	6298699	1	1							
BSP Fauna Survey	MLG021O	268575	6294500	1		1						
BSP Fauna Survey	MLG022O	270976	6298791	1		1						
BSP Fauna Survey	MLG023O	268473	6293940	1		1						
BSP Fauna Survey	MLG024W	269212	6290741	1				1				
BSP Fauna Survey	MLG025O	270268	6298260	1	1	1	1	1		1		
BSP Fauna Survey	MLG026O	269331	6297066	1	1			1			1	
BSP Fauna Survey	MLG027M	272440	6303207		1							
BSP Fauna Survey	MLG029O	276901	6297728	1								
BSP Fauna Survey	MLG030O	275874	6297705	1								
BSP Fauna Survey	MLG031R	280044	6298755	1		1	1	1	1			
BSP Fauna Survey	MLG032W	269923	6297458	1								
BSP Fauna Survey	MLG033O	272835	6296961			1						
BSP Fauna Survey	MLG034O	268531	6294293					1				
BSP Fauna Survey	MLG035W	269237	6296636	1							1	
BSP Fauna Survey	MLG036W	272654	6293091		1		1					
BSP Fauna Survey	MLG037W	269310	6296832				1					
BSP Fauna Survey	MLG038O	273395	6297606			1	1			1		
BSP Fauna Survey	MLG039W	269365	6294915				1					
BSP Fauna Survey	MLG040W	270694	6298926					1				
BSP Fauna Survey	MLG041W	272121	6296360					1				
BSP Fauna Survey	MLG042W	276138	6298417				1		1			
BSP Fauna Survey	MLG043O	276866	6297554				1					
BSP Fauna Survey	MLG044O	284043	6295655							1		
BSP Fauna Survey	MLG045O	279760	6294577							1		
BSP Fauna Survey	MLG046O	280849	6295196							1		
BSP Fauna Survey	MLG047O	276701	6297555							1		

Survey program	Site number	Easting	Northing	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Hair tube detection
BSP Fauna Survey	MLG048O	271617	6295913							1		
BSP Fauna Survey	MLG049O	273466	6300007							1		
BSP Fauna Survey	MLG050O	287866	6295663					1				
BSP Fauna Survey	MLG052W	287753	6295602							1		
BSP Fauna Survey	SXB013S	284708	6331790								1	
BSP Fauna Survey	SXB015W	281604	6325715	1								
BSP Fauna Survey	SXB016O	276918	6325480	1	1							
BSP Fauna Survey	SXB017W	278206	6325244			1						
BSP Fauna Survey	SXB018O	279006	6325767	1	1	1						
BSP Fauna Survey	SXB019O	280046	6326020	1	1							
BSP Fauna Survey	SXB020W	276368	6325958	1	1							
BSP Fauna Survey	SXB021W	283978	6325632	1	1	1		1				
BSP Fauna Survey	SXB022W	282779	6325923	1		1						
BSP Fauna Survey	SXB023O	278493	6325395					1				
BSP Fauna Survey	SXB024W	284427	6326050					1				
BSP Fauna Survey	SXB025W	282430	6328715							1		
BSP Fauna Survey	WLN001M	267530	6291566	1	1							
BSP Fauna Survey	WLN002O	267723	6291723							1		
BSP Fauna Survey	WRB001W	285925	6337875	1	1	1		1				
BSP Fauna Survey	WRB011W	276541	6337858	1		1		1		1		
BSP Fauna Survey	WRB012W	276736	6337182	1	1							
BSP Fauna Survey	WRB013W	276593	6336183	1	1							
BSP Fauna Survey	WRB014W	275726	6335053	1	1							
BSP Fauna Survey	WRB015W	276682	6334776	1	1	1		1		1		
BSP Fauna Survey	WRB016O	277681	6335372	1	1							
BSP Fauna Survey	WRB017W	278648	6335201	1	1							
BSP Fauna Survey	WRB018O	279349	6336186		1							
BSP Fauna Survey	WRB019W	278593	6337291		1							
BSP Fauna Survey	WRB020O	279565	6339321	1	1					1		
BSP Fauna Survey	WRB021W	280494	6332948							1		
BSP Fauna Survey	WRB022W	281369	6335114							1		
CRA Fauna Survey	S-F-LNE-41-050-R	276100	6321850	1	1			1		1		1
CRA Fauna Survey	S-F-LNE-41-051-M	277300	6321100	1	1			1		1		1
CRA Fauna Survey	S-F-LNE-41-052-G	274200	6323200	1	1	1	1	1	1	1		1
CRA Fauna Survey	S-F-LNE-41-054-R	272775	6322750	1	1			1		1		1
CRA Fauna Survey	S-F-LNE-41-055-M	274344	6323500	1	1			1		1		

Survey program	Site number	Easting	Northing	Diurnal bird census	Diurnal reptile census	Site spotlight census	Harp trap	Bat ultrasound detection	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Hair tube detection
CRA Fauna Survey	S-F-LNE-41-056-G	273025	6322275	1	1		1	1	1	1		1
CRA Fauna Survey	S-F-LNE-41-058-R	277800	6318150	1	1			1		1		1
CRA Fauna Survey	S-F-LNE-41-059-M	278650	6318375	1	1			1		1		1
CRA Fauna Survey	S-F-LNE-41-060-G	277150	6317825	1	1		1	1	1	1		1
CRA Fauna Survey	S-F-LNE-41-105-G	284250	6332150	1	1		1	1	2	1		
CRA Fauna Survey	S-F-LNE-41-109-G	282650	6333950	1	1			1	1	1		
CRA Fauna Survey	S-F-LNE-41-110-G	284150	6334500	1	1		1	1	1	1	1	1
CRA Fauna Survey	S-F-LNE-42-172-G	276860	6338560	1	1		1	1	1	1		
CRA Fauna Survey	S-F-SYD-42-050-R	275689	6292629	1	1		1	1		1		
CRA Fauna Survey	S-F-SYD-42-051-M	277900	6292200	1	1	1		1		1		1
CRA Fauna Survey	S-F-SYD-42-052-G	276460	6292864	1	1	1		1	1	1	1	1
CRA Fauna Survey	S-F-SYD-42-054-R	280550	6297825	1	1		1	2		1		1
CRA Fauna Survey	S-F-SYD-42-055-M	282956	6297205	1	1	1		1		1		1
CRA Fauna Survey	S-F-SYD-42-056-G	281320	6297330	1	1		1	1	1	1	1	1
CRA Fauna Survey	S-F-SYD-42-058-R	281345	6300364	1	1			1		1		
CRA Fauna Survey	S-F-SYD-42-059-M	281987	6297529	1	1	1		1		1		1
CRA Fauna Survey	S-F-SYD-42-060-G	281105	6299400	1	1		1	1	1	1		
CRA Fauna Survey	T-F-SYD-41-001	280200	6319700							1		
CRA Fauna Survey	T-F-SYD-41-002	276650	6321450							1		
CRA Fauna Survey	T-F-SYD-41-003	272500	6323100							1		
CRA Fauna Survey	T-F-SYD-41-025	273100	6323200				1					
CRA Fauna Survey	T-F-SYD-42-136	276600	6297500				1					
CRA Fauna Survey	T-F-SYD-42-137	282592	6297368				1					
CRA Fauna Survey	T-F-SYD-50-013	284150	6334400							1		
CRA Fauna Survey	T-F-SYD-50-025	284500	6325100							1		
CRA Fauna Survey	T-F-SYD-50-026	284800	6328450							1		
CRA Fauna Survey	T-F-SYD-50-027	284050	6330520							1		
Total				**88**	**77**	**46**	**37**	**52**	**16**	**61**	**8**	**15**

APPENDIX B – FAUNA SPECIES RECORDED IN SOUTH-EASTERN WOLLEMI NP

Below is a list of the fauna species recorded within south-eastern Wollemi NP on the Atlas of NSW Wildlife (as at 17th June 2008). Taxonomical nomenclature follows that used on the Atlas of NSW Wildlife, with more updated scientific names noted where relevant. Records are derived from DECC systematic surveys (Biodiversity Survey Priorities and Comprehensive Regional Assessment), 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.

Introduced species are indicated with the addition of an I.

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA	Birds Australia	Australian Museum	Other Sources
Frogs									
Myobatrachidae	*Adelotus brevis*	Tusked Frog	P		x			x	x
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P		x	x		x	xx
Myobatrachidae	*Heleioporus australiacus*	Giant Burrowing Frog	V	V	x	x		x	x
Myobatrachidae	*Limnodynastes dumerilii*	Eastern Banjo Frog	P		x	x		x	x
Myobatrachidae	*Limnodynastes ornatus*	Ornate Burrowing Frog	P		x	x			
Myobatrachidae	*Limnodynastes peronii*	Brown-striped Frog	P		x	x		x	x
Myobatrachidae	*Limnodynastes tasmaniensis*	Spotted Grass Frog	P		x	x		x	x
Myobatrachidae	*Mixophyes balbus*	Stuttering Frog	E	V				x	
Myobatrachidae	*Pseudophryne australis*	Red-crowned Toadlet	V		x			x	x
Myobatrachidae	*Pseudophryne bibronii*	Bibron's Toadlet	P			x		x	x
Myobatrachidae	*Uperoleia fusca*	Dusky Toadlet	P		x	x		x	
Myobatrachidae	*Uperoleia laevigata*	Smooth Toadlet	P		x	x		x	
Hylidae	*Litoria booroolongensis*	Booroolong Frog	E	E				x	
Hylidae	*Litoria caerulea*	Green Tree Frog	P		x			x	
Hylidae	*Litoria citropa*	Blue Mountains Tree Frog	P		x			x	x
Hylidae	*Litoria dentata*	Bleating Tree Frog	P		x	x			x
Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog	P		x	x		x	x
Hylidae	*Litoria latopalmata*	Broad-palmed Frog	P		x	x		x	x
Hylidae	*Litoria lesueuri*	Lesueur's Frog	P		x	x		x	x
Hylidae	*Litoria littlejohni*	Littlejohn's Tree Frog	V		x				
Hylidae	*Litoria peronii*	Peron's Tree Frog	P		x	x		x	x
Hylidae	*Litoria phyllochroa*	Leaf-green Tree Frog	P		x	x		x	x
Hylidae	*Litoria tyleri*	Tyler's Tree Frog	P		x	x			x
Hylidae	*Litoria verreauxii*	Verreaux's Frog	P		x	x			x
Hylidae	*Litoria wilcoxii*	Stoney Creek Frog	P		x				
Reptiles									
Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle	P		x	x		x	x
Gekkonidae	*Diplodactylus vittatus*	Wood Gecko	P		x			x	x
Gekkonidae	*Oedura lesueurii*	Lesueur's Velvet Gecko	P		x	x		x	x
Gekkonidae	*Phyllurus platurus*	Broad-tailed Gecko	P		x	x			x
Gekkonidae	*Underwoodisaurus milii*	Thick-tailed Gecko	P		x			x	x
Pygopodidae	*Lialis burtonis*	Burton's Snake-lizard	P		x			x	x
Pygopodidae	*Pygopus lepidopodus*	Common Scaly-foot	P		x	x		x	x

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA	Birds Australia	Australian Museum	Other Sources
Agamidae	*Amphibolurus muricatus*	Jacky Lizard	P		x	x		x	x
Agamidae	*Physignathus lesueurii lesueurii*	Eastern Water Dragon	P		x	x			x
Agamidae	*Pogona barbata*	Bearded Dragon	P		x	x		x	x
Agamidae	*Rankinia diemensis*	Mountain Dragon	P		x	x		x	x
Varanidae	*Varanus rosenbergi*	Rosenberg's Goanna	V		x	x			
Varanidae	*Varanus varius*	Lace Monitor	P		x	x		x	x
Scincidae	*Acritoscincus platynota*	Red-throated Skink	P		x	x			x
Scincidae	*Carlia tetradactyla*	Southern Rainbow-skink	P		x	x			x
Scincidae	*Carlia foliorum* (taxonomy revised from *Lygisaurus foliorum*)	Tree-base Litter-skink	P		x			x	
Scincidae	*Cryptoblepharus virgatus*	Cream-striped Shinning-skink	P		x				x
Scincidae	*Ctenotus robustus*	Robust Ctenotus	P			x		x	x
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Skink	P		x	x		x	x
Scincidae	*Cyclodomorphus gerrardii*	Pink-tongued Lizard	P					x	
Scincidae	*Egernia cunninghami*	Cunningham's Skink	P		x	x			
Scincidae	*Egernia whitii*	White's Skink	P		x	x		x	x
Scincidae	*Eulamprus quoyii*	Eastern Water-skink	P		x	x		x	x
Scincidae	*Eulamprus tenuis*	Barred-sided Skink	P		x	x		x	
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P		x	x		x	x
Scincidae	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink	P		x	x		x	x
Scincidae	*Lerista bougainvillii*	South-eastern Slider	P		x	x		x	x
Scincidae	*Saiphos equalis*	Three-toed Skink	P		x			x	
Scincidae	*Saproscincus mustelinus*	Weasel Skink	P		x	x			
Scincidae	*Tiliqua scincoides*	Eastern Blue-tongue	P		x				x
Typhlopidae	*Ramphotyphlops nigrescens*	Blackish Blind Snake	P		x	x		x	x
Boidae	*Morelia spilota spilota*	Diamond Python	P			x		x	x
Colubridae	*Dendrelaphis punctulata*	Green Tree Snake	P		x				x
Elapidae	*Acanthophis antarcticus*	Common Death Adder	P		x			x	
Elapidae	*Cacophis squamulosus*	Golden-crowned Snake	P			x			x
Elapidae	*Cryptophis nigrescens*	Eastern Small-eyed Snake	P		x	x			
Elapidae	*Demansia psammophis*	Yellow-faced Whip Snake	P		x			x	x
Elapidae	*Drysdalia rhodogaster*	Mustard-bellied Snake	P					x	x
Elapidae	*Furina diadema*	Red-naped Snake	P		x				
Elapidae	*Hoplocephalus bungaroides*	Broad-headed Snake	E	V	x			x	x
Elapidae	*Notechis scutatus*	Tiger Snake	P		x				
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	P		x	x		x	x
Elapidae	*Pseudonaja textilis*	Eastern Brown Snake	P		x			x	x
Elapidae	*Vermicella annulata*	Bandy-bandy	P		x	x			
Birds									
Megapodiidae	*Alectura lathami*	Australian Brush-turkey	P		x		x		
Phasianidae	*Coturnix pectoralis*	Stubble Quail	P				x		x
Phasianidae	*Coturnix ypsilophora*	Brown Quail	P			x			x
Anatidae	*Anas superciliosa*	Pacific Black Duck	P		x	x	x		x
Anatidae	*Chenonetta jubata*	Australian Wood Duck	P		x	x	x		x
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	P		x		x	x	x
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	P		x		x	x	

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA	Birds Australia	Australian Museum	Other Sources
Ardeidae	*Ardea pacifica*	White-necked Heron	P		x		x		x
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P				x	x	x
Ardeidae	*Nycticorax caledonicus*	Nankeen Night Heron	P						x
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	P		x	x	x		x
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	P		x		x		
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	P		x		x		x
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	P				x	x	x
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	P				x		x
Accipitridae	*Haliastur sphenurus*	Whistling Kite	P				x		x
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	P				x		
Falconidae	*Falco cenchroides*	Nankeen Kestrel	P				x		x
Falconidae	*Falco peregrinus*	Peregrine Falcon	P		x	x	x		
Rallidae	*Gallinula tenebrosa*	Dusky Moorhen	P			x	x	x	x
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	P		x	x	x		x
Turnicidae	*Turnix varia*	Painted Button-quail	P		x		x	x	x
Turnicidae	*Turnix velox*	Little Button-quail	P		x				
Charadriidae	*Vanellus miles*	Masked Lapwing	P			x	x		x
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	P		x				x
Columbidae	*Geopelia placida*	Peaceful Dove	P		x	x	x	x	
Columbidae	*Leucosarcia melanoleuca*	Wonga Pigeon	P		x	x	x		x
Columbidae	*Macropygia amboinensis*	Brown Cuckoo-Dove	P		x	x	x		x
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	P		x		x		x
Columbidae	*Phaps chalcoptera*	Common Bronzewing	P		x	x	x		x
Columbidae	*Phaps elegans*	Brush Bronzewing	P		x		x		
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	P		x	x	x		x
Cacatuidae	*Callocephalon fimbriatum*	Gang-gang Cockatoo	V		x	x	x	x	x
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	P		x	x	x		x
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V		x	x	x		x
Psittacidae	*Alisterus scapularis*	Australian King-Parrot	P		x	x	x		x
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	P		x	x	x		x
Psittacidae	*Neophema pulchella*	Turquoise Parrot	V		x	x	x		x
Psittacidae	*Platycercus adscitus eximius*	Eastern Rosella	P		x	x	x	x	x
Psittacidae	*Platycercus elegans*	Crimson Rosella	P		x	x	x		x
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P		x	x	x		x
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	P		x	x	x		
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo	P			x	x	x	
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo	P		x	x	x		x
Cuculidae	*Cuculus pallidus*	Pallid Cuckoo	P		x	x	x	x	x
Cuculidae	*Eudynamys orientalis*	Pacific Koel	P		x		x		
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo	P		x	x	x		x
Strigidae	*Ninox boobook*	Southern Boobook	P		x	x	x		x
Strigidae	*Ninox connivens*	Barking Owl	V				x		x
Strigidae	*Ninox strenua*	Powerful Owl	V		x	x			
Tytonidae	*Tyto novaehollandiae*	Masked Owl	V			x			
Tytonidae	*Tyto tenebricosa*	Sooty Owl	V		x				
Podargidae	*Podargus strigoides*	Tawny Frogmouth	P		x	x	x	x	x
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	P		x	x	x		x
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	P		x	x			x

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA	Birds Australia	Australian Museum	Other Sources
Apodidae	*Apus pacificus*	Fork-tailed Swift	P				x		
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	P		x	x	x		x
Alcedinidae	*Alcedo azurea*	Azure Kingfisher	P		x	x	x		x
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	P		x	x	x		x
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	P		x	x	x	x	x
Meropidae	*Merops ornatus*	Rainbow Bee-eater	P		x		x	x	x
Coraciidae	*Eurystomus orientalis*	Dollarbird	P		x	x	x	x	x
Menuridae	*Menura novaehollandiae*	Superb Lyrebird	P		x	x	x		x
Climacteridae	*Climacteris erythrops*	Red-browed Treecreeper	P		x	x	x		x
Climacteridae	*Climacteris picumnus*	Brown Treecreeper	V		x		x		x
Climacteridae	*Cormobates leucophaea*	White-throated Treecreeper	P		x	x	x	x	x
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P		x	x	x		x
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P		x	x	x		x
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P		x	x	x		x
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	P		x	x	x		x
Acanthizidae	*Acanthiza lineata*	Striated Thornbill	P		x	x	x		x
Acanthizidae	*Acanthiza nana*	Yellow Thornbill	P			x	x		x
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P		x	x	x		x
Acanthizidae	*Acanthiza reguloides*	Buff-rumped Thornbill	P		x	x	x		x
Acanthizidae	*Calamanthus pyrrhopygius*	Chestnut-rumped Heathwren	P		x	x	x		
Acanthizidae	*Gerygone mouki*	Brown Gerygone	P		x	x	x		x
Acanthizidae	*Gerygone olivacea*	White-throated Gerygone	P		x	x	x	x	x
Acanthizidae	*Origma solitaria*	Rockwarbler	P		x		x	x	x
Acanthizidae	*Pycnoptilus floccosus*	Pilotbird	P		x	x	x		
Acanthizidae	*Sericornis citreogularis*	Yellow-throated Scrubwren	P		x	x	x		x
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P		x	x	x		x
Acanthizidae	*Sericornis magnirostris*	Large-billed Scrubwren	P		x	x	x		
Acanthizidae	*Smicrornis brevirostris*	Weebill	P		x	x	x		x
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P		x	x	x		x
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P		x	x	x		x
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	P		x	x	x		x
Meliphagidae	*Entomyzon cyanotis*	Blue-faced Honeyeater	P		x		x		x
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P		x	x	xx	x	x
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater	P		x	x	x		x
Meliphagidae	*Lichenostomus melanops*	Yellow-tufted Honeyeater	P		x	x	x		x
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P		x	x	x		x
Meliphagidae	*Manorina melanophrys*	Bell Miner	P		x	x	x		x
Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater	P		x	x	x	x	x
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	P		x	x	x		x
Meliphagidae	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subspecies)	V		x	x	x		
Meliphagidae	*Melithreptus lunatus*	White-naped Honeyeater	P		x	x	x		x
Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater	P		x		x	x	
Meliphagidae	*Philemon citreogularis*	Little Friarbird	P			x			x
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	P		x	x	x	x	x
Meliphagidae	*Phylidonyris niger*	White-cheeked Honeyeater	P		x	x	x		x
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P		x	x	x		x
Meliphagidae	*Phylidonyris pyrrhoptera*	Crescent Honeyeater	P		x		x		

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA	Birds Australia	Australian Museum	Other Sources
Meliphagidae	*Xanthomyza phrygia*	Regent Honeyeater	E	E					x
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P		x	x	x	x	x
Petroicidae	*Microeca fascinans*	Jacky Winter	P		x	x	x		x
Petroicidae	*Petroica boodang*	Scarlet Robin	P		x		x		x
Petroicidae	*Petroica goodenovii*	Red-capped Robin	P		x	x	x		
Petroicidae	*Petroica phoenicea*	Flame Robin	P			x	x		
Petroicidae	*Petroica rosea*	Rose Robin	P		x	x	x		x
Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V						x
Eupetidae	*Cinclosoma punctatum*	Spotted Quail-thrush	P		x	x	x		x
Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	P		x	x	x	x	x
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	P		x	x	x	x	x
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P		x	x	x	x	x
Pachycephalidae	*Falcunculus frontatus*	Eastern Shrike-tit	P		x	x	x		x
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P		x	x	x		x
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P		x	x	x	x	x
Dicruridae	*Grallina cyanoleuca*	Magpie-lark	P			x	x		x
Dicruridae	*Monarcha melanopsis*	Black-faced Monarch	P		x		x		x
Dicruridae	*Myiagra cyanoleuca*	Satin Flycatcher	P		x	x	x		
Dicruridae	*Myiagra inquieta*	Restless Flycatcher	P		x	x	x		x
Dicruridae	*Myiagra rubecula*	Leaden Flycatcher	P		x	x	x		x
Dicruridae	*Rhipidura albiscapa*	Grey Fantail	P		x	x	x	x	x
Dicruridae	*Rhipidura leucophrys*	Willie Wagtail	P		x	x	x	x	x
Dicruridae	*Rhipidura rufifrons*	Rufous Fantail	P		x	x	x		x
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P		x	x	x	x	x
Campephagidae	*Coracina papuensis*	White-bellied Cuckoo-shrike	P		x	x	x		x
Campephagidae	*Coracina tenuirostris*	Cicadabird	P		x	x	x		
Campephagidae	*Lalage tricolor*	White-winged Triller	P		x		x		
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	P		x	x	x		x
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	P		x	x	x		x
Artamidae	*Artamus personatus*	Masked Woodswallow	P		x				
Artamidae	*Artamus superciliosus*	White-browed Woodswallow	P		x		x		
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P		x	x	x		x
Artamidae	*Gymnorhina tibicen*	Australian Magpie	P		x	x	x	x	x
Artamidae	*Strepera graculina*	Pied Currawong	P		x	x	x		x
Artamidae	*Strepera versicolor*	Grey Currawong	P		x		x		
Corvidae	*Corvus coronoides*	Australian Raven	P		x	x	x		x
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough	P		x	x	x		x
Ptilonorhynchidae	*Ptilonorhynchus violaceus*	Satin Bowerbird	P		x	x	x		x
Motacillidae	*Anthus australis*	Australian Pipit	P				x		x
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P		x	x	x	x	x
Estrildidae	*Stagonopleura bella*	Beautiful Firetail	P			x	x		x
Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch	P				x		x
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	P		x	x	x		x
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P		x	x	x		x
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	P		x	x	x		x
Sylviidae	*Cincloramphus mathewsi*	Rufous Songlark	P			x	x		
Zosteropidae	*Zosterops lateralis*	Silvereye	P		x	x	x		x
Muscicapidae	*Turdus merula*	Eurasian Blackbird [I]	U	U	x		x		

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA	Birds Australia	Australian Museum	Other Sources
Muscicapidae	*Zoothera lunulata*	Bassian Thrush	P		x	x	x	x	
Mammals									
Ornithorhynchidae	*Ornithorhynchus anatinus*	Platypus	P		x				x
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P		x	x			
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus	P		x	x		x	
Dasyuridae	*Antechinus stuartii*	Brown Antechinus	P		x	x		x	x
Dasyuridae	*Antechinus swainsonii*	Dusky Antechinus	P					x	x
Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	V	E	x	x			x
Dasyuridae	*Sminthopsis murina*	Common Dunnart	P		x	x		x	
Peramelidae	*Perameles nasuta*	Long-nosed Bandicoot	P		x				
Phascolarctidae	*Phascolarctos cinereus*	Koala	V		x	x			x
Vombatidae	*Vombatus ursinus*	Common Wombat	P		x	x			x
Petauridae	*Petaurus australis*	Yellow-bellied Glider	V		x	x			x
Petauridae	*Petaurus breviceps*	Sugar Glider	P		x	x		x	x
Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V			x		x	
Pseudocheiridae	*Petauroides volans*	Greater Glider	P		x	x		x	x
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P		x	x			x
Acrobatidae	*Acrobates pygmaeus*	Feathertail Glider	P		x	x			
Phalangeridae	*Trichosurus caninus*	Short-eared Possum	P		x	x			
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	P		x	x			x
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	P		x	x			x
Macropodidae	*Macropus robustus*	Common Wallaroo	P		x				x
Macropodidae	*Macropus rufogriseus*	Red-necked Wallaby	P		x	x			x
Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E	V	x			x	x
Macropodidae	*Wallabia bicolor*	Swamp Wallaby	P		x	x		x	x
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V					x
Rhinolophidae	*Rhinolophus megaphyllus*	Eastern Horseshoe-bat	P		x	x			
Molossidae	*Mormopterus norfolkensis*	East-coast Freetail-bat	V		x	x			
Molossidae	*Mormopterus* Species 2 (Adams *et al.* 1988)	Eastern Freetail-bat	P		x	x			x
Molossidae	*Mormopterus* Species 4 (Adams *et al.* 1988)	Southern Freetail-bat (long penis form)	P		x				
Molossidae	*Tadarida australis*	White-striped Freetail-bat	P		x	x			
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	x	x			
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	P		x	x		x	x
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	P		x	x			x
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V		x	x			
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V		x	x			x
Vespertilionidae	*Myotis adversus*	Large-footed Myotis	V		x	x			
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	P		x				
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat	P		x	x		x	
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V	V	x	x			
Vespertilionidae	*Scotorepens orion*	Eastern Broad-nosed Bat	P		x	x			x
Vespertilionidae	*Vespadelus darlingtoni*	Large Forest Bat	P		x	x			
Vespertilionidae	*Vespadelus pumilus*	Eastern Forest Bat	P		x				x
Vespertilionidae	*Vespadelus troughtoni*	Eastern Cave Bat	V		x				
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	P		x	x			
Muridae	*Hydromys chrysogaster*	Water-rat	P		x				
Muridae	*Mus musculus*	House Mouse [I]	U	U					x

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA	Birds Australia	Australian Museum	Other Sources
Muridae	*Pseudomys novaehollandiae*	New Holland Mouse	P					x	
Muridae	*Rattus fuscipes*	Bush Rat	P		x	x		x	x
Muridae	*Rattus lutreolus*	Swamp Rat	P		x	x			
Muridae	*Rattus rattus*	Black Rat [I]	U	U	x				x
Leporidae	*Oryctolagus cuniculus*	Rabbit [I]	U	U	x	x			x
Canidae	*Canis lupus*	Dingo or Wild Dog	U	U	x	x			x
Canidae	*Vulpes vulpes*	Fox [I]	U	U	x	x			x
Felidae	*Felis catus*	Cat [I]	U	U	x	x			x
Suidae	*Sus scrofa*	Pig [I]	U	U	x	x			x
Bovidae	*Bos taurus*	European Cattle [I]	U	U	x	x			x
Bovidae	*Capra hircus*	Goat [I]	U	U	x				x
Cervidae	*Dama dama*	Fallow Deer [I]	U	U	x				

APPENDIX C – FAUNA SPECIES RECORDED AROUND (BUT NOT WITHIN) SOUTH-EASTERN WOLLEMI NP

Below is a list of fauna species recorded on the Atlas of NSW Wildlife within a five kilometre radius of the study area boundary, but not recorded from within the study area (as at 17th June 2008).

Family	Scientific name	Common name	NSW Legal Status	National Legal Status
Reptiles				
Pygopodidae	*Delma plebeia*	Leaden Delma	P	
Agamidae	*Pogona vitticeps*	Central Bearded Dragon	P	
Varanidae	*Varanus gouldii*	Gould's Goanna	P	
Scincidae	*Cyclodomorphus michaeli*	Mainland She-oak Skink	P	
Scincidae	*Egernia saxatilis*	Black Rock Skink	P	
Scincidae	*Tiliqua rugosa*	Shingle-back	P	
Colubridae	*Dendrelaphis punctulatus*	Common Tree Snake	P	
Elapidae	*Parasuta dwyeri*	Dwyer's Snake	P	
Birds				
Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant	P	
Accipitridae	*Accipiter novaehollandiae*	Grey Goshawk	P	
Accipitridae	*Aviceda subcristata*	Pacific Baza	P	
Rallidae	*Gallirallus philippensis*	Buff-banded Rail	P	
Rallidae	*Lewinia pectoralis*	Lewin's Rail	P	
Rallidae	*Porzana tabuensis*	Spotless Crake	P	
Cacatuidae	*Cacatua tenuirostris*	Long-billed Corella	P	
Cacatuidae	*Eolophus roseicapillus*	Galah	P	
Psittacidae	*Glossopsitta concinna*	Musk Lorikeet	P	
Maluridae	*Stipiturus malachurus*	Southern Emu-wren	P	
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater	P	
Mammals				
Molossidae	*Mormopterus species 3*	Inland Freetail-bat (short penis form)	P	
Vespertilionidae	*Miniopterus australis*	Little Bentwing-bat	V	
Bovidae	*Ovis aries*	Sheep (feral) [I]	U	U




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