3 RESULTS AND DISCUSSION

3.1 OVERVIEW

DEC has established and surveyed a total of 394 systematic fauna survey sites within north-western Wollemi National Park, of which 326 were surveyed in 2005-06 and four in 2004-05 as part of the Biodiversity Survey Priorities fauna survey program. These sites cover the dominant habitats and landscapes present within the study area, and were surveyed during spring, summer and autumn. In addition to these surveys, members of Birds Australia have contributed significantly to the number of fauna records for the study area, as have numerous DEC staff, scientific researchers, and members of the public.

A total of 315 species of native vertebrate fauna are now known to occur in north-western Wollemi National Park, of which 279 (90 %) were recorded during the 2005-06 surveys. This total includes 36 species listed as threatened under the NSW Threatened Species Conservation Act (TSC Act) (1995), of which nine are also listed under the Commonwealth Environmental Protection and Biodiversity Conservation Act (EPBC Act) (1999). Sixteen introduced fauna species have been recorded within the study area to date, including thirteen ground mammals and three birds. An additional twelve native species (including three threatened species) have been recorded on the Atlas of NSW Wildlife for which there is some doubt regarding their occurrence in the park proper, as will be discussed below. A complete species list for all terrestrial vertebrate fauna groups is provided in Appendix C.

In addition to the above fauna, a further 51 species have been recorded within a five kilometre radius of the study area boundary (see Appendix D). This includes seven additional threatened species, of which two, the Swift Parrot (*Lathamus discolor*) and Large-footed Myotis (*Myotis adversus*), are considered highly likely to also occur within the study area.

The value of systematic fauna survey is apparent in the contribution it has made to the knowledge of fauna within the study area and the building of a species inventory. The CRA surveys, undertaken in 1997-98, added 71 species to the list of known fauna within north-western Wollemi National Park, and the BSP program, undertaken between 2004-06, added a further 45 species to the study area database. Figure 1 indicates the increase in the known number of fauna species within the study area over time, primarily as a result of dedicated systematic fauna survey. Furthermore, the BSP surveys increased the number of fauna records within the park more than three-fold, from 4667 to over 16 000. The locations of survey sites are shown in Map 5.

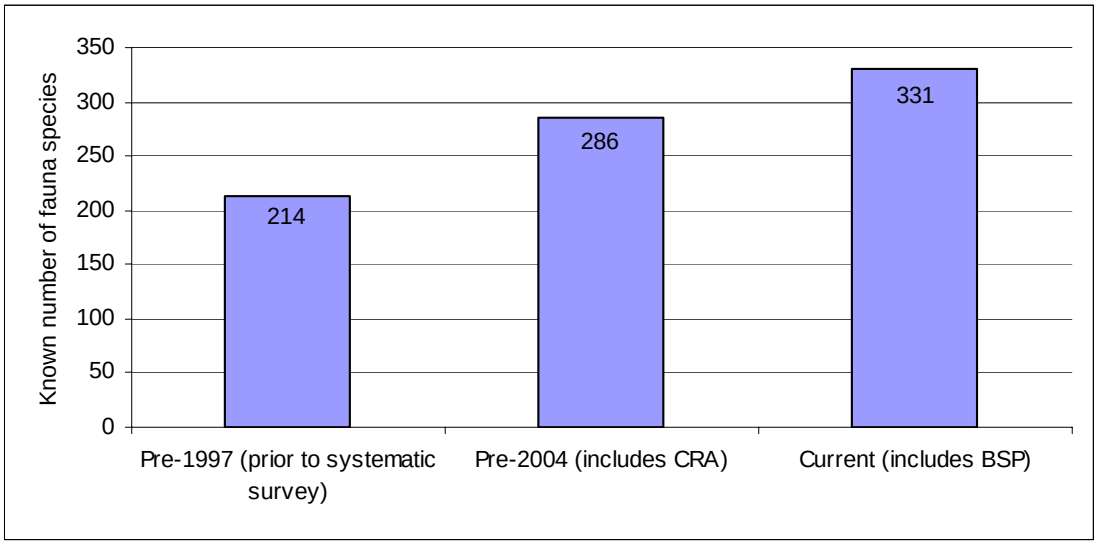


Figure 1: **Number of species recorded on the Atlas of NSW Wildlife within north-western Wollemi National Park, showing increase following systematic fauna survey**

3.2 FROGS

The systematic surveys between 1997 and 2006 confirmed the presence of 17 species of frog within the study area, of which twelve have not been detected by any other method (Appendix C). Single records exist for an additional two species: the Broad-palmed Frog (*Litoria latopalmata*) has been recorded recently, while a specimen of the endangered Booroolong Frog (*Litoria booroolongensis*) was collected in 1980. It is unknown whether the Booroolong Frog still occurs within the study area, as will be discussed in Section 5 below. Given this, the number of frog species definitely known to occur in north-western Wollemi National Park is 18, including nine Myobatrachidae (ground frogs), which lack toe discs and rarely climb trees, and nine Hylidae (tree frogs), which have toe discs and frequently climb trees or rocks (Robinson 1993). The occurrence of the Stuttering Frog (Plate 6) is of high conservation significance, as the species is listed as endangered in NSW and vulnerable nationally. There are only two other recent records of this frog within a 50 kilometre radius of the study area. The presence of the Giant Burrowing Frog (*Heleioporus australiacus*) and Red-crowned Toadlet (*Pseudophryne australis*), both listed as vulnerable under the TSC Act (1995), is also significant as both of these species reach the northern limit of their known range within the study area. These threatened species will each be discussed further in Section 5.

The success of frog surveys is largely dependent on the immediate weather, season and recent climatic conditions. In the lead up to the 2005-06 systematic survey period, the weather was relatively dry, providing poor conditions for conducting frog surveys. However, storms and heavy downpours occurred prior to and during a number of the spring and summer surveys, providing a window of opportunity to sample the frog fauna. As the duration of optimum conditions was limited, only a small number of systematic nocturnal streamside searches were undertaken. Frogs were also encountered on an opportunistic basis during these times as they used the wet weather to disperse and were encountered on roads and trails and during other systematic survey techniques such as site spotlighting, diurnal herpetofauna searches and nocturnal call playback.

Plate 6: Stuttering Frog on minor tributary of Wollemi Creek. © N. Williams/DEC

3.2.1 Discussion of species occurrence

Ground frogs

By far the most widespread and abundant frog species is the Common Eastern Froglet (*Crinia signifera*), which was observed or heard calling in all of the medium and large creeklines that were visited during the surveys, ranging from those within She-oak forest and Box - Red Gum woodland to tall moist Blue Gum Forest. This small frog calls consistently throughout the year and so is easily detected by auditory surveys, though it usually remains quite visually inconspicuous. The Red-crowned Toadlet was the next most-commonly recorded species, detected in numerous locations in the higher elevation sections of the park, on and south of the Hunter Range (see Map 9). The closely related Bibron's Toadlet (*Pseudophryne bibronii*), which has a similar call but strikingly different markings, is more widely distributed. It has been recorded in a number of small creeks and drainage lines ranging from Wattle and Cousins Creeks at moderately low elevation in the north to Gospers Creek at relatively high elevation in the south. All but one of the records for this species occur on or near higher fertility soils, derived from either Permian or basalt geologies, suggesting that the species prefers enriched soils, as has been found to be the case in the greater southern Sydney region (DEC 2006a). The high frequency of detection of Bibron's Toadlet within the study area is

Plate 7: Lesueur's Frog (note blue thighs) on Sugarloaf Creek © M. Schulz/DEC

important, as this species is thought to have declined in abundance in many parts of its range, including lowland areas in the greater Sydney area, as well as the Brigalow Belt South and Nandewar Bioregions (Andren 2004). The Bullfrog (*Limnodynastes dumerilii*) has been seen or heard calling at 14 locations, each in the northern half of the study area including along Bylong River, Blackwater Creek, Lee Creek and Ganguddy Creek near Dunns Swamp. Interestingly, both subspecies (*L. d. dumerili* and *L. d. grayi*) occur within the area and in some cases, such as Ganguddy Creek, at the same location.

The remaining ground frog species have each only been recorded sporadically and include (followed by the number of locations at which they have been detected) the Spotted Marsh Frog (*Limnodynastes tasmaniensis*, 7), Striped Marsh Frog (*Limnodynastes peronii*, 5), Giant Burrowing Frog (6), Ornate Burrowing Frog (*Limnodynastes ornatus*, 2), and Stuttering Frog (1). The low numbers of records of the *Limnodynastes* species is likely to be a result of limited survey effort under good conditions, rather than an indication of true rarity. They are each likely to occur in still pools of moderately sized creeks or rivers, as well as flooded grasslands and dams (Anstis 2002).

Tree frogs

Of the tree frogs that occur in north-western Wollemi, the Green Stream Frog (*Litoria phyllochroa*) and Peron's Tree Frog (*Litoria peronii*) have been detected most frequently, at 33 and 34 locations respectively. The Green Stream Frog is usually found in flowing streams, and is expected to occur within all of the drainage systems in the study area, particularly in or near taller forest. The Peron's Tree Frog is less widespread. This species requires still water to breed in, and is therefore restricted to pools in larger creeks and rivers, as well as artificial waterbodies such as dams. It occurs along the Capertee and Cudgegong Rivers, as well as in or beside dams near the boundary of the park, such as at Gospers and Kerry Mountain and within the Widden and Glen Alice Valleys. The Blue Mountains Tree Frog (*Litoria citropa*) has been recorded at 17 locations, each within sheltered gullies that retain almost permanent flowing water, such as Blackwater, Ovens and Numietta Creeks. The discovery of the Blue Mountains Tree Frog in north-eastern (DEC 2005a) and north-western Wollemi National Park is exciting, as this animal was not previously known to occur in the region and constitutes a north-westerly range extension for the species. The only records north of this within the NSW Wildlife Atlas come from Barrington Tops, a remnant area of rainforest and wet sclerophyll forest, with habitats similar to those in which the Blue Mountains Tree Frog was located within northern Wollemi National Park. The presence of such a species indicates the refugia properties that are provided by deeper sheltered gullies in Wollemi.

Keferstein's Tree Frog (*Litoria dentata*) has been detected at 14 widely spaced locations, including adjacent to still pools in creek lines, in farm dams beside the park and in trees far from water. Records of the Green Tree Frog (*Litoria caerulea*) are also widely spaced, but are all located near the boundary in the north of the park, in a variety of habitat types. The remaining five tree frog species have each been recorded only a handful of times, being Verreaux's Tree Frog (*Litoria verreauxii*, 3), Broad-palmed Frog (1), Stoney Creek Frog (*Litoria wilcoxii*, 2) and Lesueur's Frog (*Litoria lesueuri*, 1). The occurrence of the latter two species is interesting, as they have only recently been defined as two separate species. The Hawkesbury-Nepean River System is thought to be the geographical boundary for the distribution of these two species, with Lesueur's Frog occurring to the south and Stoney Creek Frog to the north (Donnellan & Mahony 2004). The species ranges overlap in this river system, but had previously only been reported in separate tributaries less than 25 kilometres apart (Donnellan & Mahony 2004). The species were recorded within two kilometres of each other near Dunns Swamp in October 2005, with the Stoney Creek Frog on the Cudgegong River and Lesueur's Frog (Plate 7) on Sugarloaf Creek. In November 2005 both species were recorded within the same pool on the Capertee River, just west of the study area boundary. Furthermore, both species were observed on Wollemi Creek, east of the study area, during CRA surveys, where distinct groups of each species were seen within 100 metres of each other, exhibiting a different call and showing no sign of intermediate morphology (K. Madden pers. comm.). The species complex has been recorded from other parts of Wollemi National Park prior to 2004, however it is unknown to which species these records belong. These results yield important new information regarding the distribution and cross-over of Lesueur's Frog and Stoney Creek Frog, and are worthy of further investigation in the region.

3.2.2 Other species that have the potential to occur in the study area

In addition to the above, there are seven frog species that have been recorded within five kilometres of the park boundary, of which two are considered highly likely to also occur within the study area, yet have remained undetected to date. The Smooth Toadlet (*Uperoleia laevigata*) is likely to occur around or adjacent to ditches and dams that are located near the boundary of the drier parts of the study area. The Painted Burrowing Frog (*Neobatrachus sudelli*) probably occurs within the dry, western-influenced

environments below the northern and western escarpments, as was found to be the case in north-eastern Wollemi National Park (DEC 2005a) and Goulburn River National Park (NPWS 2001b). This latter species remains underground much of the time, buried in deep alluvial sandy soils, and emerges only after heavy rain; hence it can easily go undetected. It is also possible that Fletcher's Frog (*Lechriodus fletcheri*) and the Great Barred Frog (*Mixophyes fasciolatus*) occur in the higher rainfall areas of the park, within patches of rainforest and wet sclerophyll forest in the most sheltered sandstone gullies and canyons. There is also a chance that the Red-eyed Tree Frog (*Litoria chloris*) occurs, as the species is known to occur at a few locations in north-eastern Wollemi National Park (DEC 2005a) within habitats that also exist within the current study area. The study area lies near the extremity of the known distributions for all of these latter three species, so further research into whether they occur and their distribution in the region is warranted. Such research needs to be undertaken in late spring or summer during wet conditions and outside of a drought period.

3.2.3 Review of species records

A single Jervis Bay Tree Frog was recorded at Dunns Swamp in 2000. However, this is a coastal frog not known to occur on the western slopes. The record is considered to be a misidentification and therefore has not been included in the totals provided in this report.

3.3 REPTILES

The DEC surveys between 1997 and 2006 confirmed the presence of 50 species of reptile in north-western Wollemi National Park, of which 24 were not known to occur prior to systematic surveys. An additional two species have been recorded in the park by casual observers, bringing the total number of known reptile species to 52. This total includes one species of turtle, five geckos, three legless lizards, five dragons, two monitors, 24 skinks and twelve snakes (Appendix C). One of these species, the Broad-headed Snake (*Hoplocephalus bungaroides*) is listed as Endangered under the NSW TSC Act (1995) and Vulnerable under the commonwealth EPBC Act (1999), while a second, the Rosenberg's Goanna (*Varanus rosenbergi*) is listed as Vulnerable under the TSC Act (1995). These species have been recorded at three and six widely spaced locations respectively, and will be discussed in detail in Section 5 of this report.

3.3.1 Systematic survey findings

A total of 211 systematic diurnal herpetofauna searches have been undertaken in north-western Wollemi National Park between 1997 and 2006. Forty-two reptile species were detected by this method. Based on these census results, the most common reptile species in the study area is the Pale-flecked Garden Sunskink (*Lampropholis guichenoti*), detected during 70 (33 % of) reptile searches. This is followed by the Dark-flecked Garden Sunskink (*Lampropholis delicata*, 65 sites), Lesueur's Velvet Gecko (*Oedura lesueurii*, 63 sites), Copper-tailed Ctenotus (*Ctenotus taeniolatus*, 46 sites) and White's Rock-skink (*Egernia whitii*, 43 sites, Plate 8).

Plate 8: White's Rock-skink © N. Williams/DEC

The results of the multivariate analyses performed on systematic survey data indicate that some reptile species have clear preferences for particular vegetation classes. Based on vegetation class alone, the most clearly distinct vegetation groups in terms of the reptile assemblage are the rainforests and the heathlands. Rainforests, mostly located in deep sandstone gorges, were found to be generally depauperate in reptile species, with only the Broad-tailed Gecko (*Phyllurus platurus*, also known as Southern Leaf-tailed Gecko) found to be relatively common. This large gecko is usually located under rocks or in rock crevices, often leaving behind shed skin, which is also readily identifiable. The fauna assemblage typical of wet sclerophyll forests with a mesic shrubby layer included a larger number of reptile species, namely Warm-temperate Water-skink (*Eulamprus heatwolei*), Eastern Water-skink (*E. quoyii*) and Dark-flecked Garden Sunskink. This last species is also common in sheltered dry sclerophyll forests, together with the Pale-flecked Garden Sunskink and to a lesser extent the Eastern Water-skink and Broad-tailed Gecko. The factors determining such habitat preferences are beyond the scope of this report, however it can be assumed that the broad vegetation classes used for the analysis are a surrogate for more detailed micro-climatic and micro-habitat requirements. All of the reptile species common in the more sheltered forest types (rainforest, wet sclerophyll forest and sheltered dry sclerophyll forest) are typical of coastal hinterland sandstone environments. They are thus expected to be most common in the centre and south of the study area, where the climate,

geology and topography is most closely aligned to coastal hinterland patterns. Of these species, the Warm-temperate Water-skink has the most restricted distribution in the study area, only occurring at moderately high altitudes, including along the Hunter Range, and on Mounts Coricudgy, Boonbourwa, Kerry and Coriaday.

The reptile fauna of the heathland habitats is a stark contrast to that of the sheltered forests, and is dominated by species that flourish on and around exposed rock outcrops. The most commonly detected reptile species in this vegetation class are the Copper-tailed Ctenotus and White's Rock-skink and to a lesser extent Lesueur's Velvet Gecko. Both the Dark-flecked and Pale-flecked Garden Sunskinks were located within heathlands, but at quite low frequency. The species that were not detected within heathlands also yield important information, as it suggests the exposed nature of these areas to be beyond the ecological tolerance of these species. Reptiles that were noticeably absent from heathlands included the Broad-tailed Gecko, Weasel Shadeskink (*Saproscincus mustelinus*), Yellow-bellied Three-toed Skink (*Saiphos equalis*), Eastern Water-skink and Eastern Water Dragon (*Physignathus lesueurii lesueurii*).

The shrubby dry sclerophyll forest vegetation class encompasses a diverse range of habitats, at a variety of elevations and climatic conditions. When classed together, these habitats were not found to exhibit a significantly different fauna assemblage compared to the other vegetation classes. Instead, the most frequently detected reptiles reflect the species that are most abundant across the whole study area, including Lesueur's Velvet Gecko, Dark and Pale-flecked Garden Sunskinks, Copper-tailed Ctenotus and White's Rock-skink. However, there was found to be a significant difference between the fauna assemblage of sites in dry sclerophyll forest on Permian sediments and on Narrabeen and Hawkesbury sandstone-derived soils. This difference is likely to be driven by climatic, fertility and landscape differences, for which the broad geological classes are a surrogate. The shrubby dry sclerophyll forests on Permian soils are closely aligned in terms of their reptile assemblage to the grassy woodlands, as they also occur along the dry northern and western talus slopes. The Tree-base Litter-skink (*Lygisaurus* (now *Carlia*) *foliorum*) and South-eastern Morethia Skink (*Morethia boulengeri*) are common on these dry talus slopes, yet very rarely detected on the Narrabeen or Hawkesbury sandstones. The Tree-crevice Skink (*Egernia striolata*) is also more common in these environments than on the sandstones. Conversely, Dark-flecked and Pale-flecked Garden Sunskinks, White's Rock-skink, Copper-tailed Ctenotus and Red-throated Cool-skink (*Bassiana platynota*, now known as *Acritoscincus platynotum*) were more frequently detected in dry sclerophyll forests on Narrabeen and Hawkesbury sandstone. This result was expected, as it reflects the regional influences on different parts of the study area. The reptile fauna along the northern and western escarpment is dominated by species typical of the central western slopes that extend towards the coast only where drier environments occur, (such as in the Hunter and Goulburn River Valleys) as well as species more common in northern NSW. Though not highlighted in the analyses, species that also fit into this category are the South-eastern Slider (*Lerista bougainvillii*) and Southern Rainbow-skink (*Carlia tetradactyla*). The species present on the Hawkesbury and Narrabeen sandstones, however, are typical of Sydney coastal hinterland environments and are each abundant across the sandstone reserves of the northern and southern Blue Mountains.

A more unexpected finding was that Jacky Lashtail (*Amphibolurus muricatus*) and Broad-tailed Gecko were each somewhat more frequently detected on Permian than on Narrabeen dry sclerophyll forests. The reasons for this are unknown and require further investigation, but may be linked to the fact that the Permian dry sclerophyll forest classes incorporated many gully sites, while the Hawkesbury and Narrabeen sandstone sites were largely located on ridges or exposed slopes. A number of reptile species did not exhibit differences in detection rate between different types of dry sclerophyll forest, including Lesueur's Velvet Gecko and Eastern Stone Gecko, amongst others. Presumably the presence of these species is determined by finer scale micro-habitat features than were examined herein.

3.3.2 Discussion of other species occurrence

Many of the less commonly detected reptiles species did not feature in the multivariate analysis, yet form an integral part of the study area's reptile inventory and are worthy of discussion.

Geckos

The two gecko species not discussed above were each detected for the first time in the study area during the 2005-06 DEC surveys. The Thick-tailed Gecko (*Underwoodisaurus milii*, also known as Barking Gecko) was detected at fourteen locations, along the northern and western slopes and escarpment as well as around Dunns Swamp. The Robust Velvet Gecko (*Oedura robusta*) was observed just twice, once in Cedar Creek gorge and once near the boundary between the park and

private lands on the trail to Gowrie Hut, south of Bylong. This species has the north coast at the centre of its distribution in NSW, where it inhabits dry sclerophyll forests and woodlands. It has not been recorded further south than the Watagan State Forest, situated approximately 30 kilometres south of the current records. The discovery of the gecko within north-western Wollemi National Park, together with recent discoveries in north-eastern Wollemi and Goulburn River National Parks and Manobalai Nature Reserve, contributes important information about the species towards the southern limit of its known range.

Legless lizards

All of the legless lizard species that are now known to occur in the park were first detected during the BSP surveys and have each been recorded on just two occasions. This is due to their highly cryptic nature and tendency to take cover under rocks or logs, or in leaf litter or grass tussocks, when disturbed. The Leaden Delma (*Delma plebeia*) reaches the southern limit of its distribution at the Hunter Valley and ranges. Little is known of this rare species, with only 27 sightings recorded on the Atlas of NSW Wildlife, most of which fall within the Hunter Valley and Ranges and the Nandewar Bioregion. This species is likely to occur at further sites in the dry northern valleys and lower slopes, such as was found to be the case on north-eastern Wollemi (DEC 2005a). The two other species of legless lizard, Burton's Snake-lizard (*Lialis burtonis*) and Southern Scaly-foot (*Pygopus lepidopodus*, Plate 9) are likely to be more widespread than records indicate, as elsewhere they are known to occur in a wide range of habitat types, both north, south, east and west of the study area.

Plate 9: Southern Scaly-foot © N. Williams/DEC

Dragons

Of the five species of dragon recorded in the study area, the most interesting discovery made during the BSP surveys was of the Nobbi Lashtail (*Amphibolurus nobbi*, Plate 10). This animal was observed at two locations on the slopes east of Lee Creek, within dry Box – Cypress woodland. The Nobbi Lashtail ranges from the coast and ranges of Queensland and far north New South Wales around to the western slopes of the Great Dividing Range and into South Australia (Wilson & Swan 2003). Aside from one record near Lithgow, the sightings made in 2006 are the furthest south that the species has been recorded on the eastern side of the ranges. The species is common further north, in Goulburn River National Park and Manobalai Nature Reserve and crown lands, and is one of the most abundant dragons in the Brigalow Belt South Bioregion (DEC 2005b). The species is known to inhabit dry environments (Cogger 1996) and its occurrence in the north-west of the study area is likely to be linked to the low rainfall and the presence of dry forests and woodlands. The distribution of the dragon in the upper Hunter Valley has been linked to occurrence of the Cypress Pine (R. Wells pers. comm.). The subspecies of these dragons were not recorded, but are likely to belong to *A. nobbi nobbi*.

Plate 10: Nobbi Dragon east of Lee Creek © N. Williams/DEC

Neither the Jacky Lashtail, Eastern Bearded Dragon (*Pogona barbata*) or Eastern Water Dragon have been recorded on the Hunter Main Trail, and of these only the Eastern Water Dragon has been detected in the vicinity of Mount Coricudgy. These three dragons have been more frequently detected in lower lying areas, particularly along the Army Road (Jacky Lashtail and Eastern Bearded Dragon), north and south of Dunns Swamp (all species) and along major creeklines (Eastern Water Dragon). The distribution of the Mountain Heath Dragon (*Tympanocryptis diemensis* now known as *Rankinia*

diemensis) is markedly different from this. This small dragon reaches its greatest abundance in higher altitude areas, including along the Hunter Range and around Mount Coricudgy, and has only occasionally been recorded in the far north of the park. The Mountain Heath Dragon is a frequent sight along the Army Road and near Gospers Mountain, as well as around Dunns Swamp and sandstone ridges south of the Hunter Range.

Monitors

The Lace Monitor (*Varanus varius*) is a relatively common sight throughout the sandstone reserves of the Sydney Basin, and north-western Wollemi National Park is no exception. This goanna is the second largest native carnivore in eastern Australia (second to the Dingo) and is a habitat generalist that forages across a large home range for carrion, nesting birds, reptile eggs, mammals and invertebrates (Guarino 2001). The species was recorded on close to 30 occasions in a wide range of habitat types, including at both high and low elevation. The Bell's form of this species, which has broad black and pale yellow bands on the body and tail, was seen on at least two occasions in the north-west, near Bylong River and Lee Creek. This form occurs in northern NSW and west of the ranges (Wilson & Swan 2003) and is yet another testament to the regional influences on this part of the study area. The Rosenberg's Goanna was much less frequently sighted. The six records obtained are scattered in both the north and centre of the park, as will be discussed on Section 5. The sightings made during the 2005-06 surveys are the furthest north-west that the species has been recorded on the Atlas of NSW Wildlife and contribute important information to the understanding of the species distribution and ecology.

Skinks

The occurrence of two species of Worm-skink, the Two-clawed Worm-skink (*Anomalopus leuckartii*) and Punctate Worm-skink (*Anomalopus swansoni*), is interesting. The Punctate Worm-skink has a very restricted distribution, occurring only in the northern half of the Sydney Basin Bioregion from just north of Sydney to the Hunter Valley (DEC 2006b). The DEC surveys undertaken in the Hunter Range area in 2004-05 increased the number of records for this species eight fold and found the lizard to be common on well-drained ridges, slopes and alluvial gullies in the Upper Hunter (DEC 2005b). Interestingly, though the Punctate Worm-skink was found in the Baerami Valley and on the ridgeline separating this valley from Widden Valley, it was not located during any of the 50-odd herpetofauna censuses undertaken in Widden, Myrtle, Lee or Bylong Valleys, or elsewhere in the study area. This result suggests that the ridge dividing the Widden and Baerami Valleys is the western limit of the species distribution. The Two-clawed Worm-skink, on the other hand appears to be moderately common on creek flats and lower slopes in the Widden and Myrtle Valleys, as it was found to be in Baerami and Hungerford Valleys in north-eastern Wollemi (DEC 2005a). This latter species was also recorded once in the Bylong River Valley, and is likely to be widespread in the Upper Goulburn Valleys and escarpments. The Upper Hunter and Goulburn River Valleys form the southern limit of this species' distribution.

In addition to the Eastern Water-skink and Warm-temperate Water-skink mentioned above, two further *Eulamprus* species occur, namely the Bar-sided Forest-skink (*Eulamprus tenuis*) and the Cool-temperate Water-skink (*E. tympanum*). The occurrence of Bar-sided Forest-skink was to be expected, as this species also occurs across north-eastern Wollemi and Yengo National Parks (DEC 2006b). Though this arboreal lizard was only recorded at nine locations, these locations are widely scattered and it is expected to occur at low density across the study area. The discovery of Cool-temperate Water-skink was more of a surprise, and uncertainty remains regarding its distribution in the study area. It was positively identified at only one location, near the headwaters of Blackwater Creek, just east of Mount Coricudgy. It is possible that other *Eulamprus* seen on the Hunter Range were also Cool-temperate Water-skink. However this lizard is difficult to identify from the Warm-temperate Water-skink at a distance, and individuals could not be captured to positively verify their identity. The Cool-temperate Water-skink has not previously been detected within the vicinity of north-western Wollemi National Park. The closest records on the Atlas of NSW Wildlife are located 70 kilometres to the south (north-east of Blackheath) and 80 kilometres to the north (in Barrington Tops National Park). However, the species does have a rather disjunct distribution, only occurring in montane areas, usually above 600 metres asl (DEC 2006b). Its occurrence east of Mount Coricudgy is therefore in line with known habitat preferences, as was the microhabitat in which the lizards were observed. Further survey would be required to determine the distribution and abundance of this species on the Hunter Range.

Both the Blotched Bluetongue (*Tiliqua nigrolutea*) and the Common Bluetongue (*T. scincoides*) have been recorded in north-western Wollemi, though only once and three times respectively. A Blotched Bluetongue was seen in thick grass during a herpetofauna census on a basalt-capped summit three

and a half kilometres north-west of Tayan Peak, in October 2005. This was an exciting discovery, as it constitutes a 40 kilometre northerly range extension for the species. The Blotched Blue-tongue is common in the upper Blue Mountains, frequently recorded above 800 metres asl near the towns of Katoomba, Blackheath and Lithgow and west towards Winburndale Nature Reserve (DEC 2006b). In the north of its range the lizard only occurs in montane and sub-alpine environments (Wilson & Swan 2003). The habitat in which the lizard was located in north-west Wollemi (Plate 4) is typical for the species, being montane grassy open forest though at 750 metres above sea level it is lower in altitude than most records. The wide low-lying Capertee Valley separates this location from other known localities of the species. The Blotched Bluetongue may also occur on other basalt peaks within and adjacent to the study area, such as Tayan Peak, Nullo Mountain or Mounts Coricudgy and Coriaday. Further survey would be required to ascertain this. The Common Blue-tongue has been recorded twice on the Hunter Main Trail and once on the Nullo Mountain Trail, south of 'Box Ridges'. However, this species is known to occur in a wide variety of habitats, from the coast to semi-arid areas west of the Great Dividing Range (Swan *et al.* 2004). It is therefore expected to be more widespread in the study area than records indicate, though it may only remain at relatively low density.

Snakes

Only one species of blind-snake, the Blackish Blind-snake (*Ramphotyphlops nigrescens*), has been recorded within the study area. This species is widespread and appears to be quite abundant. It has been recorded at 21 locations, including during 16 (8 % of) herpetofauna censuses, when it is usually located under rocks and occasionally under logs. Blind-snakes are notoriously difficult to detect and the species is likely to be even more abundant than records indicate.

The Elapids are the most diverse and frequently encountered group of snakes in the park, with ten species confirmed. All but the Red-bellied Black Snake have been recorded on fewer than ten occasions, reflecting their generally cryptic nature. Records of the Red-bellied Black Snake are widespread, but most concentrated around Dunns Swamp and to a lesser extent in the vicinity of the Army Road. Though the species has not been recorded on the Atlas of NSW Wildlife within the Widden or Myrtle Creek Valleys, landholders regularly observe the species in this area (B. Tindale pers. comm.) and it is considered likely to occur in all of the northern valleys in the vicinity of creeks and swampy areas. Interestingly, the frequency of encounters with Red-bellied Black Snake has declined in the Myrtle Creek area since 2002 (B. Tindale pers. comm.), which is likely to be a reflection of the species retreating or declining in numbers during the current drought. Within the park boundary, the Mainland Tiger Snake (*Notechis scutatus*) has only been recorded greater than 700 metres asl, consistent with the fact that away from the coast it is generally more common in mountainous areas (DEC 2006a). However, an individual was observed in the Glen Alice valley on lower slopes east of Numietta Creek at approximately 400 metres asl. The protection of this snake species within the park has conservation significance as it has been reported to have declined in numbers in some parts of its range, particularly the Sydney Metropolitan area (A. White pers. comm.). Records of the Small-eyed Snake are also restricted to higher altitudes, where it was located on Narrabeen and Hawkesbury sandstone as well as on basalt caps in areas such as Kerry Mountain and Mount Coriaday, the Hunter Range, Army Road and Grassy Mountain. It is uncertain, however, whether the distribution of these records represents a true absence from lower lying areas along the northern and western escarpments, or simply that the species survives in low densities and was not detected.

The Southern Death Adder (*Acanthophis antarcticus*) and Yellow-faced Whipsnake (*Demansia psammophis*) have each been observed at three locations. The Variable Black-naped Snake (*Suta spectabilis dwyeri*) and Golden-crowned Snake (*Cacophis squamulosus*) have each been recorded at two locations (including the latter once just outside of the park boundary in Goulburn River National Park), while the Eastern Bandy-bandy (*Vermicella annulata*) and the Eastern Brown Snake (*Pseudonaja textilis*) have been seen at one site each. Such low detection rates make it difficult to assess the distribution or abundance of the species in the study area. The records of Golden-crowned Snake are quite unusual. Particularly interesting is the individual that was located under a rock on a dry Box – Ironbark – Cypress slope in the Widden Valley. Confirmed sightings of this species do not occur elsewhere in the region, with the nearest records on the Atlas of NSW Wildlife (aside from the one in Goulburn River National Park) located 70-odd kilometres to the north-east (near Mount Royal National Park) and south-east (south of Putty State Forest). The Golden-crowned Snake is predominantly a coastal species, normally inhabiting rainforest or wet sclerophyll forest, or moister areas in dry sclerophyll forest (Swan *et al.* 2004). These Goulburn River and Wollemi National Park records form significant outliers from this pattern, and thus contribute important information about the species' ecological tolerances.

The Diamond Python (*Morelia spilota spilota*) has only been reported from two locations, namely between Hefrons Hole and Wilsons Clearing, and between the Cudgegong River and Hanging Rock.

However this large snake would almost certainly be more widespread than these records suggest, particularly in the sandstone gullies and gorges south of the Hunter Range. The Diamond Python favours rainforest and wet sclerophyll forest (Swan *et al.* 2004) such as occur in these sheltered environments.

Turtles

The Eastern Snake-necked Turtle (*Chelodina longicollis*) has most frequently been recorded near the periphery of the park as well as at Dunns Swamp and on the Capertee River. This species is largely restricted to permanent waterbodies, such as farm dams and larger creeks and rivers with long still pools, but may travel overland through adjacent parts of the study area during summer rains.

3.3.3 Other species that have the potential to occur in the study area

An examination of the species recorded within a five kilometre radius of the study area boundary, but not therein, provides some indication of animals that may have as yet gone undetected within the park (Appendix D). The Short-necked Turtle (*Emydura macquarii*) that is recorded on the Atlas of NSW Wildlife on the Merriwa River, 4.5 kilometres north of the study area, is likely to in fact belong to a different subspecies than is recorded, as a taxonomic review has been undertaken since the date of the record (see Wilson & Swan 2003). The record could be either a Sydney Basin Short-necked Turtle (*Emydura macquarii dharuk*) or a Hunter River Short-necked Turtle (*E. m. gunabarra*). A second turtle that is most likely to belong to this species was observed basking on an emergent rock in Dunns Swamp near Kandos Weir in 2004, though due to the long distance of observation a positive identification could not be achieved (E. Magarey pers. obs.). As this latter location is in a western-flowing river system, and due to the large size of the individual, the turtle has the potential to belong to the Macquarie Short-necked Turtle subspecies (*E. m. macquarii*), which is widespread in the Murray-Darling drainage system (Cann 1998). Further surveys would be required at Dunns Swamp in order to confirm which short-necked turtle species occurs.

The Sand Monitor (*Varanus gouldii*) is relatively common in the Hungerford Valley (DEC 2005a) and has been recorded less than one kilometre north of the park boundary on two occasions. This moderately-sized Goanna is likely to also occur along the northern and north-western slopes of the study area, where on average less than 650 mm of rain falls per annum. The Eastern Ranges Rock-skink (*Egernia modesta*) has the potential to occur in the far north, in habitats similar to where it was located in north-eastern Wollemi National Park (DEC 2005a). The Spotted Black Snake (*Pseudechis guttatus*) is known to occur in the northern alluvial valleys, and may also inhabit some of the major creeklines, flats and lower slopes within the park boundary. Both the Tussock Cool-skink (*Pseudemoia entrecasteauxii*) and Grassland Tussock-skink (*P. pagenstecheri*) are high altitude species that have been recorded around Nullo Mountain, and have the potential to occur in parts of the study area that lie above 800 metres asl, including east of Mount Coricudgy, Kerry Mountain and Mount Coriaday. The Mustard-bellied Snake (*Drysdalia rhodogaster)* also has the potential to occur in these high altitude environments. The Highland Copperhead, though not recorded in the Atlas of NSW Wildlife, has been reported from the area (Goldney & Cardale 1993), and also has the potential to inhabit areas above 600 metres asl. The Eastern Brown Tree Snake (*Boiga irregularis*) in contrast would probably only occur in the south-east of the study area if at all, particularly in sandstone caves and crevices with rainforest or forest nearby. Lastly the Proximus Blind-snake (*Ramphotyphlops proximus*) may have gone undetected due to its highly cryptic nature.

3.3.4 Review of species records

In addition to the above, the Atlas of NSW Wildlife holds records of two further snake species: the Top End Carpet Python (*Morelia spilota variegata*), reported once near the Gospers Mountain airstrip; and the Stephen's Banded Snake (*Hoplocephalus stephensii*), reported twice near Dunns Swamp campground. These sightings are likely to be mis-identifications or data entry errors. North-western Wollemi National Park is not within the known range for either the Top End Carpet Python, a snake of northern Australia (Wilson & Swan 2003), or Stephen's Banded Snake, which occurs in moist coastal forests, mostly in northern NSW (Swan *et al.* 2004). These species have thus not been included in the species inventory presented in this report.

3.4 NATIVE DIURNAL BIRDS

A complete list of all native diurnal bird species that have been recorded within north-western Wollemi National Park is provided in Appendix C. This list includes some species that are likely to represent spatial or identification inaccuracies (see Section 3.4.4). Following a review of records conducted for this report, it is concluded that 189 native diurnal bird species definitely occur within the study area. This includes eleven species that are listed as Vulnerable and two species that are listed as Endangered under the NSW TSC Act (1995), of which one species, the Regent Honeyeater, is also

listed as Endangered under the Commonwealth EPBC Act (1999). Nine of these threatened species are largely dependent on the dry woodlands that occupy the talus slopes below the northern and western escarpments, while others are more widespread through the sandstone plateaux. These threatened species will be discussed further in Section 5. Scientific names for bird species in the following discussion are presented in Appendix C.

Plate 11: Eastern Yellow Robin © J. Cooper

Also of conservation significance is the presence of a number of species that are thought to be in decline, though they have not yet been listed on either the TSC or EPBC Acts. A recent review of bird records across the nation identified numerous species that appear to have declined in numbers in recent years (Barrett *et al.* 2003). Of the species identified, the following occur within north-western Wollemi NP: Rockwarbler; White-winged Chough; Spotted Quail-thrush; Red-browed Treecreeper and Flame Robin. In addition, a number of species that have been located within the study area are thought to have declined within the Sydney Basin Bioregion in recent years (Barrett *et al.* 2003). These include the Jacky Winter, Wedge-tailed Eagle, Nankeen Kestrel, Dusky Woodswallow, White-backed Swallow, Brown Falcon, Australian Pipit, Scarlet Robin, White-winged Triller and White-throated Needletail. The presence of these species suggests that Wollemi National Park, together with the neighbouring national parks of the Blue Mountains and Hunter Range, play an important role in the ongoing regional conservation of their habitats. The Plum-headed Finch is listed as a species of conservation significance in the Brigalow Belt South and Nandewar Bioregions, as it has been affected by alteration of native grasslands, grazing and loss of woodland habitat (Andren 2004). This granivorous bird has been recorded three times within or immediately adjacent to the study area (but not by DEC), and may be in decline in this region also.

3.4.1 Systematic survey findings

The DEC surveys undertaken between 1997 and 2006 recorded the presence of 168 species of native diurnal bird, of which 13 have not been recorded by any other method. One hundred and forty-eight of these species were observed during the 234 systematic diurnal bird censuses, with the remaining 20 species only recorded by opportunistic sightings. Based on the systematic diurnal bird survey results, the most common bird species in the park in spring and summer is the Spotted Pardalote, which was recorded during 202 (86 %) of the diurnal bird censuses. This is a small bird that feeds by gleaning leaves for invertebrates (particularly psyllids and lerps) and is capable of inhabiting a wide range of habitat types, from dry woodlands in the northern and western escarpments to tall mesic forest and rainforest in the sheltered sandstone gullies. Also frequently recorded during diurnal bird censuses were the Yellow-faced Honeyeater (186 sites), White-throated Treecreeper (183 sites), Grey Shrike-thrush (150 sites), Grey Fantail (150 sites), Brown Thornbill (148 sites), Pied Currawong (145 sites), Eastern Yellow Robin (141 sites, Plate 11), Rufous Whistler (140 sites) and Eastern Spinebill (140 sites). All of these birds are not only habitat generalists, but are also highly vocal or highly visible, making them easy to detect during bird surveys in both woodland and forest throughout the study area.

The results of analyses based on data collected during the bird and herpetofauna censuses indicate differences in the bird assemblage between major vegetation classes. Though a number of species, including those listed in the previous paragraph, are habitat generalists and occur in the majority of vegetation classes, other species prefer particular habitat characteristics and are more abundant in or restricted to particular vegetation classes. Detecting such patterns was the aim of the multivariate analyses of the results of the bird and reptile censuses. As expected, the most distinct differences in bird assemblages were found to occur between the rainforest habitats and the dry grassy woodland habitats. The other habitats lie between these two extremes, with wet sclerophyll forests and sheltered dry sclerophyll forests grouping towards the rainforest end of the scale and non-grassy dry sclerophyll forests scattered throughout the middle of the scale. It must be noted that the patterns discussed below reflect habitat preferences only in the spring and summer months. Many bird species utilise different habitats in the autumn and winter.

A distinct bird group occurs within the rainforests and wet sclerophyll forests with mesic shrubby understoreys that occur in the sheltered sandstone gullies and basalt caps through the centre of the study area. As well as supporting more generalist species such as Spotted Pardalote and Grey Fantail, these habitats share a distinct wet forest bird assemblage that includes the Lewin's

Honeyeater, Rufous Fantail and Black-faced Monarch. However, only the well-developed rainforests support Yellow-throated Scrubwren, Large-billed Scrubwren, Brown Gerygone, Bassian Thrush and Rose Robin. Brown Gerygone was detected during all of the diurnal bird censuses undertaken in rainforests. Many bird species common in the wet sclerophyll forests also occur in sheltered dry sclerophyll forests, such as the Golden Whistler, Eastern Spinebill, White-browed Scrubwren, Superb Lyrebird, Striated Thornbill, Eastern Whipbird and Crimson Rosella. The Grey Shrike-thrush and Rufous Whistler tended to be more common in the sheltered dry sclerophyll forests.

The shrubby dry sclerophyll forests are typified by the habitat generalist species mentioned above. When classed together the shrubby dry sclerophyll forests were not found to exhibit a distinctly different fauna assemblage compared to the other vegetation classes. This result is likely to be because of the diverse range of habitats that the 'dry sclerophyll forest' class includes. When underlying geology is taken into account, however, the dry sclerophyll forests on Permian soils are seen to have a distinctively different bird community than those on Narrabeen and Hawkesbury sandstone-derived soils. The shrubby dry sclerophyll forests on Permian soils have many bird species in common with the grassy woodlands, as both occur along the escarpment footslopes and alluvial flats in the north and west of the park where rainfall is moderately low and soil fertility generally high. These habitats each commonly support (in addition to the generalist species above) Mistletoebird, Weebill, Yellow-tufted Honeyeater, White-naped Honeyeater and the threatened Brown Treecreeper and Black-chinned Honeyeater. The Australian Magpie, Australian Raven, Laughing Kookaburra, Grey and Pied Butcherbirds and Brown-headed Honeyeater are each also more common in the grassy woodlands and dry sclerophyll forests on Permian soils than they are on sandstone woodlands. Interestingly, the Rockwarbler was found to occur more frequently on the Permian than the sandstone geologies, despite being near the north-western limit of its range in these habitats and typically thought to be a sandstone species. This result may be attributable to the significant amount of microhabitat available along the talus slopes, in the form of large boulders fallen from the sandstone escarpment above, together with overhangs and caves.

The bird species occurring at high frequency in exposed dry sclerophyll forests on Hawkesbury and Narrabeen sandstone, but low frequency on Permian soils, include White-eared Honeyeater, Striated Thornbill, Brown Thornbill and Eastern Spinebill. In terms of the bird assemblage, heathlands share many species with the exposed dry sclerophyll forests on sandstone, including White-eared Honeyeater, Grey Shrike-thrush, Laughing Kookaburra and Pied Currawong.

3.4.2 Discussion of other species occurrence

Many native diurnal bird species did not feature in the multivariate analyses, but are never-the-less a feature of north-western Wollemi National Park and worthy of mention.

Birds of prey

Thirteen species are known to occur within the study area. These birds are most frequently detected on an opportunistic basis, rather than during systematic censuses, making it difficult to accurately assess habitat preferences. The most commonly observed species is the Wedge-tailed Eagle (recorded on 36 occasions), a large raptor with a distinctive flight silhouette that is usually seen soaring high above the tree canopy. The Brown Goshawk, Brown Falcon and Nankeen Kestrel are also common, the latter frequently seen perched on dead stags or man-made structures at the interface between cleared and forested lands. The remaining nine species have each been recorded on fewer than ten occasions and include the Peregrine Falcon, Collared Sparrowhawk, Black-shouldered Kite, Little Eagle, Australian Hobby, White-bellied Sea-eagle, Grey Goshawk, Letter-winged Kite and Square-tailed Kite, listed in decreasing order of the number of times they have been recorded. The pattern of detection of these species gives some indication of the type of habitat utilised most frequently. The Brown Falcon, Black-shouldered Kite and Nankeen Kestrel are most frequently observed near the park boundary as they utilise cleared lands adjacent to the park for hunting reptiles, rodents and insects (N. Williams pers. comm.). In contrast, the Brown Goshawk, Grey Goshawk and Collared Sparrowhawk forage largely within forests and woodlands, and are therefore more widespread throughout the study area proper. The Peregrine Falcon is also likely to be most common along the northern and western escarpments, as it would nest and roost in caves and cliff edges, foraging for birds within both cleared and forested lands. The protection of habitat for the Brown Falcon and Black-shouldered Kite on the edges of the park is important as both species have been reported by Birds Australia to have declined in numbers in the Sydney Basin Bioregion since the 1980s (Barrett *et al.* 2003).

Waterbirds

The number of bird species occurring within north-western Wollemi National Park is elevated by the presence of Dunns Swamp on the damned Cudgegong River. Many waterbird species have been observed on this large waterbody but nowhere else in the study area, including the Hardhead, Musk Duck, Hoary-headed Grebe, Australasian Grebe (though also recorded in dams and farmlands at the boundary of the park), Darter, Great Cormorant, Little Black Cormorant, Pied Cormorant, Great Egret, Black-necked Stork, Eurasian Coot, Dusky Moorhen, Purple Swamphen, Spotless Crake, Latham's Snipe and Australasian Reed-warbler. As these species prefer large permanent swamps and ponds with established aquatic vegetation, none of them would be expected to occur within the habitats that comprise the large majority of the park, though they may fly over and occasionally visit dams or other permanent waterbodies on the study area periphery.

Pigeons and Doves

The BSP surveys recorded a large number of dove and pigeon species using north-western Wollemi National Park. These are (followed by the number of locations at which recorded): Wonga Pigeon (108); Common Bronzewing (90); Peaceful Dove (40); Crested Pigeon (17); Bar-shouldered Dove (2 by DEC and once by a landowner (P. Lonrigan pers. comm.)); Brown Cuckoo-dove (3); Brush Bronzewing (14); Diamond Dove (2); and Emerald Dove (1). While the first two of these species are common across sandstone reserves of the Sydney Basin and the next three would be expected to live near the boundaries of the park, the discovery of the latter three was quite interesting. An Emerald Dove was seen and heard calling in warm temperate Coachwood-Sassafras rainforest on a tributary of Koondah Creek in November 2005. Such habitat is typical of the species, but it is unusual for it to be recorded so far from the coast and is the most westerly record of the species in central NSW. Birds Australia has previously reported the species further east in the region, in the vicinities of Appletree Flat, Putty Road (near Parsons Creek) and the Wolgan River. The Brush Bronzewing also approaches the western limit of its distribution in NSW within the region, though it has also been recorded in Goulburn River National Park. In contrast, the Diamond Dove is a bird of inland NSW, visiting the coast only during dry periods and mostly in summer (Pizzey & Knight 1999). The sighting of this species in northern Wollemi (in the Glen Alice and Bylong Valleys) is therefore a case of opportunistic timing and an indication of drought conditions further west. It is important to note that the dove has only been observed below the western and northern escarpments, and would be unlikely to occur on the sandstone plateaux. Yet again, the juxtaposition of eastern and western species demonstrates that northern Wollemi lies at the confluence of bioregional influences.

Patterns across the study area

A number of bird species approach the edge of their known range within north-western Wollemi National Park. This includes birds that are near their northern limit, including the Gang-gang Cockatoo, Rockwarbler, Pilotbird and Crescent Honeyeater. The Rockwarbler is restricted to the Sydney Basin, where it is usually seen hopping around rock outcrops or piles of sandstone boulders. The abundance of this species across northern Wollemi National Park (DEC 2005a) and Goulburn River National Park (NPWS 2001b) suggests it to be secure at this north-western limit of its range, despite reported declines elsewhere in the Sydney Basin (Barrett *et al.* 2003). The north and west of the study area also provides habitat for a suite of species that are more typical of dry woodlands on the central western slopes, west of the Great Dividing Range. Included in this suite are many of the threatened 'declining woodland birds' (see Section 5), as well as White-browed Babbler, Western Gerygone, Jacky Winter, White-winged Chough and Striped Honeyeater. In stark contrast, the Australian Brush-turkey is typical of north-coast rainforests, and approaches its south-westerly distribution limit in Wollemi National Park. This bird was found to inhabit a number of gully lines in the centre and north of the study area, as well as wet sclerophyll forests at high elevation along the Hunter Range. A further suite of species approach the western limit of their distribution, including the Brown Gerygone and Black-faced Monarch, and are largely restricted to the higher rainfall coastal hinterland environments through the central sandstone plateaux. The fact that all of these birds, each with divergent habitat requirements, are accommodated is a testament to the area's microhabitat and landscape diversity.

As mentioned above, it is important to note that the large majority of bird surveys have been undertaken in the spring and summer, providing a profile of the avifauna in these seasons. Numerous bird species have different distribution during the colder months, either migrating out of the area (e.g. Yellow-faced Honeyeater), migrating into the area (possibly Swift Parrot), or becoming more wide ranging within the area in response to decreased insect activity and therefore having less specific habitat allegiances (e.g. Silvereye, Australian Museum 1979). Yet other species are nomadic in response to flowering events: Noisy Friarbird and New Holland Honeyeater, for example, both forage

on a variety of tree and shrub species, often congregating in large numbers to gather nectar; Painted Honeyeater feeds almost exclusively on mistletoes of the genus *Amyema* and is nomadic in response to the fruiting of mistletoes and the abundance of rainfall (Keast 1968, Pizzey & Knight 1999). Such movements highlight one of the important conservation roles played by large contiguous areas of wilderness, such as that of which the study area is a part, in the provision of a wide range of connected microhabitats that are capable of accommodating many species during different seasons and different stages of their life cycle.

3.4.3 Other species that have the potential to occur in the study area

Twenty-three additional native diurnal bird species have been recorded within a five kilometre radius of the study area, yet not within it (Appendix D). This list gives some insight into species that may occur within the park yet gone unrecorded to date. Of these species, the following are considered likely to occur, followed by the type of habitat which they may inhabit: Australian Pelican (Dunns Swamp); Cattle Egret (farmland interface); Australian White Ibis (farmland interface and Dunns Swamp); Pacific Baza (open forest and woodland, particularly along water courses); Swift Parrot (Box – Ironbark woodland); Southern Whiteface (farmland interface in the north); White-cheeked Honeyeater (variety of forest types); Masked Woodswallow (variety of woodlands and open forests); Little Grassbird (Dunns Swamp). The Black-breasted Buzzard, Black Kite, Black Falcon, White-breasted and Black-faced Woodswallows are each likely to be rare visitors to the study area. In addition, Emu was found to be quite common in Goulburn River National Park during DEC surveys in 2001, and it is possible that the species also occurs in low numbers below the north-western escarpment of Wollemi National Park.

3.4.4 Review of species records

A large proportion of the bird records in the Atlas of NSW Wildlife are derived from Birds Australia datasets. As mentioned above, records collected during the first Birds Australia survey (between 1978 and 1981) have a very low degree of spatial accuracy and there is no guarantee that any of the sightings attributed to a certain point actually occurred at that location. Ten species recorded during the first Birds Australia survey have not been detected within the study area by any other method. Table 4 presents a list of these species and an assessment of whether the bird is actually likely to occur within the park. The bird list for the study area is artificially elevated by the inclusion of the first two species in Table 4, and thus they have not been included in the species totals presented in this report. The last eight species listed in the table have the potential to utilise habitats present within the park proper, and therefore have been included in the species totals.

Species common name	Date last recorded	Comment
Horsfield's Bushlark	1978	Known to prefer grasslands and croplands and is unlikely to inhabit the park proper.
Zebra Finch	1979	Probably only an occasional visitor to the region during times of drought. Unlikely to utilise habitats in the park proper.
Whistling Kite	1978	May utilise pasture near the park boundary or occasionally occur at Dunns Swamp.
Black-fronted Dotterel	1981	Known to utilise dams near the boundary of the park but otherwise only likely to occur at Dunns Swamp.
Black Swan	1978	Prefers large open wetlands and swamps. May occasionally occur at Dunns Swamp but unlikely to occur elsewhere in the park.
Yellow-billed Spoonbill	1978	May utilise dams and pasture near the park boundary or occasionally occur at Dunns Swamp. Unlikely to occur elsewhere within the park.
Straw-necked Ibis	1978	Would utilise dams and paddocks in cleared lands, but may roost in trees within the park boundary. Also may occur at Dunns Swamp.
Barking Owl	1979	Likely to occur within the park boundary in dry woodland habitats.
White-backed Swallow	1981	May occur along major watercourses and forage within the boundary of the park, particularly in summer during drought conditions.
Golden-headed Cisticola	1978	May utilise rank grasslands near the park boundary or the edges of Dunns Swamp. Unlikely to occur elsewhere within the park.

Table 4: Native diurnal bird species recorded only during the first Birds Australia survey

The Spectacled Monarch has been recorded on a single occasion, thought to be heard calling on Army Road south of Box Hole Clearing in 1997. However, the bird was not sighted and since the call resembles that of rosellas (Pizzey & Knight 1999), it is possible that it was mis-identified. The Spectacled Monarch is typically located in coastal rainforests and thickly vegetated gullies, rather than the exposed sandstone habitat where it was recorded. It is most common in northern Queensland

(Barrett *et al.* 2003), but individuals have been seen as far south as Port Stephens ((Pizzey & Knight 1999). The occurrence of Spectacled Monarch in the park is possible, but considered unlikely, and would require further for confirmation.

A single report of a Green Catbird exists on the Atlas of NSW Wildlife, from Coorongooba Creek west of Cyrils Rocks, in 1986. This location is quite far west for this species, which usually occurs in more coastal rainforests and timbered watercourses (Pizzey & Knight 1999). Though there is a possibility that the species occurs in the park it is considered unlikely, and therefore has not been included in the species' totals in this report.

The close examination of diurnal bird records in the Atlas of NSW Wildlife undertaken for this report has led to a revision of the number of species known to occur within north-western Wollemi NP. With the removal of spatially inaccurate records and possible mis-identifications (see Appendix C), 188 species are now known to occur.

3.5 NOCTURNAL BIRDS

The DEC surveys confirmed the presence of eight species of nocturnal bird through a range of survey techniques including nocturnal call playback, site spotlighting, and opportunistically. A ninth species, the Barking Owl, was recorded by Birds Australia in 1979 in the vicinity of the Widden Valley. The Barking Owl, together with the Powerful, Sooty and Masked Owls, is listed as Vulnerable under the NSW TSC Act (1995).

3.5.1 Systematic survey findings and discussion of species occurrence

Eighty-five nocturnal call playback surveys for the threatened owls have been undertaken in the study area. Response rates were low, with the Powerful Owl responding to 10 censuses (12 %), the Sooty Owl to three (4 %) and the Masked Owl to one (1 %). These results differ from those obtained in north-eastern Wollemi, where the Powerful Owl was less frequently detected (responding to 5% of playback censuses) and the Barking Owl more frequently (responding to 6% of playback censuses). The owl response rates obtained across northern Wollemi National Park were generally low in comparison to those obtained in the greater southern Sydney region, where Powerful Owl responded to 16 % of censuses, Sooty Owl to 9 %, Masked Owl to 3 % and Barking Owl to 0.8 % (DEC 2006a). Though the Barking Owl was not detected by CRA or BSP surveys it is considered highly likely to persist in the Goulburn River Valley escarpments and valleys, in similar dry woodland habitats as it was located in north-eastern Wollemi National Park in 2004 (DEC 2005a). The Barking Owl and other threatened owls will be discussed in more detail in Section 5 of this report.

The composition of vertebrate prey items located in the regurgitated pellets of the threatened large forest owls collected during 2005-06 conformed to the results of previous studies (e.g. Kavanagh 2002a). The Powerful Owl pellet analysed was composed entirely of arboreal mammals, namely Greater Glider (*Petauroides volans*), Common Ringtail Possum (*Pseudocheirus peregrinus*) and Sugar Glider (*Petaurus breviceps*). The Sooty Owl pellet analysed had a mix of native ground and arboreal mammals, including Brown Antechinus (*Antechinus stuartii*), Bush Rat (*Rattus fuscipes*) and Sugar Glider.

The remaining five nocturnal bird species are all common and widespread throughout reserves in the greater Blue Mountains and Hunter regions. The Southern Boobook (*Ninox boobook*) is the most widespread and frequently recorded of the nocturnal bird species in the study area, heard calling during 35 (42 %) of nocturnal call playback surveys and 65 (60 %) of site spotlighting surveys, as well as 37 times opportunistically. It has been detected within all of the major habitat types, including gullies, slopes and ridgetops on both Permian and Narrabeen Sandstone geologies. Such habitat diversity is typical of the species, which occurs across Australia from coastal rainforest to desert mulga (Pizzey & Knight 1999), and is perhaps attributable to its diverse and adaptable diet (McNabb 2002). Despite this, reporting rates of the Southern Boobook have apparently declined across the Sydney Basin Bioregion between 1981 and 2001 (Barrett *et al.* 2003), making its abundance in large reserves such as Wollemi National Park important. In contrast to the Boobook, the Barn Owl (*Tyto alba*) has only been recorded in two locations, each on the perimeter of the park in the Widden Valley. The Barn Owl is a nomadic species, its occurrence dictated by the distribution and density of rodents (M. Schulz pers. comm.). It may utilise other parts of the study area where rodents occur near the agriculture-forest margin, such as the Glen Alice, Lee Creek or Bylong River Valleys. The Barn Owl is however unlikely to occur within denser forested areas, as it depends on open country, such as grassy woodlands or grasslands, for hunting its prey.

The call of the Australian Owlet-nightjar (*Aegotheles cristatus*) was heard during 26 nocturnal call playback surveys, 30 site spotlighting censuses and eleven diurnal bird surveys, as well as opportunistically on 22 occasions. Though very vocal, and thus easily detected by its call, this bird is

hard to spot and has only been seen four times during the DEC surveys. The Australian Owlet-nightjar records are widely distributed throughout the study area, but are most dense in the west, particularly the north-western gullies and slopes below the escarpment. The larger White-throated Nightjar (*Eurostopodus mystacalis*) is also widespread, but less frequently detected, having been seen or heard calling at a total of 25 locations during DEC surveys. These observations were made at a variety of points in the landscape, however the majority derive from ridgetops and upper slopes, or else from near the boundary between cleared and forested land. The White-throated Nightjar usually forages for insects at canopy height, particularly within larger gaps in the canopy (N. Williams pers. comm.). This tendency to utilise more open vegetation types may explain its pattern of distribution within the study area.

The Tawny Frogmouth (*Podargus strigoides*) was encountered in all areas of the park that were targeted for systematic survey, from the dry escarpments and gullies in the north to higher elevation forests on the Hunter Main Trail and Gospers Mountain. This result is to be expected, as this distinctive bird is common in forests and woodlands throughout the Sydney Basin, and indeed has been recorded in a wide range of habitats across the Australian continent (Pizzey & Knight 1999). It is capable of persisting in disturbed environments, and is often seen perched on fence posts and paddock trees in the agricultural landscape, and even within parks and gardens in the Sydney metropolitan area. Part of this adaptability may be attributable to its varied and opportunistic diet, which includes insects, frogs, rodents and other small ground-dwelling animals.

3.6 ARBOREAL MAMMALS

The DEC surveys undertaken between 1997 and 2006 confirmed the presence of nine species of arboreal mammal within north-western Wollemi National Park, of which four had not been recorded prior to the CRA surveys and an additional two were not known prior to BSP surveys (Appendix C). Some uncertainty exists about the occurrence of a tenth species, the Koala (*Phascolarctos cinereus*). A single scat identified to probably belong to a Koala was collected on lower Blackwater Creek in September 2005, but the identification was not confirmed. Given the existence of suitable habitat, and the fact that Koalas are known to still occur in similar environments in north-eastern Wollemi National Park (DEC 2005a), it is considered highly likely that the species occurs within the study area, though probably only at low abundance. The Koala, together with the Eastern Pygmy-possum (*Cercartetus nanus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*), is listed as Vulnerable under the NSW TSC Act (1995). These species will be discussed further in Section 5 of this report. The remaining six species are more common within particular habitats of the Sydney Basin, as discussed below.

Plate 12: Common Brushtail Possum © N. Williams/DEC

3.6.1 Systematic survey findings and discussion of species occurrence

One hundred and nine systematic site spotlight censuses were undertaken within the study area during CRA and BSP surveys. Based on the spotlight survey results, the most frequently encountered species of arboreal mammal is the Common Brushtail Possum (*Trichosurus vulpecula*, Plate 12), detected during 46 (42 % of) censuses. This large possum was also detected during 18 nocturnal call playback censuses, five hair tube lines and 56 times opportunistically. The Common Brushtail Possum is most abundant at lower elevations and has been recorded at twice as many locations on Permian sediments than Narrabeen Sandstone. It has not been recorded at more than 925 metres asl in the study area, and appears most abundant in the dry Box woodlands on the northern escarpment slopes and valleys. This result is consistent with the pattern observed in north-eastern Wollemi National Park in 2004-05 (DEC 2005a). Across NSW, the Common Brushtail Possum has been located more frequently in drier open forests and woodlands (Kavanagh 2004), particularly along watercourses. Furthermore, their distribution is not limited by the presence of large hollows, as they are known to utilise a range of den sites, from stags to fallen logs and rock crevices (Kerle 2001).

The Greater Glider is also widespread, its bright eye-shine detected during 44 (40 % of) site spotlight censuses, as well as nine nocturnal call playback surveys, 85 times opportunistically and remains in one Powerful Owl pellet, one Spotted-tailed Quoll scat and one Fox scat. The distribution of Greater

Glider records is markedly different from that of the Common Brushtail Possum, due to a difference in habitat preferences. Greater Gliders are known to prefer tall forests, particularly in higher elevation areas with flat topography and enriched soils (e.g. Kavanagh *et al.* in Kavanagh & Wheeler 2004, DEC 2006a). Within the study area, the species was found to be largely absent from the dry low elevation talus slopes in the north, with just four sightings made in the more sheltered gullies, often where Rough-barked Apple occurs. In contrast, the Greater Glider is the most frequently encountered arboreal mammal in higher elevation areas such as along the Hunter Main Trail (and around Mount Coricudgy and Kerry Mountain), the Army Road, particularly in the vicinity of Gospers Mountain, as well as west of Nullo Mountain and north and south of Dunns Swamp. The most important factors that contribute to habitat selection of the Greater Glider are thought to be the level of nutrients in eucalypt leaves and buds (their only food) and the availability of high hollows in large old trees (Kerle 2001). Peppermint forests contain high levels of nutrients in their leaves (Kerle 2001) and the occurrence of Peppermint eucalypt species on the Hunter Main Trail and Army Road is likely to account for the high abundance of Greater Glider there. Interestingly, this glider was also found to be quite common in the Glen Alice valley, in richer areas where tall Box, Rough-barked Apple and/or Mountain Grey Gum grow.

The Sugar Glider is more frequently detected by its distinctive yapping call than by its eye-shine or movement. Of the 28 spotlighting censuses during which this species was recorded (26 % of sites), three times were by visual observation and 25 times were by hearing the call. In addition, this small mammal was detected during 19 (23 % of) nocturnal call playback censuses, 37 times opportunistically as well as remains in one regurgitated Powerful Owl pellet and one Sooty Owl pellet. The Sugar Glider uses a variety of habitats, but requires suitable trees with hollows for nesting and sufficient foraging material, particularly nectar and pollen, *Acacia* gum, the sap of certain eucalypts and invertebrates (Suckling 1995a). It has been detected within each of the major habitat types within the study area, including the dry alluvial gully and talus slope woodlands in the north and west, wet and dry sclerophyll forests on the sandstone gullies and plateaux and the montane forests around Mount Coricudgy and the Hunter Range. This species smaller body size, lower energy demands, and more diverse diet enable it to occupy many environments not inhabited by the closely related Squirrel Glider (Quin 1995). Within the study area the Squirrel Glider has only been recorded in the low elevation alluvial Box - Red Gum - Rough-barked Apple woodlands and forests in the north, as will be discussed further on Section 5.

Though the Yellow-bellied Glider was detected during just 21 spotlight censuses, it was seen or heard calling 63 times opportunistically, as well as during 15 nocturnal call playback surveys. The habitat preferences of this species will be discussed further in Section 5, but it is widely distributed in gully lines and sheltered slopes throughout the study area, as well as on some ridgelines and deep sandy plateaux, particularly where Grey Gum and/or other tall smooth-barked eucalypts occur.

The remaining arboreal mammals have each been recorded on many fewer occasions than the above species. The Common Ringtail Possum prefers habitats with a well developed mid-stratum or shrub layer, in which to forage, shelter and build its spherical nests (dreys) (Davey in Kerle 2004). The species also sometimes build nests in tree hollows and rock overhangs (M. Schulz pers. comm.). In the north of the study area the Common Ringtail Possum has only been located in sheltered situations, such as on Cedar, Cousins, Table Bay and Blackwater Creeks. In the higher rainfall areas it has been located in a wider variety of situations, such as on Mount Coricudgy, Mount Monundilla and the Hunter Range, though the majority of records are still on sheltered slopes and gullies, where a dense sub-canopy layer exists.

The Feathertail Glider (*Acrobates pygmaeus*) is cryptic and was not known to occur within the study area until the BSP surveys. During these surveys it was detected at eight locations, including seven times during spotlight censuses and once a during nocturnal call playback survey. On at least four of these occasions this small agile marsupial was discovered amongst the blossom of flowering trees, including Grey Gum, Grey Box and Rough-barked Apple. The Feathertails' diet consists primarily of nectar, insect honeydew and arthropods (Goldingay & Kavanagh 1995). Therefore careful slow scanning of flowering feed tree species is an effective way to detect this animal, particularly when it is stationary whilst licking nectar from blossoms. The small number of observations of Feathertail Gliders in the study area is not sufficient to ascertain patterns of habitat use, but the species is likely to be much more abundant and widespread than records indicate. The slightly larger Eastern Pygmy-possum is also very elusive, and again was not known from the study area prior to the 2005-06 DEC surveys. As will be discussed in Section 5, this predominantly nectar-feeding possum was only detected by hair and remains, including bone fragments located in a Fox scat (see also Section 3.10.2 on feral predator scat analyses).

The Mountain Brushtail Possum (*Trichosurus caninus*) has been detected at just eight locations in the study area, including four times by hair tube surveys on the Growee and Nullo Mountain Trails, three times opportunistically on Mount Coricudgy, Mount Monundilla and the Hunter Range and probably once during a spotlight census on a tributary of Koondah Creek (this last individual was heard but could not be seen to completely confirm identification). The species was not located in lower elevation forests and woodlands in the north and west of the study area, consistent with results from similar habitats in north-eastern Wollemi National Park (DEC 2005a). This result is to be expected, as the Mountain Brushtail Possum is known to prefer tall forests at higher elevation (Kerle 2001). Within the study area, this species was not located below 500 metres asl and most frequently above 600 metres asl.

3.7 NATIVE GROUND MAMMALS

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

The DEC surveys between 1997 and 2006 confirmed the presence of fifteen species of native ground mammal, of which two were recorded for the first time during CRA surveys and four for the first time during BSP surveys. Burrows and scats of a sixteenth species of native ground mammal, the Swamp Rat (*Rattus lutreolus*), have been identified by bushwalkers in several diatremes south of the Hunter Range (Macqueen 2005). A seventeenth species, the Platypus (*Ornithorhynchus anatinus*) is known to occur at Dunns Swamp (C. Pavich pers. comm.). Two of the native ground mammal species, the Spotted-tailed Quoll and Brush-tailed Rock-wallaby are listed as threatened under both state and federal legislation. The confirmation of the persistence of both of these species within the study area in 2006 is exciting, as they have both suffered recent and drastic population declines across the state. The preservation of habitat for these species within north-western Wollemi National Park, together with neighbouring reserved lands, has high conservation significance, as will be discussed further in Section 5 of this report.

3.7.1 Systematic survey findings and discussion of species occurrence

Wombat

By far the most commonly recorded ground mammal within the study area is the Common Wombat (*Vombatus ursinus*), detected over 230 times by direct observation, burrow entrances, and its distinctive, often prominently placed, scats. This distinctive animal was also the most commonly recorded ground mammal during recent surveys of north-eastern Wollemi (DEC 2005a) and northern Yengo (DEC 2005c) National Parks, Manobalai Nature Reserve (DEC 2005b) and across the southern Blue Mountains reserves (DEC 2004b, 2004c, 2004d). The abundance of records can largely be attributed to the readily-recognisable scats, however, and does not necessarily indicate true greater abundance than some macropod species, for example. The varied diet of the Common Wombat (including a mix of grasses, sedges, rushes, and roots of shrubs and trees (McIlroy 1995)), together with its adaptability, enables it to utilise a wide variety of habitat types. Evidence of the species has been recorded in all areas of the park subject to systematic survey, in the full range of elevation, rainfall, and vegetation classes, from exposed dry sclerophyll woodland and heath to sheltered gully rainforest. Though the wombat forages and travels through all of these habitats, it would only breed in habitats with a soil type that enables burrow construction. Sadly, a number of individuals observed in 2005-06 had mange, a debilitating disease caused by mites that alters animal behaviour and eventually leads to death. This disease appeared most prevalent at the boundary between the park and cleared lands. However, further research would be required to confirm such a boundary effect and ascertain the affect of the disease on local populations.

Macropods

In addition to the Brush-tailed Rock-wallaby, four species of macropod have been recorded within the study area, a suite of species shared with north-eastern Wollemi and Yengo National Parks (DEC 2005a, c). As in these areas, the most commonly recorded macropod is the Swamp Wallaby (*Wallabia bicolor*, otherwise known as Black Wallaby, Plate 13), detected at over 170 widely distributed locations. This species is a browser that feeds on a wide variety of forbs, ferns, shrubs,

grasses, fungi and vines (Hollis *et al.* 1986), and is thus not limited to grassy habitats like many other macropod species. The species typically occurs in habitats with at least moderately dense undergrowth, which in the study area includes most gully lines and sheltered slopes, as well as shrubby dry sclerophyll forests. A large number of the Swamp Wallaby records derive from remains found in Wild Dog/Dingo scats (see Section 3.10.2). The Red-necked Wallaby (*Macropus rufogriseus*) prefers to feed on grasses and herbs, and has been found in other areas to shelter in dense vegetation during the day and emerge to feed in grassy areas at night. This medium-sized wallaby has been recorded at over 70 locations in the study area, again in a wide variety of habitat types but most frequently in the vicinity of grassy areas. Interestingly, the species was not recorded on the sandstone geologies along the Hunter Range, but was frequently seen on or near the basalt soils of Mount Coricudgy and Kerry Mountain, where more grassy habitats predominate.

Plate 13: Swamp Wallaby © N. Williams/DEC

Less commonly recorded macropods in the park are the Common Wallaroo (*Macropus robustus*, recorded at 50 locations) and the Eastern Grey Kangaroo (*Macropus giganteus*, recorded at 25 locations). The distribution of records of the Common Wallaroo indicate a clear preference for the low rainfall, low elevation sections of the park, particularly the Lee Creek, Bylong River, Myrtle Creek, Widden Brook and Glen Alice Valleys. A similar pattern was observed in north-eastern Wollemi National Park (DEC 2005a) and is to be expected given that this large robust mammal is well adapted to drier environments. The Common Wallaroo is likely to be more abundant than records suggest, frequently going undetected due to its shy nature not readily identifiable scats. Steep escarpments and rocky hills are a constant feature of this species preferred habitat (Poole 1995); and such features in the form of talus slopes, rocky escarpments and sandstone outcrops and overhangs abound in the north and west of the study area. Records of the Eastern Grey Kangaroo are concentrated around the perimeters of the park, mostly adjacent to cleared agricultural lands. This species has a clear preference for open grassy habitats for foraging that are adjacent to woodlands for shelter.

Monotremes

Only one species of monotreme was recorded during the BSP and CRA surveys, the Short-beaked Echidna (*Tachyglossus aculeatus*, Plate 14). This unmistakable egg-laying mammal predominantly eats termites and ants and is found in almost all terrestrial environments across Australia (Menkhorst & Knight 2001). Recent DEC surveys have indicated it to be widespread across the sandstone reserves of the upper Hunter and southern Blue Mountains. Though the Echidna has been directly observed on just two occasions, traces of the animal have been located at over 70 locations throughout the park, in the form of scats or of characteristic diggings in the side of ants nests or termite mounds.

Plate 14: Short-beaked Echidna © N. Williams/DEC

Australia's second species of monotreme, the Platypus (*Ornithorhynchus anatinus*), has been observed on a number of occasions at Dunns Swamp (C. Pavich pers. comm.). In addition, an individual was seen on the Capertee River two and a half kilometres west of the study area boundary during DEC surveys in November 2005, swimming and floating on the surface of a large pool in the river. This species would also occur elsewhere on the Capertee River, as well as potentially in some of the other permanent watercourses in the park, such as Blackwater and Wollemi Creeks or the Cudgegong River.

Small ground mammals

Small ground mammals were surveyed using Elliott traps and hair tubes, which were set at 23 and 17 sites respectively. Four species of small native ground mammal were detected by these methods, being the Bush Rat, Brown Antechinus, Yellow-footed Antechinus (*Antechinus flavipes*) and Dusky Antechinus (*A. swainsonii*), listed in order of the number of times detected using these methods. Three further species have been detected using other methods: the Common Dunnart (*Sminthopsis*

murina, seen during a herpetofauna search and once in a Fox scat), Water-rat (*Hydromys chrysogaster*, seen four times opportunistically) and Swamp Rat (identified by bush walkers).

Plate 15: Bush Rat after capture in an Elliott trap © N. Williams/DEC

The Bush Rat and Brown Antechinus are both common and widely distributed throughout the park. The Bush Rat (Plate 15) was captured at 16 (70 % of) Elliott trap sites and 17 % of hair tube sites, while the Brown Antechinus was detected at nine Elliott sites (39 %) and 26 % hair tube sites respectively. Both species have been recorded most frequently in the wet and dry sclerophyll forests on the sandstone plateaux, where they would both be very common and abundant in appropriate habitats. The Yellow-footed Antechinus is less widespread, detected by DEC at just one Elliott trap site and one hair tube site. Prior to the DEC surveys the species had recorded at four locations. The records of Yellow-footed Antechinus are all in the northern half of the park, yet in a range of habitat types from woodland along a small tributary of Widden Brook to montane rainforest on the eastern side of Mount Coricudgy. The Dusky Antechinus has been recorded twice, detected once by a hair collected in a hair tube near the headwaters of Blackwater Creek, and once from remains in a Wild Dog scat found on the Kerrabee Trail. The Common Dunnart also appears to be only sparsely distributed, with one found under a log on the northern slope of Tayan Peak and one found in forest in the Wollemi Creek catchment. This latter species is known elsewhere to inhabit a wide range of woodlands and open forests, but is notoriously difficult to trap with Elliott traps or hair tubes. It thus may be more widespread in the park than records currently indicate. The Water-rat on the other hand has quite specific habitat requirements, occurring in permanent fresh or brackish water, particularly near swampy areas (Olsen 1995). The species appears quite abundant on the Cudgegong River near Dunns Swamp, where individuals as well as traces of activity (in the form of Crayfish shells left in overhangs and on rocks in the centre of the river) have been found. The Water-rat also occurs on Ovens Creek in the south-eastern quarter of the study area, and is likely to inhabit other permanent creeks in this area, including Wollemi Creek and the Capertee River.

The distribution of Long-nosed Bandicoot (*Perameles nasuta*) in the study area remains poorly understood, as survey techniques were not undertaken to specifically target this medium-sized nocturnal marsupial. Individuals have only been observed directly on three occasions. Bandicoots leave behind distinctive conical-shaped diggings, created as they dig for invertebrate prey (Triggs 1996). Such foraging traces have been recorded at a further 17 locations. However, the species of Bandicoot cannot be confidently determined from diggings alone, as they could have been made by either the Long-nosed Bandicoot, Northern Brown Bandicoot (*Isoodon macrourus*), or even the Long-nosed Potoroo (*Potorous tridactylus*). As the Long-nosed Bandicoot is more common in the study area it can be expected to have made many of the observed conical-shaped diggings. The locations of the diggings and the Long-nosed Bandicoot sightings are all south of the Hunter Range, and with the exception of those in the Glen Alice Valley, generally occur in the higher rainfall areas of the park. This is to be expected, as the Long-nosed Bandicoot is primarily a coastal species, and may not tolerate the dry conditions prevalent along the northern escarpment. Recent surveys in southern Sydney have also found this species to prefer high rainfall areas (DEC 2006a). This distribution of the Long-nosed Bandicoot in northern Wollemi requires further study, however, as it is known to occur within low rainfall habitats in north-eastern Wollemi National Park (DEC 2005a). As discussed below, further survey would also be required to confirm whether the Northern Brown Bandicoot and/or Long-nosed Potoroo exist within the study area.

Dingoes

There is no direct evidence regarding the extent to which Dogs within the study area have Dingo heritage. Currently, all of the Wild Dogs recorded have been entered into the Atlas of NSW Wildlife under the name 'Dingo/Wild Dog' (*Canis lupus*) as it is not possible to ascertain the ancestry of individuals without DNA testing. However, all of the individuals that were directly observed during the 2005-06 surveys exhibited marked domestic Dog morphological characteristics and are probably at least partially derived from farm Dogs. These Dogs were all observed within fifteen kilometres of each other along the Army Road. The Army Road may provide a conduit for the spread of domestic Dog varieties into more remote sections of the park. Recent research undertaken within Yengo National Park has indicated that Dogs in the core of the park have a very high degree of Dingo heritage, exhibited in their DNA, appearance and behaviour (T. Horwood pers. comm.). It is unknown whether a similar pattern occurs in Wollemi National Park, but it is possible that Dingoes persist in remote

sections of the park, far from roads and farmlands. The Dingo has been listed as regionally significant in the Brigalow Belt South, Nandewar and Upper and Lower North-east New South Wales (Andren 2004), and a species of conservation concern in the greater southern Sydney region (DEC 2006a). It is recommended that the research program being undertaken in Yengo National Park be expanded to cover northern Wollemi National Park also. Such research should aim to: ascertain patterns in the heritage of Dogs/Dingoes across the region; identify key areas of Dingo purity and Wild Dog invasion; provide an understanding of the dynamics of social, territorial and foraging behaviour; provide an understanding of the interaction between Dingo/Dog packs and other predators; and hence provide the basis for informed management strategies. At the very least, genetic material should be collected from any dead Dogs, and sent for analysis to determine the animal's heritage. Ideally, such research should be undertaken before broad-scale Wild Dog control programs are implemented or continued, particularly in more remote areas.

3.7.2 Other species that have the potential to occur in the study area

In addition to the above, a further four species of native ground mammal have been recorded within a five kilometre radius of the study area, yet not within it (Appendix D). It is likely that the New Holland Mouse (*Pseudomys novaehollandiae*) does occur in the study area, as it was found to be relatively widespread in the adjacent north-eastern section of Wollemi National Park (DEC 2005a) as well as in Goulburn River National Park (NPWS 2001b). The New Holland Mouse reaches the western limit of its distribution in central NSW in this region, so the discovery of the species in the study area would be interesting. Northern Brown Bandicoot also has the potential to occur, as it was detected from a Sooty Owl roost in Wollemi Creek, just 3.5 km to the east of the study area. The Parma Wallaby (*Macropus parma*) has been recorded in northern Yengo National Park. However, it is considered unlikely to inhabit the study area as habitat is marginal and there is considerable uncertainty about the reliability of the records in the local area.

There is uncertainty about the occurrence of the Long-nosed Potoroo in the study area. This species is listed as Vulnerable under the NSW TSC Act (1995). CRA hairtube surveys undertaken west of Nullo Mountain in 1997 captured a hair that was later identified to 'probably' belong to a species of Potoroo (*Potorous* sp.). Furthermore, in 1998 skeletal remains of at least four Long-nosed Potoroo were identified from a Sooty Owl roost in Wollemi Creek, approximately 3.5 km east of the study area. The species was also apparently collected by the CSIRO in the Myrtle Creek Valley in 1970. However, there is serious doubt regarding the reliability of this latter record, as the location notes describe the Illawarra, and it is highly likely that it has been erroneously entered into the Atlas of NSW Wildlife. The Long-nosed Potoroo is primarily a coastal species in south-eastern Australia, occurring in heathy woodland or rainforest and wet sclerophyll forests with dense ground cover interspersed with more open areas for foraging (Menkhorst & Knight 2001). Based on the proximity of confirmed records, and the presence of potential habitat, it is considered possible that Long-nosed Potoroo does also occur in the study area. Habitat exists in the higher altitude areas and in some of the more sheltered gully systems. Further survey is required to confirm this species is occurrence, and methodology for this is recommended in Section 4.6. Due to the current level of uncertainty, a profile has not been generated for the species in Section 5 of this report.

A number of possible sightings of the Eastern Quoll (*Dasyurus viverrinus*) have been reported from the Nullo Mountain area (C. Pavich pers. comm.). This species was once widely distributed throughout south-eastern Australia (probably including the study area), but is now considered to be extinct on the mainland (NPWS 1999h). Confirmation that the species is still extant in NSW would be extremely significant. Currently the Eastern Quoll is only known to occur in Tasmania. Further investigations of the sightings are therefore warranted, and a suggested methodology is outlined in Section 4.6 below. Confirmation of the species occurrence would trigger the immediate launching of a research programme to assess the status of the population, identify any threats, and determine the appropriate recovery actions, in line with recommended priority actions for the species (DEC 2005o).

3.7.3 Review of species records

The Southern Brown Bandicoot (*Isoodon obesulus*) has been reported to occur between Wheelbarrow Gap and Wilsons Clearing (Goldney & Cardale 1993). However north-western Wollemi National Park is well outside the known range of this endangered species and this report is considered to be a mis-identification.

3.8 BATS

The Microchiroptera, or microbats, are a sub-order of bats that are generally small, feed almost exclusively on insects and navigate using echolocation (Churchill 1998). The DEC surveys undertaken between 1997 and 2006 confirmed the presence of 20 species of microbat, including both

tree and cave-roosting species. Only five of these species were known to occur prior to systematic surveys. Eight of the microbat species now known to occur in north-western Wollemi National Park are listed as Vulnerable, namely the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), East-coast Freetail-bat (*Mormopterus norfolkensis*), Large-eared Pied Bat (*Chalinolobus dwyeri*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*, Plate 16), Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), Greater Long-eared Bat (*Nyctophilus timoriensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Eastern Cave Bat (*Vespadelus troughtoni*). In addition, one species of Megachiroptera (commonly known as fruit bats) has been recorded within the park, the Grey-headed Flying-fox (*Pteropus poliocephalus*). This species is also listed as Vulnerable under both state and federal legislation, and brings the total number of bats now known to occur in the study area to 21. The threatened species will be discussed in greater detail in Section 5, but where relevant are also referred to below.

3.8.1 Systematic survey findings

A total of 112 harp trapping sites were surveyed between 1997 and 2006, resulting in the capture of sixteen species of microbat. In terms of frequency of capture, the Little Forest Bat (*Vespadelus vulturnus*) is the most common species, captured in 81 (72 % of) traps. Next most frequently captured were the Chocolate Wattled Bat (*Chalinolobus morio*, 47 % of traps), Large Forest Bat (*Vespadelus darlingtoni*, 45 %) and Gould's Long-eared Bat (*Nyctophilus gouldi*, 43 %). This is a slightly different result than was achieved in north-eastern Wollemi National Park, where the Large Forest Bat was captured far less frequently. The Gould's Wattled Bat (*Chalinolobus gouldii*, 23 %) and Large-eared Pied Bat (also 23 %) were also frequently captured.

In addition to the harp traps, ultrasound calls were recorded and analysed from 61 survey sites. The Anabat censuses resulted in the detection of a different set of 18 species. The same three species were most commonly detected by this method as by capture in harp traps, namely Large Forest Bat (54 % of Anabat sites), Chocolate Wattled Bat (52 %) and Little Forest Bat (51 %). However, the Eastern Bentwing-bat was much more frequently detected by Anabat than harp trap (28 % Anabat sites as opposed to only three per cent of harp trap sites). Gould's Wattled Bat and Large-eared Pied Bat were also frequently detected by Anabat (30 % and 25 % of sites respectively). The difference in species' detection rates between the harp traps and Anabats largely results from differences in bat behaviour and foraging habits, combined with the type of call the bats emit. The Long-eared Bats (*Nyctophilus* spp.) have only been detected by harp trapping, as the species of this genus cannot be reliably distinguished by their ultrasonic call using standard parameters (Pennay *et al.* 2004). These bats can orientate and forage without using echolocation (Churchill 1998). When Long-eared Bats do emit calls these consist of a relatively weak pulse that travels only a short distance (N. Williams pers. com.). For these reasons, short indistinct call sequences are often all that is recorded by ultrasound recording devices. In contrast, species that forage in open areas or above the tree canopy, including the Yellow-bellied Sheathtail-bat, Eastern Bentwing-bat and the Freetail-bats (*Mormopterus* spp.) are much more frequently detected by Anabat and comparatively rarely captured in harp traps. These results highlight the need to apply a diversity of survey methods to adequately sample the bat community in any given area.

Plate 16: Eastern False Pipistrelle © N. Williams/DEC

3.8.2 Discussion of species occurrence

The study area supports a diversity of microbat species, with the number of species recorded the same as that of north-eastern Wollemi National Park, and greater than that recorded across the entire greater southern Sydney region (19 species, DEC 2006a). The rich mix of bat species is attributable to the large range of microhabitats, environments and landscape features present within the park.

Tree-roosting microbats

Several species, including some of the most commonly recorded such as Little Forest Bat, Chocolate Wattled Bat and Gould's Long-eared Bat, are habitat generalists, occurring in a wide range of environments from the dry woodlands on the northern creeklines and talus slopes, across the sandstone plateaux and to the high elevation basalt peaks. These are all tree-roosting species that

are generally more tolerant of fluctuations in temperature and humidity at roosting sites and therefore occupy a broad range of habitats (Churchill 1998). However, some tree-roosting species are more specialised. For example the Large Forest Bat, though common, has not been recorded below 500 metres asl in the study area, and is most frequently detected above 600 metres. A similar finding has been made for this species in the southern Blue Mountains (DEC 2004b), providing further evidence to the theory that the species is best adapted to cooler higher rainfall climates (Churchill 1998).

The distribution of the tree-roosting Freetail-bats correlates with regional influences on the study area and the distribution of preferred microhabitats. The East-coast Freetail-bat and Eastern Freetail-bat (*Mormopterus* sp. 2) are both typically eastern Australia animals, occurring along and to the east of the Great Dividing Range (Churchill 1998). Correspondingly, both species have been recorded most frequently on the sandstone plateaux, and are absent from the dry northern perimeter. In contrast, the Southern Freetail-bat (*Mormopterus* sp. 4 (long penis form)) is more common in western NSW, typically inhabiting dry or semi-arid areas inland of the Great Dividing Range (Churchill 1998). This species has only been detected near the western boundary of the study area, including within the drier environments of the Lee Creek Valley. Interestingly, however, all three species were detected by Anabats placed on the Capertee River and facing over a farm dam bordering the park in the Glen Alice Valley. It is unusual to record these three species together, and once again demonstrates the confluence of environments contained within north-western Wollemi NP. Permanent water was present at both of these locations and it is likely that the bats were coming in to drink or forage, the water attracting species that would normally roost in quite different environments from each other. Similarly both inland and coastal species of Broad-nosed Bat are found within the study area: the Eastern Broad-nosed Bat (*Scotorepens orion*) and the Inland Broad-nosed Bat (*Scotorepens balstoni*). The Eastern Broad-nosed Bat is more widespread, detected nine times by ultrasonic call and once in a harp trap, most frequently in the southern half of the study area, but also in the north-west. The Inland Broad-nosed Bat was detected three times by harp trap and twice by Anabat, but only along the western boundary of the study area.

The White-striped Freetail-bat (*Tadarida australis*) is one of only two species of bat in central NSW that emit navigation calls that are audible to humans (the second being the Yellow-bellied Sheathtail-bat). This enables the bat to be detected on an opportunistic basis during a range of night time survey techniques including site spotlighting and nocturnal call playback, as well as by the Anabat detector. The White-striped Freetail-bat is a fast-flying species that is adapted to foraging in open areas or above the tree canopy, usually 50 metres or more above the ground (Churchill 1998). It is therefore rarely captured in harp traps, and was not detected by this method. Never-the-less, due to its strong and audible echo-location pulse, the White-striped Freetail-bat is one of the most frequently recorded bats in the study area, detected at almost 120 locations that encompass the full range of environments. In contrast, the Yellow-bellied Sheathtail-bat is uncommon, recorded on only one (see Section 5).

Cave-roosting microbats

Four obligate cave-roosting bat species have been recorded within the study area, supported by the abundance and complexity of sandstone caves and overhangs. These caves are generally fairly shallow, however, and provide few of the truly “dark” roost sites that are preferred by some species such as Eastern Bentwing-bat. Three of the cave-roosting species are widespread across the study area, namely the Large-eared Pied Bat (recorded at 40 locations), Eastern Bentwing-bat (30 locations) and Eastern Horseshoe-bat (*Rhinolophus megaphyllus*, 31 locations). The distribution of records of the former two species are mapped and discussed in Section 5. The Eastern Horseshoe-bat is widely distributed, recorded from Lee Creek and Widden Brook Valleys in the north, through ridges and gullies on the sandstone plateau, to Gospers Mountain in the south. Roosts of the species were encountered four times, once in a deep recess adjacent to Redbank Creek, and three times in sandstone overhangs near the headwaters of Koondah and Wirraba Creeks. The Eastern Horseshoe-bat is listed as regionally significant in the Brigalow Belt South Bioregion and of conservation significance in Nandewar (Andren 2004) as these are amongst the very few areas that the bat occurs on the western side of the Great Dividing Range. For the same reason, the occurrence of the Eastern Horseshoe-bat in western Wollemi and Goulburn River National Parks holds significance to the conservation of the species at the western edge of its range in central NSW.

The Eastern Cave Bat has been positively recorded on just four occasions, each in the northern half of the study area (see Map 17). As will be discussed in Section 5, these are amongst the most southerly records for the species, and together with records recently collected in north-eastern Wollemi, northern Yengo and Goulburn River National Parks, have greatly increased the understanding of the species in the Sydney Basin Bioregion. Two of the sightings of the Eastern Cave Bat were of roosting individuals, including in a sandstone overhang south of Blackwater Creek and in a deep crack in the ceiling of a large sandstone overhang south of Dunns Swamp. Neither of these roost sites showed

evidence of being a maternity colony. The species can be very difficult to distinguish using ultrasonic call, so its abundance and distribution may be underestimated in relation to bats that can be detected by this method.

3.8.3 Other species that have the potential to occur in the study area

Of the additional bat species recorded within a five kilometre radius of north-western Wollemi National Park, only the threatened Large-footed Myotis (*Myotis macropus*) is considered likely to also occur within the study area. This species has twice been recorded on the Capertee River, just west of the study area, and has the potential to also forage near permanent water along major drainage channels within the study area, such as elsewhere on the Capertee River, along Blackwater and Wollemi Creeks or along the Cudgegong River including at Dunns Swamp. This species is discussed further in Section 5.

A historic record of Little Red Flying-fox (*Pteropus scapulatus*) also occurs on the Capertee River, approximately six kilometres west of the study area boundary. Little Red Flying-foxes set up more temporary camps than those of other flying-fox species as they are reliant on flowering blossom that usually only lasts four to six weeks (Churchill 1998). It is possible that Little Red Flying-foxes utilise north-western Wollemi National Park on rare occasions, when eucalypts are in heavy flower or when food resources are limited elsewhere. However they have not been recorded within either the neighbouring north-eastern Wollemi or northern Yengo National Parks to date (DEC 2006b).

3.8.4 Review of species records

A single record of the Little Mastiff-bat (*Mormopterus planiceps*) exists within the Atlas of NSW Wildlife, identified from ultrasonic call during CRA surveys. The *Mormopterus* have undergone significant taxonomic revision since this time, with *M. planiceps* split into two species in NSW: Southern Freetail-bat (*M.* sp. 4 (long penis form)) and Inland Freetail-bat (*M.* sp. 3 (short penis form)). The identity of the *Mormopterus* detected during the CRA is not known, but since the Southern Freetail-bat has been recorded since, it is expected to belong to this taxon. It must be noted, however, that Inland Freetail-bat has recently been recorded in north-eastern Wollemi National Park (DEC 2005a), and therefore has the potential to also occur in the study area.

The Southern Forest Bat (*Vespadelus regulus*) was also recorded during the CRA surveys. However since only unclear ultrasound recordings were collected and a positive identification could not be achieved, these records are considered to be suspect. This bat has never been captured using harp traps in the study area, suggesting that much of the habitat in the reserve is not suitable for the species.

3.9 DISTRIBUTION OF THREATENED SPECIES

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

The distribution of threatened species records in relation to the largest Mitchell Landscapes present in north-western Wollemi National Park are presented in Table 5. For each species, the landscape containing the greatest proportion of the total number of records is highlighted in bold. The 'Wollemi Ranges' clearly hold the greatest proportion of threatened fauna records overall and is the most significant Landscape for at least seventeen threatened species. However, this Landscape is massive and covers a large proportion of the study area (see Table 1). In relation to the proportion of land encompassed therein, the 'Upper Goulburn Valleys and Escarpment' Landscape has a particularly high concentration of threatened fauna records. The 'Sydney Basin Western Escarpment' also holds a proportionately high number of records for many threatened species. In combination, these last two Landscapes hold the large majority of habitat for at least twelve threatened fauna species. As only a restricted amount of these Landscape types is conserved within the regions reserve system, these threatened species are arguably of the highest conservation priority.

The Landscapes extend both inside and outside of the national park boundary, approximately one kilometre in either direction but further into the park along major creeklines. They primarily encompass Box – Gum – Ironbark woodlands, with dominant canopy species including Grey Box, Slaty Box, Red Gum, Grey Gum, Rough-barked Apple and various Ironbarks.

Common name	Mitchell Landscape						
	Lees Pinch Foothills	Upper Goulburn Valleys and Escarpment	Wollemi Ranges	Sydney Basin Basalt Caps	Sydney Basin Diatremes	Sydney Basin Western Escarpment	Colo River Gorges
Giant Burrowing Frog	0	0	**89**	0	0	11	0
Red-crowned Toadlet	0	0	**100**	0	0	0	0
Stuttering Frog	0	0	**100**	0	0	0	0
Rosenberg's Goanna	0	0	**100**	0	0	0	0
Broad-headed Snake	0	0	**100**	0	0	0	0
Gang-gang Cockatoo	1	10	**72**	4	7	5	0
Glossy Black-cockatoo	4	18	**75**	0	2	1	0
Turquoise Parrot	0	**61**	19	0	0	7	9
Brown Treecreeper (eastern subspecies)	4	**51**	16	0	0	21	5
Speckled Warbler	3	**57**	24	1	0	9	1
Painted Honeyeater	0	**100**	0	0	0	0	0
Black-chinned Honeyeater (eastern subspecies)	2	**59**	14	0	0	20	3
Regent Honeyeater	0	**50**	**50**	0	0	0	0
Hooded Robin (south-eastern form)	0	**50**	10	0	0	40	0
Grey-crowned Babbler (eastern subspecies)	33	**67**	0	0	0	0	0
Diamond Firetail	0	**74**	0	0	0	26	0
Barking Owl	0	**50**	0	0	0	0	0
Powerful Owl	0	8	**92**	0	0	0	0
Masked Owl	0	**50**	**50**	0	0	0	0
Sooty Owl	0	0	**88**	0	13	0	0
Spotted-tailed Quoll	0	33	**67**	0	0	0	0
Eastern Pygmy-possum	0	0	**100**	0	0	0	0
Yellow-bellied Glider	0	27	**61**	0	4	4	1
Squirrel Glider	0	**83**	17	0	0	0	0
Brush-tailed Rock-wallaby	0	30	**60**	0	10	0	0
Grey-headed Flying-fox	0	0	**50**	0	0	0	0
Yellow-bellied Sheathtail-bat	0	**100**	0	0	0	0	0
East-coast Freetail-bat	0	0	0	0	0	11	11
Large-eared Pied Bat	4	18	**65**	0	2	11	2
Eastern False Pipistrelle	0	7	**77**	7	7	0	0
Eastern Bentwing-bat	0	32	**57**	2	2	2	2
Large-footed Myotis	0	0	0	0	0	0	**75**
Greater Long-eared Bat	**80**	20	0	0	0	0	0
Greater Broad-nosed Bat	0	0	**70**	0	0	0	10
Eastern Cave Bat	**62**	0	38	0	0	0	0
Total	**3**	**31**	**50**	**1**	**2**	**8**	**2**

Table 5: Percentage of threatened fauna records in each Mitchell Landscape (includes all DEC records located within and five kilometres surrounding north-western Wollemi National Park)

3.10 INTRODUCED SPECIES

3.10.1 Introduced mammals

The 2005-06 DEC surveys confirmed the presence of ten species of feral introduced mammal in north-western Wollemi National Park. This includes species that are well established and widespread (Fox and Wild Dog, Plate 17), species that are widespread but have mostly been recorded at the edge of the park or in disturbed areas (Rabbit (*Oryctolagus cuniculus*), House Mouse (*Mus musculus*) and Feral Pig (*Sus scrofa*)) and species that have only been reported on a few occasions (Feral Cat (*Felis catus*), Feral Goat (*Capra hircus*), Deer (*Cervus* sp.), Brown Hare (*Lepus capensis*) and Black Rat (*Rattus rattus*)). Three additional species (Cattle (*Bos taurus*), Sheep (*Ovis aries*) and Horse (*Equus caballus*)) were also recorded, however these are expected to be escaped farm animals (Cattle and Sheep) or animals being used for recreation (Horse scats recorded on Myrtle Trail and Army Road). The distribution of introduced carnivores and omnivores within the study area is presented in Map 6 and of herbivores in Map 7.

Plate 17: Wild Dog/Dingo near Gospers Mountain © H. Achurch/DEC

Two species of introduced carnivore are abundant within the study area (Map 6). The Wild Dog (or Dingo/Dog) has been directly observed on just four occasions but detected by its scats at over 100 locations, while the Fox has been directly observed on six occasions and identified from its scats at over 60 locations (Map 6). It is difficult to ascertain from these records the preferred habitats of Wild Dogs or Foxes within the study area, as the scats were mostly collected from roads and trails where they are easily visible. However both species have been recorded in all major environments, ranging from the dry northern and western gullies and talus slopes to the high altitude forests on the Hunter Range. Of the areas surveyed, Wild Dogs appeared to reach their greatest density along the Army Road, where 24 scats were collected along a five kilometre stretch. The Army Road may provide a conduit for the invasion of domestic Dog varieties into more remote sections of the park. Wild Dogs/Dingoes are known to occur within these more remote sections, as many scats were collected near helicopter drop-off points in the south-eastern section of the park, and evidence of activity has been collected by bushwalkers (Macqueen 2005). A third species of introduced carnivore, the Feral Cat, is less frequently detected, recorded by its footprints at four locations and scats at a fifth. Two of these records are deep within the park, while the other three are located fairly close to its boundary. The Feral Cat is a very elusive animal and because scats are typically buried and difficult to locate, it is much less frequently detected by scat location than are Foxes or Wild Dogs/Dingoes. It is therefore unclear whether the low number of Feral Cat sightings actually reflects low density, or is simply because the animal has largely gone undetected.

The most frequently recorded introduced herbivore is the Rabbit, observed on 23 occasions, detected by its scats at 24 locations and from remains in predator scats at a further five sites. The majority of these records were collected near the perimeter of the study area (Map 7), with almost half of the records being located within the 'Upper Goulburn Valleys and Escarpment' and the 'Sydney Basin Western Escarpment' Mitchell Landscapes. Here Rabbits abound within the more fertile grassy areas and are highly visible along roads and trails and at the edges of bushland. Due to the high number of threatened species that occur in these Mitchell Landscapes, the Rabbit may be having a disproportionately large impact in these environments. The species has also been recorded up to six kilometres inside of the park boundary, but usually near areas that have suffered some disturbance in the past such as diatremes near Gospers Mountain and Tayan Peak. The exception to this is its occurrence along Blackwater Creek and in the sandy country north of the Cudgegong River. Never-the-less, the impact of Rabbits is expected to be limited in extent. Even more limited is the impact of Brown Hare, recorded at just two locations including Dunns Swamp and the Widden Valley.

The distribution of Feral Pigs in the study area appears to be quite limited. These animals leave distinctive traces from foraging and wallowing behaviour, as well as easily recognisable scats, and are therefore easy to detect when present. However, the animals have only been recorded in the western half of the study area, namely neighbouring the 'Hillview' property south of Bylong, north of Nullo Mountain, on Towinhingy Creek (Map 6) and in the vicinity if the Glen Alice Trail (Washington & Mullins Imrie 1998). The pest may also occur in other areas that have high fertility soil, grassy ground cover or are at high elevation (DEC 2006a), such as near Mounts Coricudgy and Coriaday. However, no evidence of Feral Pig has been recorded in the dry northern valleys or talus slopes, nor on the sandstone plateaux, and it is unlikely to be a problem in these areas.

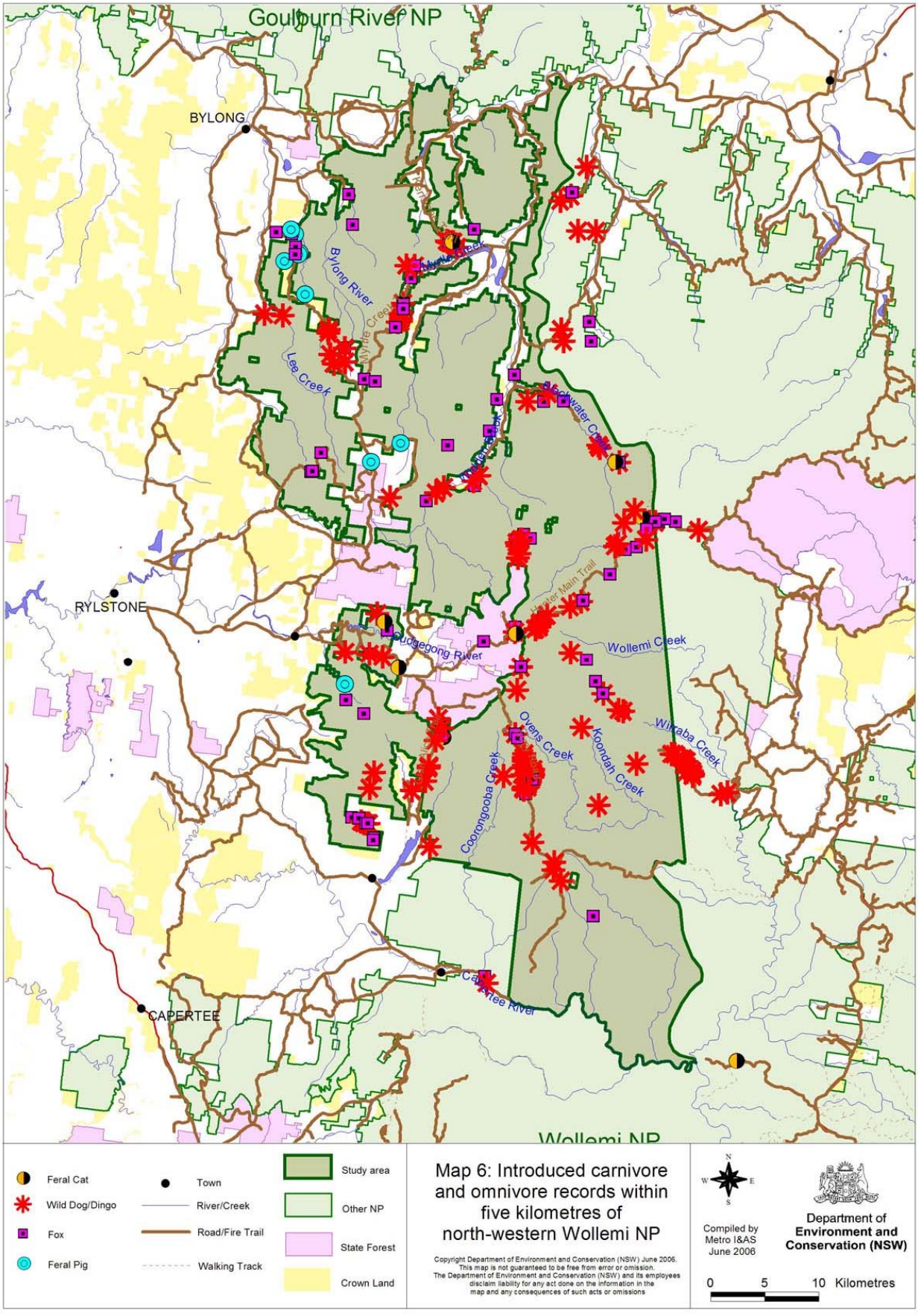
The distribution of introduced rodents (House Mouse and Black Rat) is largely restricted to the perimeter of the park, or areas that have previously been inhabited such as the Livery Stable and Geebung Ground. Feral Goats pose a much greater threat. To date they have mostly been recorded near the park perimeter, but also once on the Bylong River (at a site where Brush-tailed Rock-wallaby scats were also located), once in Cedar Creek gorge and once in the vicinity of the Glen Alice Trail by Washington & Mullins Imrie (1998)). Feral Goats have the capacity to further invade bushland, particularly the dry rocky and hilly lands along the northern and western slopes and escarpments. The distribution of Feral Deer is not well understood and warrants further investigation. During the 2005-06 surveys Deer scats and footprints were observed at one location just north of the old Deer farm at 'Box Ridges'. It is unknown whether this record represents a lone escaped or released animal, or a wild population. If the latter is the case then the species has the potential to spread and could pose a threat to native ecosystems through alteration of vegetation structure and competition. It is recommended that surveys be undertaken to ascertain the extent of Feral Deer in the park, and if a population is discovered that action be taken to prevent its spread.

Cattle have been recorded at eight locations within the national park, up to four kilometres inside the boundary. Though these are likely to be escaped or wandering farm animals, they may still be having an impact on the bush, particularly along major creeklines. 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 may have flow-on effects for the native fauna that rely on these creek-line habitats.

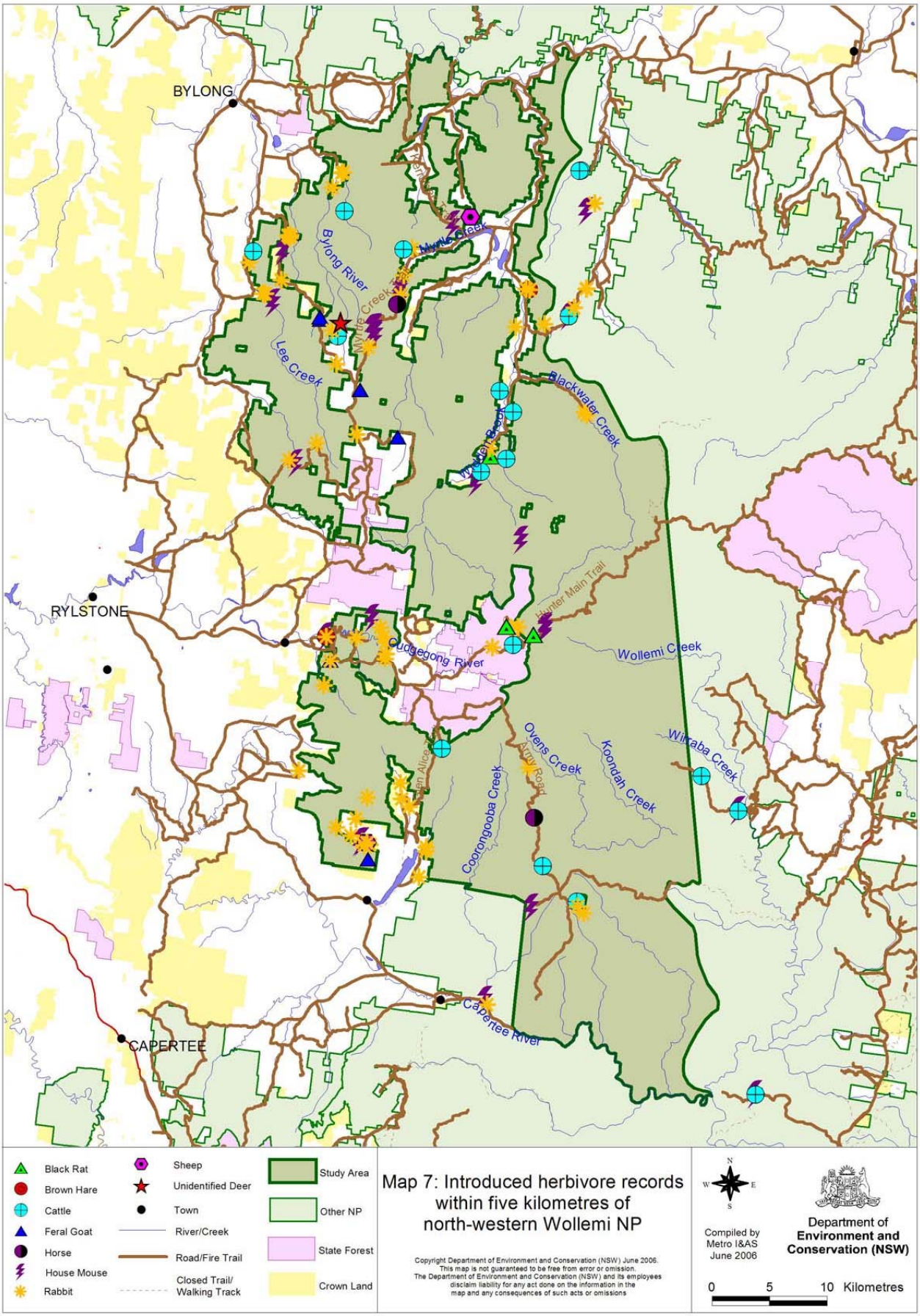
The introduced mammal species are likely to be having a significant negative impact on the native terrestrial flora and fauna of the study area. Six of the species are listed as a Key Threatening Process under the TSC Act (1995) and the EPBC Act (1999), as they are known to adversely affect threatened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

- Predation by the Fox is a major threat to the survival of native Australian fauna, with non-flying mammals weighing between 35 and 5500 grams and ground-nesting birds at greatest risk (NSW Scientific Committee 1998a). Species of particular concern are the Spotted-tailed Quoll and Brush-tailed Rock-wallaby. Fox predation has been implicated in limiting habitat choice and population size of a number of medium-sized marsupials (NSW Scientific Committee 1998a). The fact that Foxes prey upon native animals within the study area is evident from scat analysis, as summarised in Section 3.10.2 below.
- Feral Cats threaten native fauna by direct predation, being capable of killing vertebrates up to three kilograms (NSW Scientific Committee 2000a). Preference is shown for mammals weighing less that 220 grams and birds less than 200 grams, but reptiles, and amphibians are also eaten (NSW Scientific Committee 2000a). Current impacts on native fauna are likely to be most severe in modified, fragmented environments and in areas where the abundance of alternative prey (such as Rabbits and House Mice) fluctuates widely (NSW Scientific Committee 2000a).
- Feral Rabbits impact negatively on indigenous fauna species via competition for resources, alteration of the structure and composition of vegetation, ring-barking of trees and shrubs and digging of burrows, which in turn contribute to soil erosion (NSW Scientific Committee 2002a). They compete for food and/or shelter with some native fauna species, such as the Brush-tailed Rock-wallaby (NSW Scientific Committee 2002a), and are thought to have contributed to the extinction of several small mammal species (DEH 2004a). Feral Rabbits form the major component of the diet of Feral Cats and Foxes in many areas and can maintain populations of these predators at high levels. Sharp declines in Rabbit numbers (such as those caused by disease outbreaks) can cause these introduced predators to prey on indigenous fauna species to a greater extent than they would otherwise be able to (Smith and Quin 1996).
- Feral Goats have a major impact on native vegetation through soil damage and overgrazing and can cause significant habitat degradation by trampling, deposition of droppings, and the introduction of weeds (NSW Scientific Committee 2004a). They can compete with native animals for food, water and shelter (NSW Scientific Committee 2004a) and have particularly been implicated as a threat to the Endangered Brush-tailed Rock-wallaby through competition (NSW Scientific Committee 2003a) and to the Broad-headed Snake through habitat disturbance (Murphy1996). Feral Goats may also have an impact on roosting habitat of cave-dwelling bats such as the Vulnerable Large-eared Pied Bat.
- Feral Pigs compete for food resources with native fauna and actively predate upon native birds, reptiles, bird and reptile eggs, and frogs. They spread weeds and diseases such as root-rot fungus (*Phytophthora cinnamomi*) (DEH 2004b). Through their wallowing, rooting and foraging habits they are capable of significant habitat destruction including alteration of drainage patterns and soil structure (NSW Scientific Committee 2004b).
- Feral Deer impact on native fauna through environmental degradation caused by overgrazing, trampling, ring-barking, dispersal of weeds, acceleration of erosion, concentration of nutrients and degradation of water quality (NSW Scientific Committee 2004c). Feral Deer may compete with native herbivores for food, particularly in times of drought or after fire.

Clearly the potential for introduced predators and herbivores to significantly impact on native fauna in the study area is of concern. Comprehensive targeted survey of the species, assessment of their impacts and interrelationships with other predator and prey species, both native and introduced, followed by appropriate management actions, should remain a high priority for park management. Suggestions to help guide feral animal control are provided in Section 4.4 of this report.



Map 6: Introduced carnivore and omnivore records within five kilometres of north-western Wollemi National Park



Map 7: Introduced herbivore records within five kilometres of north-western Wollemi National Park

3.10.2 Predator scat analysis

The analysis of Wild Dog/Dingo and Fox scats yields interesting information about the mammal prey composition of the predators diet. Sixty Fox and 91 Wild Dog/Dingo scats were collected and analysed during the course of the DEC surveys, and the results are presented in Figure 2. Only general conclusions can be drawn from these results due to the fact that bulky prey items will be excreted in more than one scat and hence their frequency in scats is likely to be an over-representation of the number of individuals ingested. Furthermore, identification from hair and remains is more reliable for some species than others, resulting in over-representation of these species in the dataset.

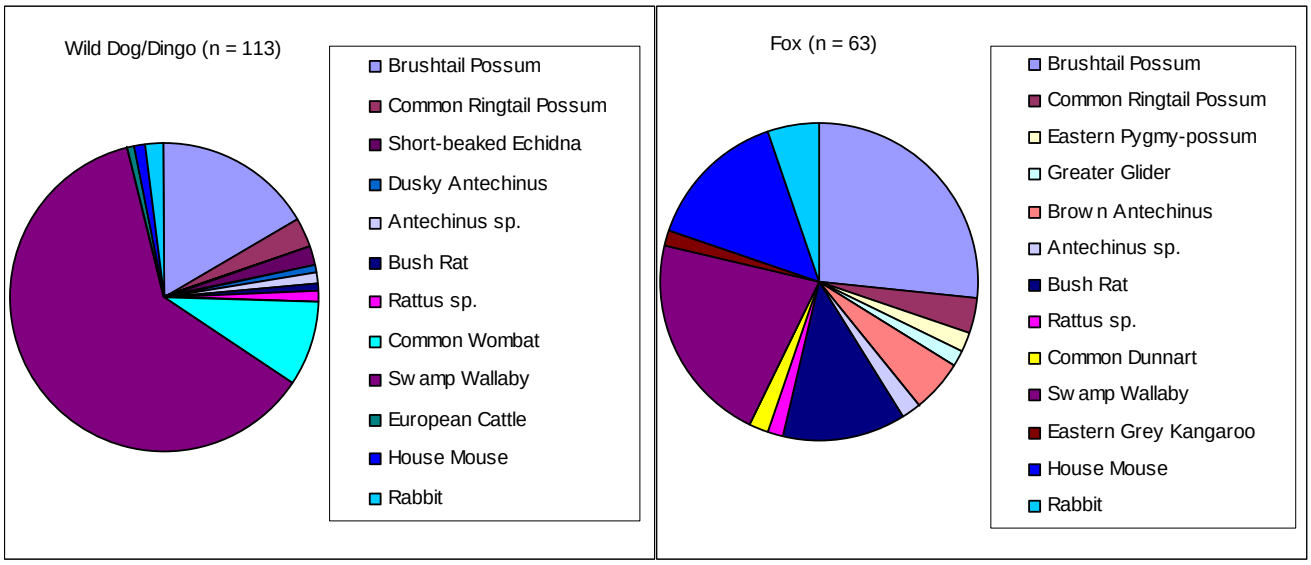


Figure 2: Mammal prey items (hair and skeletal remains) identified from predator scats collected in north-western Wollemi National Park during CRA and BSP surveys

It is clear from Figure 2 that the mammalian component of the diet of both predators is dominated by native ground mammals, which comprise 76 % of remnants identified from Wild Dog/Dingo scats and 46 % from Fox scats. The Fox appears to have a more varied diet, which includes 34 % arboreal mammals and 20 % introduced ground mammals. Contents of the Wild Dog/Dingo scats analysed is dominated by the Swamp Wallaby, and to a lesser extent the Common Wombat, with 20 % comprised of arboreal mammals and only 4 % introduced ground mammals.

3.10.3 Introduced birds

Introduced birds have only been recorded on the perimeter or just outside the boundary of the reserve (Map 8). Two species, the Common Starling (*Sturnus vulgaris*) and Common Myna (*Acridotheres tristis*) occur at the interface between cleared and forested lands, recorded on the boundary twice and once respectively. Both species are currently more common in cleared farming country, including in the Widden, Lee Creek and Capertee Valleys. This result is typical of Common Starlings, whose preferred habitat in Australia is disturbed lands such as urban areas, pastoral country and gardens (Pizzey & Knight 1999). The Common Myna is also usually closely associated with human habitation though the species will inhabit open grassy woodlands remnants supporting hollow-bearing trees (Pell & Tidemann 1997). A third species, the Eurasian Blackbird (*Turdus merula*), has been recorded by Birds Australia on the boundary of the park, east of Numietta Creek in the Glen Alice Valley. This bird is also more common in open country, but has the potential to invade open woodlands and forests (Pizzey & Knight 1999).

Of these three introduced species, the Eurasian Blackbird has the greatest potential to invade far into the park, including along all the major creeklines that run through the sandstone ranges. 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*) or through preying on native invertebrates (Garnett & Crowley 2000). It is also implicated in the spread of some invasive weed species such as Blackberry (Loyn & French 1991). The Eurasian Blackbird is thought to be gradually expanding its range and increasing in number through bushland south of Sydney (DEC2006a), and was reported by Barrett *et al.* (2003) as a species that had increased in the frequency of recordings across its Australian distribution between 1984 and 2002. Thus, though the Eurasian Blackbird has to date only been

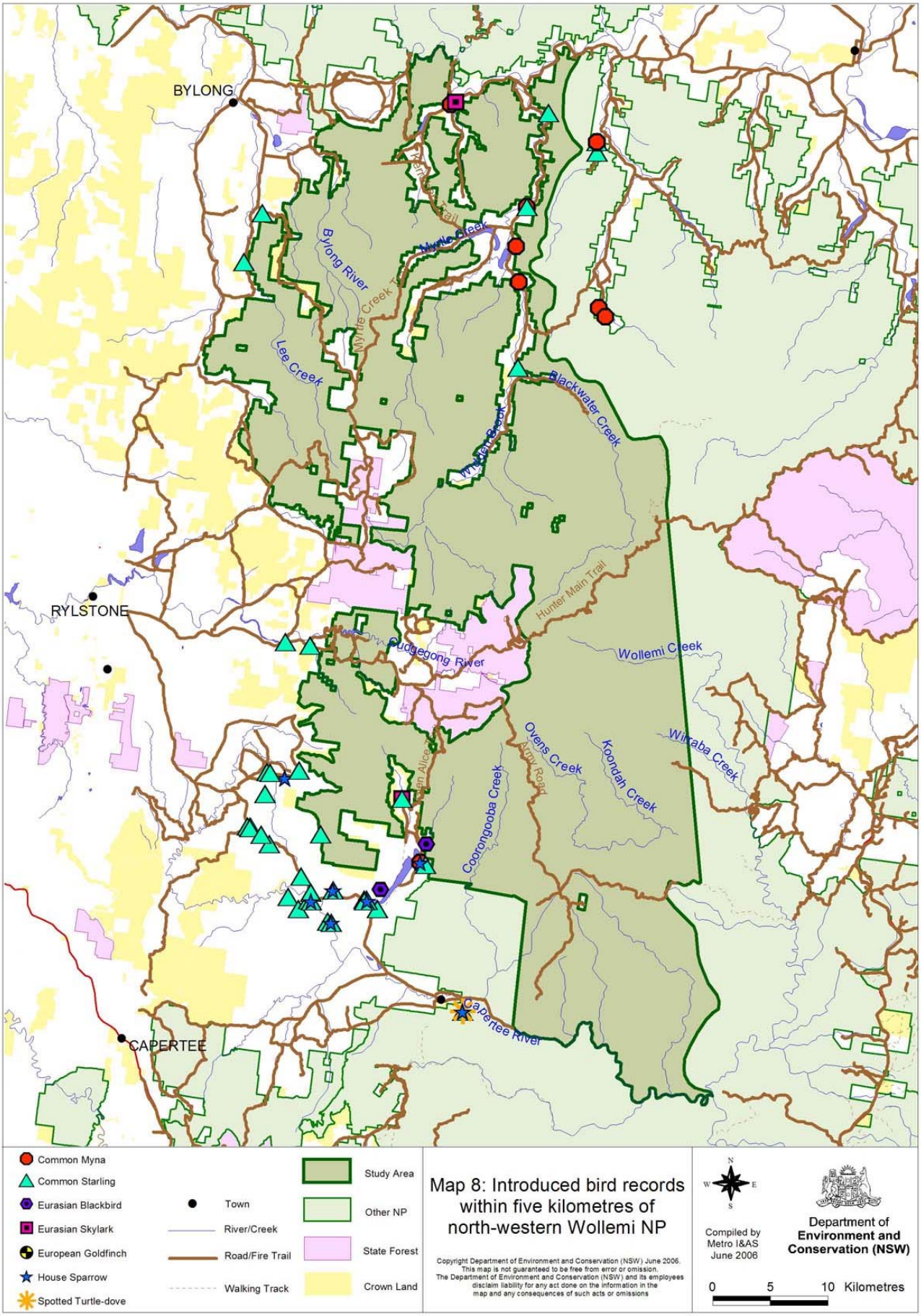
recorded on the boundary of the park, it has the potential to significantly impact on native fauna species further into the park in the future.

The threat posed to native animals by the Common Starling and Common Myna is largely limited to the boundaries of the park, particularly the valleys and lower slopes below the northern and western escarpments, and areas that have been subject to disturbance in the past. However, the habitats in this narrow band have high conservation value and thus if introduced birds occur here in moderate to high numbers the threats posed are likely to be significant. The Common Starling is well established in rural areas and is known to compete with native birds and bats for nest sites such as tree hollows. The species coats its nest cavity with a deep lining that quickly becomes contaminated with parasites, such that hollows become unsuitable for other species (IUCN 2005). The Common Startling is also likely to compete for food resources with some native species, and is implicated in the spread of invasive weed species (Loyn and French 1991).

The Common Myna is infamous for its aggressive nature, often seen bullying its own and other species for food, hollow nesting sites and territories, particularly in woodland areas. The species is known to evict native birds, including parrots, Kookaburras (*Dacelo* spp.), Dollarbirds (*Eurystomus orientalis)* and Australian Magpie-larks (*Grallina cyanoleuca*) from their nests, before dumping out their eggs or chicks (Environment ACT 2004). It is also considered to be a threat to the local survival of mammals that depend on tree hollows, such as Sugar Glider, White-striped Freetail-bat and even Common Brushtail Possum (Environment ACT 2004, M. Schulz pers. comm.). There is evidence that the Common Myna is spreading out from urban areas into more rural settings, which may increase the impact on native wildlife. Barrett *et al.* (2003) listed the Common Myna as a species that had increased in the frequency of recordings across their distribution between 1984 and 2002. Local residents in the Upper Hunter Area have noticed increasing numbers of the Common Myna in recent years (J. Barlow pers. comm.). Threatened species that depend on hollows in woodland habitats, such as the Brown Treecreeper and some microbats, are particularly at threat from these introduced species.

Though the Common Starling and Common Myna are unlikely to invade far into the park, the species have the potential to significantly impact on native species in the 'Upper Goulburn Valleys and Escarpment' and 'Sydney Basin Western Escarpment' Landscapes, which are each of high conservation priority. The distribution of Common Myna, Common Starling and Eurasian Blackbird within the valleys that indent the north and west of the park should be monitored. If either species is found to move further into the park, or to increase in number in the woodlands at the edge of the park, action should be taken to control the birds. Any such action must be sure to target the introduced species and not impact on native bird species.

Four further species have been recorded within a five kilometre range of the study area: Spotted Turtle-dove (*Streptopelia chinensis*), Eurasian Skylark (*Alauda arvensis*), House Sparrow (*Passer domesticus*) and European Goldfinch (*Carduelis carduelis*). None of these species are considered likely to occur within the body of Wollemi National Park, however, and therefore do not currently pose a significant threat to native wildlife.



Map 8: Introduced bird records within five kilometres of north-western Wollemi National Park