The Vertebrate Fauna of North-eastern Blue Mountains National Park

Department of **Environment & Climate Change** NSW

THE VERTEBRATE FAUNA OF NORTH-EASTERN BLUE MOUNTAINS NATIONAL PARK

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OVERVIEW

This report presents the results of a systematic survey and review of existing data on terrestrial vertebrate fauna in the north-eastern section of Blue Mountains National Park. The study area encompasses 19 000 hectares of land between the Great Western Highway and Bells Line of Road, of which the large majority is deeply incised rugged sandstone plateau. It comprises a relatively small proportion of the extensive Blue Mountains - Wollemi National Park reserve system.

The systematic fauna survey was carried out in order to sample the range of habitats present in the study area and improve the understanding of the fauna values held within the reserve. Eighty-seven systematic survey sites sampled birds, bats, arboreal and terrestrial mammals, reptiles and amphibians. Surveys were conducted between December 2007 and May 2008 incorporating an unusually cool and wet summer.

North-eastern Blue Mountains National Park is characterised by fauna that is typical of Sydney sandstone hinterland environments. At least 211 native species are confirmed to occur, of which twenty-one are listed under the NSW Threatened Species Conservation Act (1995). Our studies in the broader Sydney Basin region have found this level of fauna diversity consistent across many of the sandstone reserves. The majority of fauna found in the study area are well represented in the NSW reserve system. A few species, however, are highly threatened with one, the Stuttering Frog, possibly recently locally extinct from the study area.

The majority of north-eastern Blue Mountains National Park supports rocky dry sclerophyll forests and woodlands. These environments are home to over twenty reptile species and numerous shrub-frequenting birds. This includes the Endangered Broad-headed Snake, for which the study area holds high regional conservation significance. By contrast deeply incised gorges offer considerable protection from sun, wind and fire. Tall eucalypt forests and rainforests form long ribbons of contiguous habitat for a different suite of species including Greater Glider, Spotted-tailed Quoll and large forest owls.

Some vegetation types are highly restricted in extent, yet provide specialised habitat for a range of important species. The hanging swamps and heathlands provide habitat for a rich suite of frogs and reptiles, as well as some birds uncommon in the Sydney region such as the Southern Emu-wren, Beautiful Firetail and Lewins Rail. Similarly, species assemblages are largely unique within the shale sandstone transition forests on the eastern boundary of the park. The threatened Black-chinned Honeyeater and regionally significant Jacky Winter occur here, while habitat is provided for other declining woodland species such as Squirrel Glider and Speckled Warbler. These transitional forests and woodlands are poorly represented in the reserve system and subject to several key threatening processes which are a high priority for management.

Historical records exist for one of the regions most critically threatened species, the Brush-tailed Rock Wallaby, which occupies patchily distributed sites containing rocky cliff lines, boulders and chutes near permanent water. Additional survey to confirm whether this species still survives in the study area is of highest management priority.

Introduced species were found to be less diverse than in some neighbouring reserves, with the Wild Dog being the most widespread. Very few Fox records are known from the park, though this may be because the prevailing weather conditions at the time of the survey masked Fox traces. The highest priority for pest management in the study area is to undertake further survey and control of the emerging problem of Feral Deer.

This project has contributed greatly to knowledge of the current composition and distribution of wildlife across the study area, identified numerous threatened species, and improved the understanding of conservation management priorities. The data collected for this project will later be used to model habitat for threatened species across the region.

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1 INTRODUCTION

1.1 PROJECT RATIONALE

In 2003 the Central Branch of the Parks and Wildlife Group of the NSW Department of Environment and Climate Change (DECC) established a biodiversity survey priorities (BSP) program for DECC managed estate within the Branch. This program recognises that information which documents the biodiversity values held within reserves is fundamental to successful reserve management and to generating an improved understanding of the contribution reserves make to the protection of vegetation communities, plant and animal populations and their habitats. Prior to establishment of the program there was only sparse and incomplete information that described the role reserves play in ensuring the viability of fauna species across large regions and local areas. Typically the largest reserves, which potentially offer a significant contribution to biodiversity conservation, have been the most poorly understood and the most deficient in data quality and quantity. The BSP program goes some way towards addressing this information shortfall by surveying the most poorly known reserves and combining this work with larger regional conservation assessment projects.

Knowledge of the biodiversity values of the large sandstone reserves that border the western rim of the Sydney Basin is fundamental to understanding the conservation status of many species. In 2003 sections of Blue Mountains National Park were recognised as having a relatively small amount of information on fauna (NPWS 2003a) and hence as a priority for wildlife survey. The southern section of Blue Mountains National Park was the subject of survey between 2003 and 2005, after which followed the production of a series of reports on the vertebrate fauna of the entire Greater Southern Sydney Region (DECC 2007a, b). These reports, which were produced as a joint project by the Sydney Catchment Authority and the Department of Environment and Climate Change, provide detailed information on the distribution of threatened species habitats and set regional priorities for the conservation of threatened and regionally significant fauna and their habitats. The Greater Northern Sydney region is now being addressed to a similar level of detail, and has been the focus of survey since 2005. The north-eastern section of Blue Mountains National Park was identified as one of the priority areas for fauna survey in this region, and is the focus of this current project and report.

1.2 PROJECT AIMS

The primary objectives of the surveys were to:

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

The specific objectives of this report are to:

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

1.3 STUDY AREA

1.3.1 Location and context

The study area lies entirely within Blue Mountains National Park (Map 1) and extends from the northern boundary (south of Bells Line of Road) to the built up area around the towns and suburbs of the lower Blue Mountains (in the vicinity of Winmalee to Woodford) (Map 2). The western limit of the study area is bounded by Woodford and Wentworth Creeks, the Grose River and Barkala Ridge, while

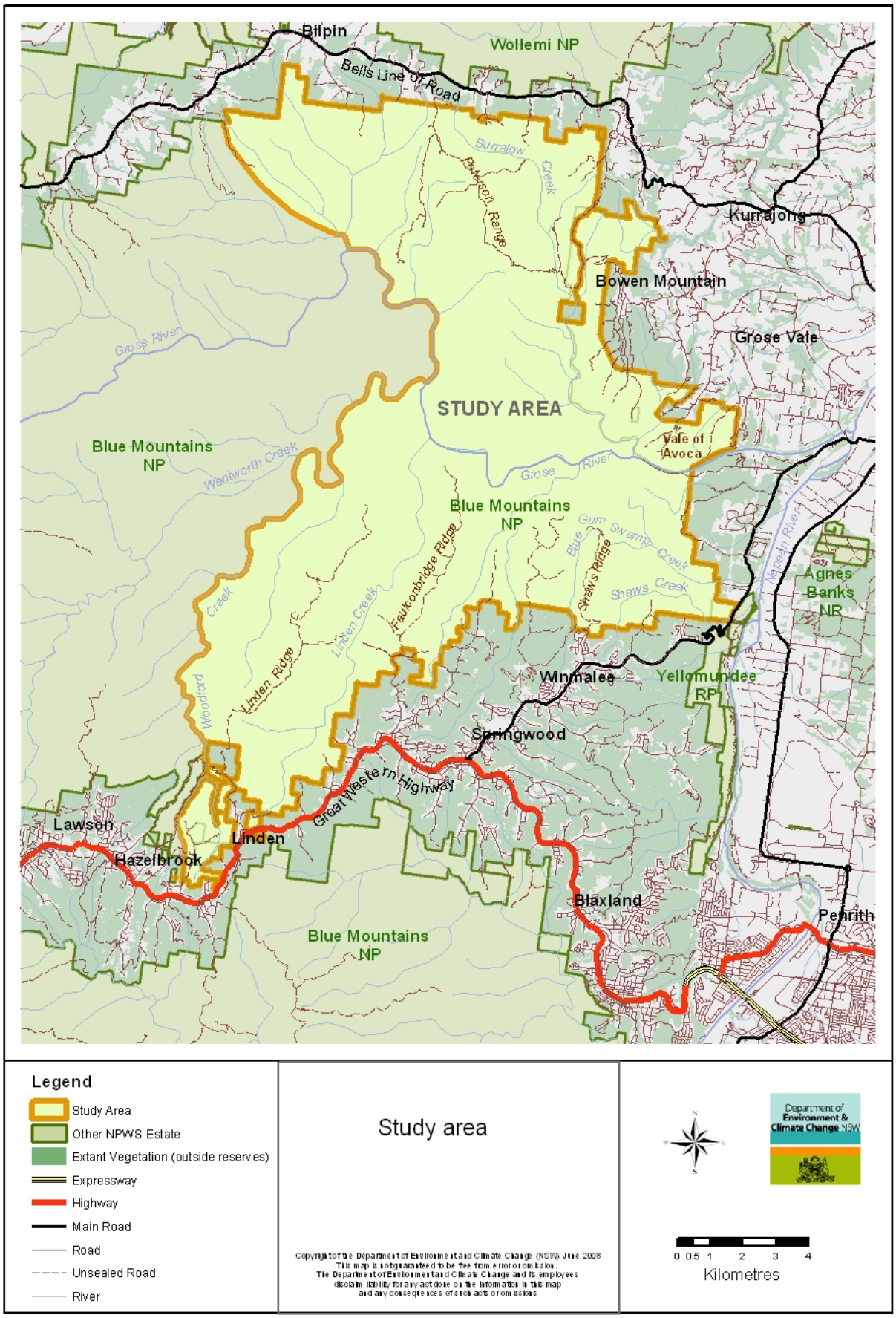
the east is defined by a change in geology from sandstone to the shales of the Cumberland Plain. The study area encompasses approximately 19 000 hectares of land. The area is located approximately 60 kilometres west north west of the Sydney UBD.

The vast majority of the study area lies within the catchment of the Grose River, a tributary of the Hawkesbury River. The far south-eastern corner of the area drains via Blue Gum Swamp, Lynchs and Shaws Creeks into the Nepean River. North-eastern Blue Mountains NP lies within an expanse of sandstone-based reserves that run around the western rim of the Sydney Basin. To the north, beyond Bells Line of Road and the associated developments lies Wollemi National Park, while to the west and south lay the remainder of Blue Mountains National Park. To the east and south-east is the commencement of the Cumberland Plain and the urban lands of the greater Sydney Metropolitan Area.

The majority of north-eastern Blue Mountains NP (west of Burralow Creek) lies within the Greater Blue Mountains World Heritage Area. The centre of the area also forms part of the Grose Wilderness Area.

Map 1: Location of study area and surrounding conservation areas

Map 2: Detail of study area and major landscape features



1.3.2 Biogeography, geology, geomorphology and soils

The study area falls within the Sydney Basin Bioregion which extends from just north of Batemans Bay to Nelson Bay and almost as far west as Mudgee (NPWS 2003b). Within this bioregion a temperate climate dominates with warm summers and no dry season. The study area is located entirely on the Blue Mountains Plateau and bordered to the east by the Lapstone Monocline which separates it from the Cumberland Basin (Jones and Clark 1991).

The two predominant geological types within the study area are Hawkesbury Sandstone and the Narrabeen Series. The Narrabeen Series is mainly only discernible along the major gullies and creek lines, chiefly the Grose River Valley, Woodford, Dawes, Faulconbridge and Springwood Creeks in the south, the various creek systems in the Devils Wilderness in the north-west and in the eastern part of the park along Burralow Creek and other associated minor creeks. Hawkesbury Sandstone is principally found along the major ridge tops. In the east around Bowen Mountain and south in the Vale of Avoca some influence of the Mittagong Series occurs, where slightly richer soils give rise to taller forests (Bannerman and Hazelton 1990). Narrabeen and Hawkesbury Sandstone topography are both characterised by narrow rocky ridges, often bound by rock-faces, above stepped slopes that also feature rock outcrops. Erosion of the rock-faces has resulted in the formation of caves, vertical fissures, overhangs and crevices. The sandstone plateau in the lower half of the study area is dissected by the deep valley of the Grose River which has cut its way through the plateau leaving continuous sheer cliff line exposures. Soils derived from Narrabeen and Hawkesbury Sandstones are generally sandy and are characterised by low nutrient levels. These soils erode quickly and thus tend to be shallow to skeletal on ridge tops, but deeper on benches or at the bottom of slopes.

In limited areas along some of the major valleys patches of deep alluvial sand deposits occur. This results in waterlogged soils and large amounts of organic material deposits of which Burralow Swamp is the predominant example (Bannerman and Hazelton 1990). Throughout the area there are also a number of hanging swamps and sedge lands found on the sides of hills and at higher elevations. These hanging swamps are formed by water percolating through the porous sandstones from ridgetops meeting with impervious bands of shale or claystone which block the downward movement of water and causes it to flow horizontally along these layers and emerge on the surface (Pickett and Alder 1997).

The northern limit of the study area coincides with the occurrence of fertile shale-derived soils along Bell's Range, evident by the predominance of orchards and small farms. These shale-influenced soils are largely absent from the national park bar a few minor incursions in the north of the study area.

1.3.3 Elevation and climate

From the west of the study area the intensely dissected lower part of the Blue Mountains Plateau descends gradually from elevations of about 600 metres above sea level (asl) near the township of Woodford to about 200 metres asl near Kurrajong Heights. The plateau then ends abruptly along the Lapstone Structural Complex (Jones and Clark 1991) which essentially forms the eastern boundary of the study area and sees elevations abruptly drop to barely 20 metres asl. The Grose River forms the deepest gorge in the study area, commencing at approximately 100 metres asl in the west and flowing down to about 15 metres asl before exiting the park in the east.

Climatic patterns in the study area are typical of lower elevation areas of the Blue Mountains, with an average of between 1000 and 1200 millimetres of rain per year. The far eastern boundary of the area, around Vale of Avoca and the lower reaches of the Grose River, is drier receiving an average of 800 to 900 millimetres of rain per year.

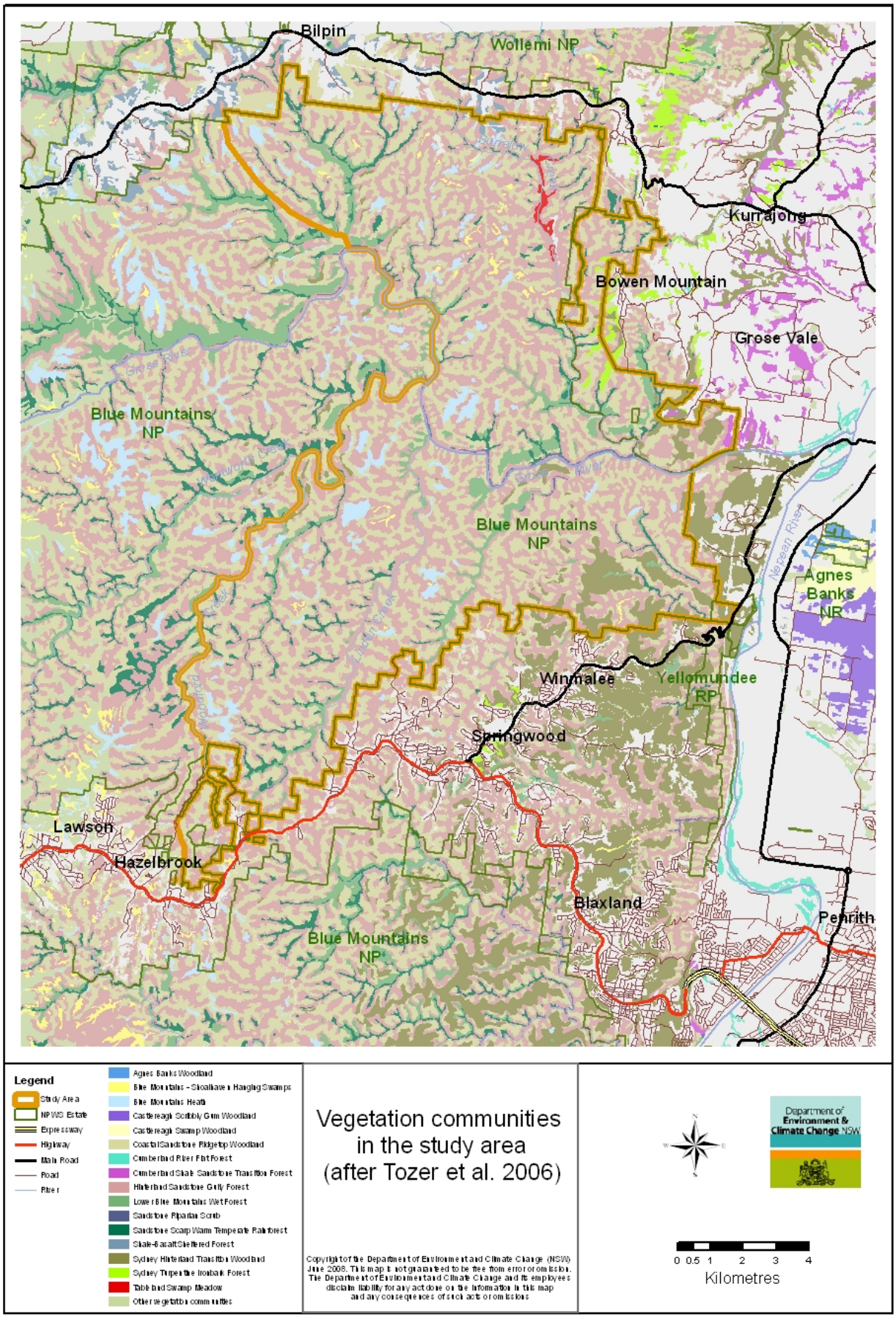
1.3.4 Vegetation

Vegetation patterns across the study area have most recently been compiled by Tozer *et al.* (2006) as part of the south-east NSW vegetation mapping project. The vegetation communities described in that paper are presented in Table 4 and Map 3. Following is a very brief synopsis of broad patterns across the study area. The large majority of the study area supports dry sclerophyll forests and woodlands. On ridgetops and exposed slopes of Hawkesbury Sandstone dominant canopy species variously include Red Bloodwood (*Corymbia gummifera*), Silvertop Ash (*Eucalyptus sieberi*) and Scribbly Gum (*Eucalyptus racemosa*), while the diverse shrub layer includes species from the families Fabaceae, Epacridaceae and Proteaceae such as Wattles (*Acacia* spp.), Banksias (*Banksia* spp.) and Peas. Where soils are shallower and damper, such as along sections of Linden Ridge the woodlands grade

into heath, or upland swamps in areas of impeded drainage. On sheltered slopes and deeply incised drainage lines the ridgetop woodland gives way to taller sandstone gully forest, dominated by Smooth-barked Apple (*Angophora costata*), Sydney Peppermint (*Eucalyptus piperita*) and Red Bloodwood with a shrubby understorey that varies from dry to slightly mesic and can include Geebungs (*Persoonia* spp.), Wattles and Christmas Bush (*Ceratopetalum gummiferum*), amongst others. Larger more sheltered slopes and gullies with slightly deeper soil support a wetter forest dominated by Turpentine (*Syncarpia glomulifera*) and Smooth-barked Apple with species such as Blueberry Ash (*Elaeocarpus reticulatus*) growing amongst a mix of scramblers and climbers. The most sheltered drainage channels support warm temperate rainforest characterised by a closed tree canopy of Coachwood (*Ceratopetalum apetalum*), Lily Pilly (*Acmena smithii*) and Sassafras (*Doryphora sassafras*), a mesic shrub layer and an open fern-dominated ground cover. On the shallow sands and gravel alluvium along the banks of the Grose River a riparian scrub occurs, characterised by Water Gums (*Tristaniopsis laurina*) over hanging the waters edge and a spindly shrub layer of Long-leaved Lomatia (*Lomatia myricoides*) and Teatree (*Leptospermum morrisonii*). In contrast, on the waterlogged soils of Burralow Swamp an unusual community occurs dominated by Teatree (*Leptospermum juniperinum* and *L. obovatum*) with a dense groundcover of water-tolerant soft-leaved sedges and forbs.

Along the eastern boundary of the reserve the infertile sandy soils of the sandstone plateau meet the more fertile soils of the Cumberland Plain to form transitional woodlands. Sydney Hinterland Transition Woodland grows on loamy soils derived from sediments of the Hawkesbury or Mittagong formations and has a slightly more open understorey than the classic sandstone woodlands with a denser ground cover of forbs and grasses. Dominant canopy species include Red Bloodwood, Grey Gum (*Eucalyptus punctata*), Smooth-barked Apple and Turpentine. Right on the far eastern extremity of the study area, on the margins of the Cumberland Plain, shallow clay soils occur above the underlying sandstone strata giving rise to Cumberland Shale Sandstone Transition Forest. This community is dominated by Ironbarks (*Eucalyptus fibrosa* and *E. crebra*) with Grey Gum and Forest Oak (*Allocasuarina torulosa*), and characterised by a more grassy ground layer with the proportion of shrubs and grasses determined by the amount of clay relative to sand in the soil. This community is listed as an Endangered Ecological Community under the NSW Threatened Species Conservation Action (1995) (TSC Act) due to the threat of urban expansion, weed invasion and high frequency fires (Tozer *et al*. 2006). The higher rainfall falling on shale-derived soils to the north gives rise to Sydney Turpentine Ironbark Forest, a few fingers of which spread into the park along ridgetops west of Bowen Mountain. Sydney Turpentine Ironbark Forest is also listed as an Endangered Ecological Community under the TSC Act.

Map 3: Native vegetation of north-eastern Blue Mountains NP as mapped by Tozer *et al.* (2006)



1.3.5 Wildfire history

Little information is available on fire history prior to 1957, though it is sure that fire has long been a regular feature of Blue Mountains National Park and surrounding environments. Comprehensive records have been compiled and kept since 1975. In the last 20 years almost the entire study area has burnt once, extensive areas have burnt twice, and sections of the north and south have burnt on three or four occasions. The large majority of the area burnt in the fires of 1993-94, with only the north-east and south-west corners remaining unburnt. The north-east corner, however, burnt in 2001-02, leaving the far south-west corner as the longest unburnt section of the study area. Small fires have burnt in this area in 1997-98, 2003-04 and 2005-06, but a large section has not burnt since 1977-78, as is the case with many bushland areas immediately north of townships along the Great Western Highway.

1.4 PROJECT TEAM

This project was instigated and managed by the Information and Assessment Section, Metropolitan Branch, Environmental Protection and Regulation Group, Department of Environment and Climate Change NSW. Funding was provided by the Central Branch, Parks and Wildlife Group, Biodiversity Survey Priorities Program. George Madani, Elizabeth Magarey and Daniel Connolly were primarily responsible for the management of this project. George Madani and Elizabeth Magarey undertook field survey planning and logistics and report writing. Report maps were produced by Kylie Madden. 2007-08 (BSP) field surveys were undertaken by George Madani, Martin Schulz, Narawan Williams and Elizabeth Magarey, with assistance provided by Meagan Ewings. Staff of the Hawkesbury Area provided assistance in planning and logistical support. Kerry Oakes designed the report cover and formatted the report.

2 METHODS

2.1 PRE-EXISTING FAUNA DATA

2.1.1 Major sources of non-systematic records

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

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

- Bird surveys by the Royal Australian Ornithologists Union (RAOU) (undertaken between 1977 and 1981; Blakers *et al.* 1984) and by Birds Australia (undertaken in 1999 and 2000; Barrett *et al*. 2003). RAOU data is at a coarse spatial scale and there is no guarantee that all or even any of these sightings actually occurred at the given point locality. Consequently some of this bird data presents a misleading picture of the species composition of the study area. One point locality for these surveys lies within the study area. Most of the records collected by Birds Australia have a higher degree of spatial accuracy and are more useful for the purposes of this project. Observations arising from this data largely lie near the peripheries of the park, particularly Panorama Lookout, Burralow Creek, Vale of Avoca, along Faulconbridge Ridge, Shaws Ridge and Swamp Creek and in the vicinity of Linden, Woodford and Lake Woodford.
- Surveys for Brush-tailed Rock-wallaby in Blue Mountains Region undertaken in 2003 (Rummery *et al.* 2003). In the study area these consisted of on-ground searches of potential habitat for signs of Brush-tailed Rock-wallaby occupation in the form of fresh scats.
- Urban Bushland Biodiversity Survey, which undertook six diurnal bird censuses between Vale of Avoca (Woods Reserve) and Cabbage Tree Creek.
- Mixophyes Survey, which extended across the Blue Mountains but in the study area involved assessment of potential habitat and one nocturnal streamside census on Blue Gum Swamp Creek.

2.1.2 Systematic fauna survey data

Prior to the current study a few projects had included implementation of systematic fauna survey techniques in north-eastern Blue Mountains National Park (Table 1, see Section 2.3 for technique description).

Table 1: Systematic fauna survey effort prior to July 2007

	Diurnal bird survey	Diurnal herpetofauna	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Number or records stored in Atlas	Locations of sites	Timing of Survey
Comprehensive Regional Assessment Surveys	6	4	0	0	2	1	11	0	196	Faulconbridge Ridge, Paterson Range, Burralow Creek, Tabaraga Ridge and north-west of Bowen Mountain.	August 1997 (nocturnal call playback), March – April 1998 (rest of techniques)
SCA Special Areas Fauna Survey	2	0	2	0	0	1	0	0	78	In the vicinity of Lake Woodford	December 2003
Total	8	4	2	0	2	2	11	0	274		

2.2 SURVEY SITE SELECTION

The aim of the 2007-08 fauna survey was to proportionately sample the full range of habitat types contained within north-eastern Blue Mountains NP. Two separate strata were used as surrogates for habitat type: 1) the vegetation map for the study area (Tozer *et al.* 2006); 2) a stratification grid that was created to incorporate the following biotic and abiotic variables: parent geology/soil type; aspect; elevation; landscape position; broad vegetation structure. The classes used for each variable for the second stratification are presented in Table 2. Theses two strata were used to undertake a gap analysis of previous systematic fauna survey effort, and to identify habitat types that had not been previously sampled, or had been undersampled in proportion to the area they occupy within the park. The habitat types identified in this gap analysis were prioritised for sampling. In addition, the distributions of existing survey sites and fauna sightings across the study area were examined to identify 'spatial gaps' in fauna knowledge. The selection of sites was also prioritised towards filling large spatial gaps in fauna data wherever possible.

Table 2: Classes used for stratification of study area

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

Sites were initially selected using ArcMap 9.1, utilising the stratification layer and vegetation map in combination with topographic maps. Proposed site locations were then ground-truthed to ensure that they were representative of the intended stratum, had been minimally affected by recent burning or other habitat modification, and comprised a single vegetation community. If these criteria were not met, an alternative location was found.

Systematic survey sites were 100 by 200 metres in area, and where possible were spaced a minimum of one kilometre from each other (two kilometres for nocturnal call playback surveys). In some cases

during hikes, due to the terrain and the time taken to walk between sites, survey sites were placed closer than one kilometre. In this case, care was taken to ensure that adjacent sites sampled different habitats and that animals were never double counted.

Appendix A provides the specific AMG and survey techniques undertaken at each survey site, while Map 4 shows the placement of sites across the study area. The tables and map include all systematic surveys undertaken within the study area by DECC between 1997 and 2008 (i.e. during both CRA and BSP programs).

2.3 SURVEY TECHNIQUES

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

Field survey teams were supplied with field proformas to facilitate comprehensive, consistent recording of field data and to increase accuracy and efficiency of data entry into the DECC Biodiversity Subsystem (BSS) of the Atlas of NSW Wildlife computer database. The names of observers and recorders were noted on every data sheet to aid data verification and entry.

2.3.1 Systematic site-based methods

Site attributes

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

Diurnal bird survey

Diurnal bird censuses comprised a twenty-minute observation and listening search within a two hectare (100 by 200 metre) area, conducted by an experienced bird surveyor. Censuses were conducted only during periods of relatively high bird activity (usually in the early morning) and reasonable detectability (e.g. low wind and cicada activity). Almost all surveys were undertaken in spring and summer. All bird species and the abundance of individuals seen or heard were recorded. Individuals were scored as on-site if they were detected within the two hectare plot. Individuals recorded outside the plot, in adjacent vegetation types or flying overhead were recorded as off-site.

Diurnal herpetofauna search

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

This census technique entailed active searching of potential reptile and frog microhabitats within the half hectare area. Active or basking reptiles were identified by sight or captured and identified by the use of keys. Sheltering or cryptic species were detected by searching around, under and within fallen logs, litter, decorticating and fallen bark, rock outcrops and other likely shelter sites. Incidental observations of other fauna were also recorded.

Nocturnal site spotlighting survey

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

Harp trapping

While ultrasonic recorders were used principally to detect high-flying bat species, collapsible bat traps, known as harp traps (Tidemann and Woodside 1978), captured low-flying species. Two nights of trapping were conducted at each bat trap site, in spring and summer. Sites were selected for their perceived potential to interrupt bats along their flight paths, and were usually positioned on tracks or creeklines or in gaps between trees where adjacent vegetation may 'funnel' flying bats.

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

Bat ultrasonic ('Anabat') call recording

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

CRA

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

BSP

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

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

Nocturnal streamside search

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

Nocturnal call playback

Nocturnal birds and mammals are often detected only when they vocalise for territory or social contact, behaviour which can be elicited by broadcasting specific calls. A standard survey census involved broadcasting the calls of each of the four large forest owls - Powerful Owl, Masked Owl, Sooty Owl and Barking Owl - from the centre of a site. Prior to call broadcasts, on arrival at the site, the surrounding area was searched by spotlight for five minutes to detect any fauna in the immediate vicinity and then a ten minute period of listening was undertaken.

A pre-recorded compact disc of each species' call series was played, amplified through a megaphone. Calls of each species were played for five minutes, followed by a five minute listening period. The surrounding area was again searched by spotlight after a final ten minute listening period. After the census, the response or presence of any fauna, date and time that response occurred, and weather details such as amount of cloud cover was recorded. Very windy and rainy periods were avoided

where possible. Censuses conducted in poor weather were noted. Censuses were undertaken in autumn and winter.

Elliott trapping

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

2.3.2 Opportunistic methods

Predator and herbivore scat and pellet collection

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

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

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

Searches of caves and overhangs

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

Incidental records

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

Targeted searches for Stuttering Frog

A limited amount of targeted survey was undertaken for the Stuttering Frog during the 2007-08 BSP surveys. This included looking for tadpoles in potential habitat areas (including sheltered rock pools and flowing creeks) and undertaking playback of the species call in potential habitat on an opportunistic basis. Habitat for the species was also targeted during the systematic nocturnal streamside search censuses.

2.4 SURVEY TIMING

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

Table 3: Timing of BSP 2007-08 systematic fauna surveys within north-eastern Blue Mountains National Park

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

2.5 SURVEY SITE LOCATIONS

For the 2007-08 project, DECC established and surveyed 87 systematic survey sites. Map 4 shows the location of these survey sites, together with the 23 systematic survey sites established during the CRA and SCA Special Areas fauna surveys. A breakdown of sites by technique type and vegetation type is presented in Table 4. Appendix A provides the specific AMG (Australian Map Grid) and the survey techniques undertaken at each site. The tables and map include all systematic surveys undertaken within the study area by DECC between 1997 and 2008.

Map 4: Location of systematic fauna survey sites in north-eastern Blue Mountains NP

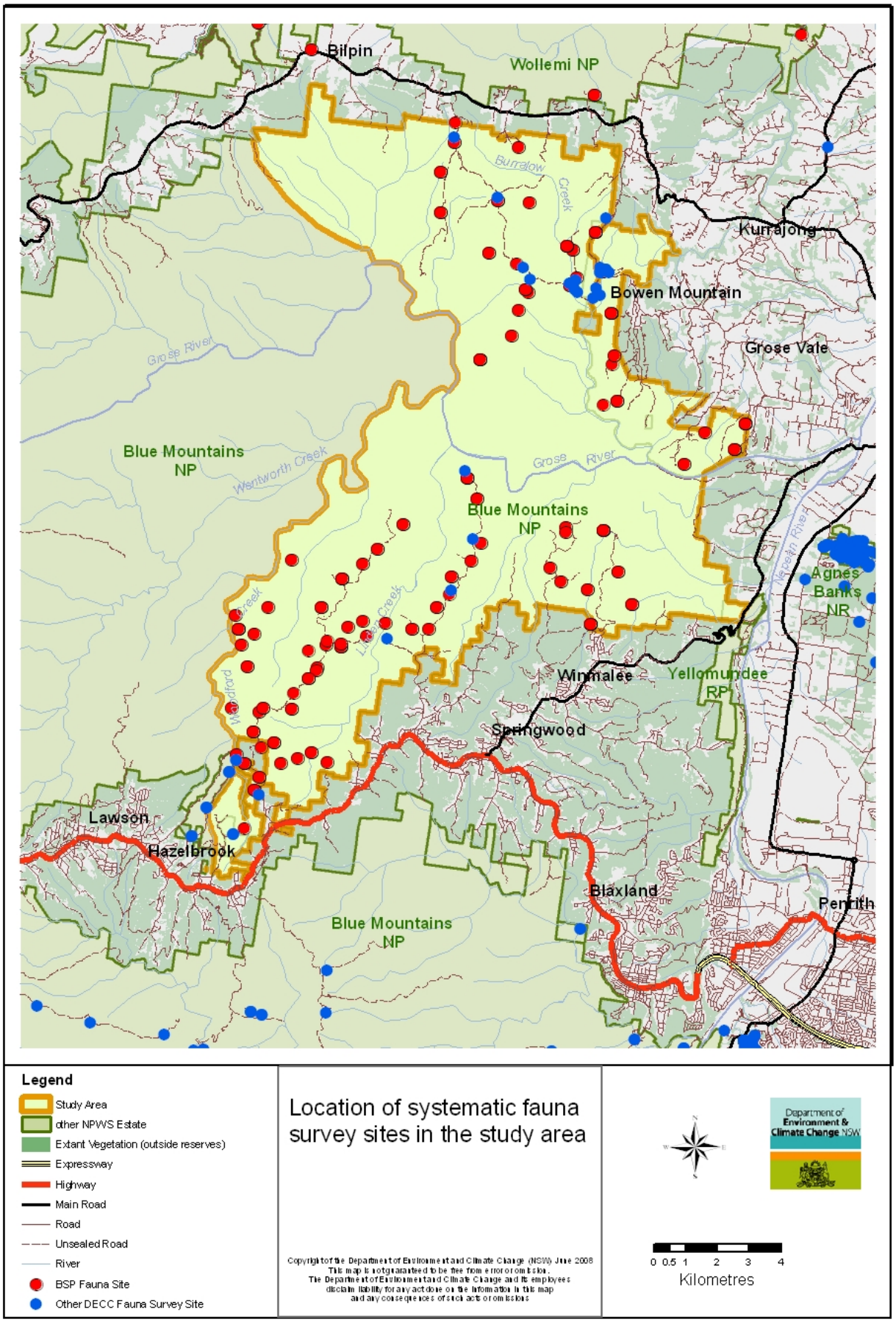


Table 4: Vegetation types within north-eastern Blue Mountains NP and corresponding allocation of systematic fauna survey effort as at June 2008

Vegetation type (Tozer *et al.* 2006)	Area (hectares)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping
Hinterland Sandstone Gully Forest	8164.3	16	14	6	6	5	3	11	
Coastal Sandstone Ridgetop Woodland	7815.4	12	17	12	17	6		11	1
Lower Blue Mountains Wet Forest	800.4	1	1				1		
Sandstone Scarp Warm Temperate Rainforest	697.7	6	3	2			2	1	
Sydney Hinterland Transition Woodland	681.4	1	1						
Blue Mountains Heath	554.2	6	7	4	3			2	1
Blue Mountains - Shoalhaven Hanging Swamps	93.5	5	5				1		
Sandstone Riparian Scrub	80.1								
Tableland Swamp Meadow	54.7	1	1	1		1			1
Sydney Turpentine Ironbark Forest	49.0	2	2	1	1	1			
Shale-Basalt Sheltered Forest	26.9		1						
Cumberland Shale Sandstone Transition Forest	23.2	3	3	2	2	1		1	
Grey Myrtle Dry Rainforest	4.1								
Tableland Swamp Forest	2.9								
Coastal Sandstone Plateau Heath	1.4								
Sydney Swamp Forest	0.6		1	1				1	
Total	19049.6	53	56	29	29	14	7	27	3

3 FAUNA SPECIES INVENTORY AND OVERVIEW OF SURVEY RESULTS

3.1 REVIEW OF PRE-EXISTING FAUNA RECORDS

All records of vertebrate fauna for the study area on the Atlas of NSW Wildlife were reviewed as part of this project. Several records were identified as having a high degree of spatial inaccuracy, or as potential mis-identifications or database errors. Other species were accurately recorded at the time of survey, but are now considered to be locally extinct. In order to make the species inventory provided in this report as accurate as possible, all species that have only been recorded during the first RAOU survey (between 1978 and 1981) have been excluded.

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

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

Scientific name	Common name	Reason for omission from species inventory
Mixophyes fasciolatus	Great Barred Frog	Recorded just outside the western boundary of the study area above the dam on Woodford Creek on a single occasion in 1997. Historically recorded from around Kurrajong and Bowen Mountain (A. White pers. comm.). Uncertain whether the species ever occurred within the actual boundaries of the study area, and if so may now be locally extinct.
Limnodynastes ornatus	Ornate Burrowing Frog	Single undated record of very low spatial accuracy.
Egernia saxatilis	Black Rock Skink	A single record during 1997. Considered unlikely to occur in the study area as usually a higher elevation species.
Coturnix ypsilophora	Brown Quail	Records of low spatial accuracy prior to 1981.
Coturnix chinensis	King Quail	Single record of low spatial accuracy. Suitable habitat not present in park proper.
Anas gracilis	Grey Teal	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Aythya australis	Hardhead	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Cygnus atratus	Black Swan	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Tachybaptus novaehollandiae	Australasian Grebe	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Anhinga melanogaster	Darter	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Phalacrocorax sulcirostris	Little Black Cormorant	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Phalacrocorax carbo	Great Cormorant	Records of low spatial accuracy prior to 1981. Occurs at Lake Woodford but suitable habitat not present in park proper.
Phalacrocorax melanoleucos	Little Pied Cormorant	Records of low spatial accuracy prior to 1981. Occurs at Lake Woodford but suitable habitat not present in park proper.

Scientific name	Common name	Reason for omission from species inventory
Pelecanus conspicillatus	Australian Pelican	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Ardea alba	Great Egret	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Ardea intermedia	Intermediate Egret	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Bubulcus ibis	Cattle Egret	Single record of low spatial accuracy prior to 1981. Suitable habitat not present in park proper
Ardea pacifica	White-necked Heron	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Egretta garzetta	Little Egret	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Egretta novaehollandiae	White-faced Heron	Records of low spatial accuracy prior to 1981. Occurs at Lake Woodford but suitable habitat not present in park proper.
Platalea flavipes	Yellow-billed Spoonbill	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Platalea regia	Royal Spoonbill	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Threskiornis molucca	Australian White Ibis	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Threskiornis spinicollis	Straw-necked Ibis	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Haliaeetus leucogaster	White-bellied Sea-Eagle	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Falco longipennis	Australian Hobby	Records of low spatial accuracy prior to 1981. Suitable habitat limited in reserve proper.
Fulica atra	Eurasian Coot	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Gallinula tenebrosa	Dusky Moorhen	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Porphyrio porphyrio	Purple Swamphen	Records of low spatial accuracy prior to 1981. Occurs at Lake Woodford but suitable habitat not present in park proper.
Elseyornis melanops	Black-fronted Dotterel	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Columba livia	Rock Dove	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Neophema pulchella	Turquoise Parrot	Records of low spatial accuracy prior to 1981. Suitable habitat limited in park proper.
Psephotus haematonotus	Red-rumped Parrot	Records of low spatial accuracy prior to 1981. Suitable habitat not present in park proper.
Ninox connivens	Barking Owl	Records of low spatial accuracy prior to 1981. Unlikely to occur in park proper.
Tyto alba	Barn Owl	Records of low spatial accuracy prior to 1981. Unlikely to occur in park proper.
Apus pacificus	Fork-tailed Swift	Records of low spatial accuracy prior to 1981. Would aerially feed over the park.
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	Records of low spatial accuracy prior to 1981.
Acanthiza nana	Yellow Thornbill	Records of low spatial accuracy prior to 1981.
Pyrrholaemus saggitatus	Speckled Warbler	Records of low spatial accuracy prior to 1981. Habitat very restricted in reserve proper. Chance that species may still occur in Cumberland Shale Sandstone Forest on the eastern boundary of the park.
Petroica phoenicea	Flame Robin	Records of low spatial accuracy prior to 1981.

Scientific name	Common name	Reason for omission from species inventory
Myiagra cyanoleuca	Satin Flycatcher	Records of low spatial accuracy prior to 1981.
Myiagra inquieta	Restless Flycatcher	Records of low spatial accuracy prior to 1981. Has the potential to occur around the Vale of Avoca.
Lalage tricolor	White-winged Triller	Records of low spatial accuracy prior to 1981.
Cracticus nigrogularis	Pied Butcherbird	Single record on boundary of study area. Unlikely to occur in park proper.
Artamus personatus	Masked Woodswallow	Records of low spatial accuracy prior to 1981.
Artamus cyanopterus	Dusky Woodswallow	Records of low spatial accuracy prior to 1981. Likely to occur but not accurately recorded to date.
Artamus superciliosus	White-browed Woodswallow	Records of low spatial accuracy prior to 1981.
Anthus australis	Australian Pipit	Records of low spatial accuracy prior to 1981.
Passer domesticus	House Sparrow	Single record on boundary of study area. Unlikely to occur in park proper.
Carduelis carduelis	European Goldfinch	Records of low spatial accuracy prior to 1981.
Lonchura castaneothorax	Chestnut-breasted Mannikin	Records of low spatial accuracy prior to 1981.
Taeniopygia bichenovii	Double-barred Finch	Records of low spatial accuracy prior to 1981. Has the potential to occur around the Vale of Avoca.
Taeniopygia guttata	Zebra Finch	Records of low spatial accuracy prior to 1981.
Petrochelidon ariel	Fairy Martin	Records of low spatial accuracy prior to 1981.
Pycnonotus jocosus	Red-whiskered Bulbul	Records of low spatial accuracy or immediately outside the park boundary in backyard areas. Unlikely to occur in reserve proper.
Cincloramphus mathewsi	Rufous Songlark	Records of low spatial accuracy prior to 1981.
Turdus merula	Eurasian Blackbird	Recorded from a backyard in Woodford, not in study area proper.
Sturnus vulgaris	Common Starling	Records of low spatial accuracy prior to 1981.
Phascolarctos cinereus	Koala	Record appears to be a database error. This species may well occur in the study area, but has not been included in this report as it has not been recorded on the Atlas of NSW Wildlife to date.

3.2 FAUNA SPECIES INVENTORY

A total of 211 native vertebrate fauna species are currently confirmed to occur within north-eastern Blue Mountains NP. This total is comprised of 16 frogs, 32 reptiles, 130 native birds and 33 native mammals. In addition the Dingo, three introduced mammals and two introduced bird species have been detected.

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

Table 6: Number of vertebrate fauna known to occur in north-eastern Blue Mountains NP

Total no. native fauna species known to occur	211
No. species listed as threatened under the TSC Act	21
No. species listed as threatened under the EPBC Act	8
No. introduced mammals	3
No. introduced birds	2

3.2.1 Amphibians

In total sixteen species of frog are known to occur within north-eastern Blue Mountains NP. Seven of these are ground frogs belonging to the family Myobatrachidae, which lack toe discs and rarely climb trees. The remaining nine are tree frogs of the Hylidae family which do have toe discs and can and do regularly climb trees and rocks (Robinson 1993). Between 1998 and 2008, systematic nocturnal streamside searches detected eight of these species. Seven additional species were detected during diurnal herpetofauna searches, site spotlighting, nocturnal call playback census or opportunistically. Only two frogs previously known to occur in the park were not detected during the 2007-08 BSP surveys, while six species were recorded for the first time on the Atlas of NSW Wildlife. This includes the Giant Burrowing Frog, Eastern Banjo Frog, Dusky Toadlet, Eastern Dwarf Tree Frog, Tyler's Tree Frog and the Stoney Creek Frog. Of the two frogs not recorded, the Stuttering Frog has drastically declined from large parts of its range including the Greater Blue Mountains area, and is listed as Endangered under the TSC Act. The only records for this species are 1960s museum records of very low spatial accuracy and it is possible that the species is locally extinct from the study area. The likelihood of the Stuttering Frog occurring in the study area is discussed further in Section 4.

Plate 1: Red-crowned Toadlet with eggs © G. Madani

The most significant amphibian findings during the 2007-08 surveys included the large number of new locations for Red-crowned Toadlet (Plate 1) and also the first Atlas of NSW Wildlife records of Giant Burrowing Frog. Both species are listed as Vulnerable under the TSC Act. Tadpoles of both species were located on a number of occasions, with Red-crowned Toadlet in particular being quite prominent. Tadpoles of this species were found in rock pools along many first and second order creeklines and in December the males were quite vocal, calling from ditches along many of the ridgetop fire trails in the Linden Ridge area. Giant Burrowing Frogs were also heard calling in December and a number of tadpoles were found in a small stream associated with a hanging swamp in the Paterson Range area.

The frog fauna in north-eastern Blue Mountains NP is largely typical of sandstone hinterland reserves and similar to that recorded in sandstone country of adjoining parks such as southern Wollemi NP and Parr SCA. The most commonly recorded frog was the Common Eastern Froglet which was detected during 57 % of streamside searches and in almost all water bodies surveyed opportunistically. The other frequently detected frogs were Peron's Tree Frog and the Leaf-green Tree Frog, each recorded during 42 % of nocturnal streamside searches. Leaf-green Tree Frogs and Red-crowned Toadlets were most commonly detected opportunistically; toadlets were most commonly heard calling from drainage channels along roads, while Leaf-green Tree Frogs were most often heard along major creeks. A number of frogs were only recorded at a few locations due to the limited amount of suitable habitat in the study area. For example Dusky Toadlets prefer grassier sites on better soils where they breed in grassy depressions following

flooding by rain (Smith and Smith 1990). This sort of habitat is mainly found at lower elevations such as around the Vale of Avoca area adjoining farmland on the eastern perimeter of the study area. Another restricted species in the study area is the Eastern Dwarf Tree Frog, which prefers emergent vegetation around still water bodies, such as those located at Burralow Swamp. Other frog species were infrequently recorded because they begin to approach the western limit of their distribution in the study area, such as the predominantly coastal Tyler's Tree Frog.

The Stoney Creek Frog, which has only recently been formerly recognised as a separate species from Lesueur's Frog, was recorded for the first time in the study area along Woodford Creek in December 2007. Interestingly it was located within 200 metres of a previous Lesueur's Frog sighting near the dam wall at Woodford Creek. This information is useful in improving our understanding of the distribution of this newly defined species.

3.2.2 Reptiles

Thirty-two species of reptile are now known to inhabit north-eastern Blue Mountains NP. Prior to the commencement of systematic fauna surveys, only twenty-two species of reptile were known from the study area. The systematic surveys carried out between 1998 and 2008 recorded a total of thirty reptile species, confirming the presence of twenty-two species and locating an additional eight previously unrecorded species. The reptile fauna is comprised of three geckoes, two legless lizards, four dragons, one goanna, twelve skinks and ten species of snake (Appendix B).

Of significant note was the discovery of two Broad-headed Snakes within the study area, which are listed as Endangered under the TSC Act and Vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act (1999) (EPBC Act). One of these individuals was located under exfoliating rock in late summer, while the second was found emerging from a tree hollow at night time in autumn (Plate 2). These sightings provide extremely important information on the current habitat use and distribution of this rarely detected species, and build on existing records and anecdotal reports to provide evidence that the study area is significant to the conservation of this species. The species will be discussed further in Section 4.

Plate 2: Broad-headed Snake at the base of a tree in north-eastern Blue Mountains NP © G. Madani/DECC

Reptile diversity in north-eastern Blue Mountains NP is typical of the region and most species recorded are what one would expect to find in the hinterland sandstone country of the Sydney Basin. The most commonly detected species during diurnal herpetofauna searches were Dark-flecked Garden Sunskink and Broad-tailed Gecko, detected 49 % and 38 % of the time respectively. The Copper-tailed Skink is also common, detected during 36 % of the reptile censuses. Most Broad-tailed Geckos were found in crevices and rock cracks, or through the detection of sloughed skins, located amongst the abundant rocky outcrops in the study area. Lesueur's Velvet Gecko was another very common gecko, detected during 27 % of diurnal herpetofauna searches. This species is largely confined to sandstone rock outcrops and rocky ridges where they are commonly found sheltering under loose rock. Dark-flecked Garden Sunskinks and Copper-tailed Skinks are diurnal and surface active and hence were readily observable foraging in leaf litter and scampering across rock outcrops. Mountain Heath Dragons were the most commonly encountered dragon species, recorded during 21 % of systematic searches. This species was regularly encountered in the drier sclerophyll woodland on upper slopes and ridge tops where there was ground debris such as fallen timber and leaf litter. The abundance of small geckoes and skinks is an important factor contributing to the high richness of the snake fauna found in the study area, as they provide prey for species such as Yellow-faced Whip Snakes, Mustard-bellied Snakes and most significantly Broad-headed Snakes.

The most commonly detected snake was the Blackish Blind Snake recorded during 14 % of systematic searches. These snakes are difficult to detect during dry periods as they spend much of the time beneath the soil surface or in leaf litter. The high amount of rain which fell during the 2008 survey period brought these snakes closer to the surface, making them more detectable than normal and indicating their true abundance. Another commonly detected snake was the Mustard-bellied Snake. This species was recorded opportunistically far more frequently than during systematic searches and was often found during the day, out in the open and strongly associated with leaf litter. The species was found in a range of habitats including rocky heath, dry sclerophyll woodland and on one occasion in a hanging swamp. These snakes were particularly visible in December when five individuals were seen on the same day. Considering that two separate pairs were observed together on that day and that the snakes were not as commonly detected during the rest of the survey season, the behaviour could infer some attribute of breeding biology. Such information is worthy of note considering the Mustard-bellied Snake is a little known species with a generally restricted distribution in the Sydney Basin.

Across the study area there is a distinct pattern in reptile assemblages based on vegetation communities and habitat attributes. For example sheltered, moist areas are more likely to support species such as Three-toed Skink and Weasel Skink, whereas exposed rock outcrops on ridge tops favoured more saxicoline species such as White's Skink, Lesueur's Velvet Gecko and Copper-tailed Skink. Blue Mountains Heath proved to have both a high diversity and abundance of reptile species. This can be attributed to the profusion of areas for basking and general availability of a variety of suitable cover. Linden Ridge in particular was a veritable hotspot for reptiles with one site in particular turning up four species of snake in one systematic herpetofauna search. Such areas are thus important in any future considerations for park management such as during hazard reduction burns.

The study area does not exceed elevations of 600 metres asl. Hence a number of high altitude species which occur in other parts of the Blue Mountains are absent from the study area, such as the Southern Water-skink (*Eulamprus tympanum*) and the Yellow-bellied Water-skink (*Eulamprus heatwolei*). Some species approach their distributional limits within the park, such as Pink-tongued Lizard (Plate 3) which nears the southern limit of its known distribution.

Plate 3: Pink-tongued Lizard basking on Linden Ridge © E. Magarey/DECC

3.2.3 Native diurnal birds

A review of records of diurnal birds recorded in north-eastern Blue Mountains indicates that at least 123 native species occur in the study area. Some of these are sedentary, while others are migratory, seasonal visitors or nomads. The BSP 2007-08 systematic surveys recorded a total of 98 native diurnal bird species, of which three had not previously been confirmed for the study area.

Five diurnal bird species are listed as threatened under the TSC Act, being Gang-gang Cockatoo, Glossy Black-cockatoo, Black-chinned Honeyeater (eastern subspecies), Regent Honeyeater and Swift Parrot. Within the study area, there is widespread suitable habitat for both Cockatoo species, whereas the remaining species have only been recorded from the eastern periphery of the park. This indicates that these species are irregular visitors that most likely only visit the study area during prominent flowering events in the more fertile communities within the park such as the Cumberland Shale Sandstone Transition Woodland and Sydney Hinterland Transition Forest. The majority of the park does not provide suitable habitat for these latter species. However, the preferred habitats of these species are poorly represented in the reserve system and consequently the areas of Cumberland Shale Sandstone Transition Forest and Sydney Hinterland Transition Woodland within the park are of high significance. Use of the park by each of these threatened species will be discussed further in Section 4.

Within the study area occur a number of other species which, although not listed under the TSC Act, appear to have declined in numbers in recent years (Barrett *et al*. 2003). This includes Crested Shrike-tit, Rockwarbler, Red-browed Treecreeper, Spotted Quail-thrush, White-winged Chough and Scarlet Robin. The occurrence of these species within the park highlights the importance of this reserve in ongoing regional conservation of the habitats.

The species most commonly recorded during systematic bird censuses were those which are characteristic of dry sclerophyll woodlands and forests on sandstone plateau. These included Eastern Spinebill (recorded during 68 % of systematic diurnal bird censuses), White-throated Treecreeper (65 %), Crimson Rosella (58 %), Brown Thornbill (55 %), Pied Currawong (54 %), Grey Shrike-thrush (48 %) and Spotted Pardalote (47 %). These species are also highly vocal and therefore readily observed. The abundance of Crimson Rosella suggests the influence of higher elevation or higher rainfall, as this species was not so commonly encountered in lower elevation areas of the northern greater Blue Mountains such as southern Yengo NP or Parr SCA (DECC 2008a). Other bird species were recorded infrequently in north-eastern Blue Mountains NP as a consequence of limited habitat availability. Such is the case with bird species which prefer more mesic environments such as along creeklines and more sheltered forest, including Rose Robin (8 %), Yellow-throated Scrubwren (4 %), Red-browed Treecreeper (2 %) and Crescent Honeyeater (recorded during one bird census only).

Plate 4: Beautiful Firetail © M. Schulz

Hanging swamps and heathland were found to support a species assemblage not present elsewhere in the study area. Hanging swamps are irregularly dispersed and restricted in extent across the study area, yet still provide a haven for very habitat specific species such as Lewins Rail, Beautiful Firetail (Plate 4) and Southern Emu-wren. Similarly, species assemblages were largely unique within transition forests, particularly the Cumberland Shale Sandstone Forest on the eastern boundary of the park. Some species were only recorded from this vegetation community, and no where else in the study area, including the threatened Black-chinned Honeyeater (eastern subspecies), Jacky Winter, Fuscous Honeyeater, Peaceful Dove, White-winged Chough, Little Lorikeet, Buff-rumped Thornbill, and White-bellied Cuckoo-Shrike. This vegetation community thus plays an important role in supporting species that are not found elsewhere in the park and whose preferred habitats are poorly represented in the reserve system. There is also potential for the threatened Speckled Warbler to occur in this community, as well as to a lesser extent the Diamond Firetail. Such habitat should therefore be strongly considered if possibilities arise for making additions to the park.

3.2.4 Nocturnal birds

Seven species of nocturnal bird are known to occur in the study area including four owls, the Australian Owlet Nightjar, White-throated Nightjar and Tawny Frogmouth. Three of the owl species are listed as Vulnerable under the TSC Act (Powerful Owl, Masked Owl and Sooty Owl) and will be discussed in detail in Section 4.

The most commonly encountered nocturnal bird was the Australian Owlet Nightjar which was recorded during 79 % of nocturnal call playback surveys and 55 % of site spotlighting surveys. This is a common species that is regularly detected by its unmistakeable call and propensity to call at any time of the day. This bird calls year round and is often seen on roads it will hawk for insects and other prey. The Southern Boobook was more commonly detected through its call during site spotlighting censuses rather than from being directly observed (heard during 44 % of site spotlighting surveys), while the White-throated Nightjar was recorded most often on an opportunistic basis. During the BSP surveys in February 2008, whilst surveyors were walking to a site during the day along an upper slope, two adult White-throated Nightjars were flushed and proceeded to swoop around the surveyors. Closer investigation revealed a perfectly camouflaged chick sitting motionless on the floor with its eyes closed (Plate 5). Records of all of the nocturnal birds, with the exception of the threatened owl species, are scattered across the study area through a range of habitat types.

3.2.5 Arboreal mammals

Six species of arboreal mammal have been recorded within north-eastern Blue Mountains NP, though the systematic spotlighting surveys carried out over the summer of 2007-08 confirmed the presence of only five of these species. The sixth species, the Squirrel Glider, listed as Vulnerable under the TSC Act has been recorded on just two occasions, once in the vicinity of Bowen Mountain in 1996 and once on Blue Gum Swamp Creek in 1977 (DECC 2008b). Inspection of these areas during the BSP surveys did not locate any Squirrel Gliders or high quality habitat for the species, and hence it is uncertain whether the species occurs within the study area today. This issue will be discussed further in Section 4.

Plate 5: White-throated Nightjar chick on Faulconbridge Ridge © M. Schulz/DECC

Sugar Gliders were the most frequently detected arboreal mammal during systematic site spotlighting surveys, detected during 51 % of censuses. The species was regularly observed feeding in flowering Stringybarks and also recognized through its distinctive yapping call. In the study area Sugar Gliders are more frequently encountered on the less fertile sandstone ridge tops and slopes. This stands in contrast to the pattern of habitat use of the other arboreal mammals. Greater Gliders, Common Ringtail Possums and Feathertail Gliders were only recorded from more sheltered environments in areas of higher soil fertility associated with creeklines, such as around Blue Gum Swamp. These areas are more productive and support taller sheltered forest with larger trees and a greater number of tree hollows. Overall these mammal species were rare in the study area, with Common Ringtail Possums and Greater Gliders only being recorded during 7 % of systematic surveys and Feathertail Gliders being found on only a single occasion. Common Brushtail Possums too were found to be rare on sandstone ridgetops, favouring areas along transition zones between more fertile vegetation communities. These possums were more common adjacent to human settlement and more fertile lowlands such as near the Vale of Avoca.

3.2.6 Native ground mammals

Ten native terrestrial mammals are known to occur within north-eastern Blue Mountains NP from the Atlas of NSW Wildlife. This includes one monotreme, three dasyurids, one species of bandicoot, three macropods and two rodents. The presence of seven species was confirmed during the 2007-08 systematic surveys through a combination of Elliot trapping, predator scat analysis, spotlighting and opportunistic sightings.

An eleventh species, the Brush-tailed Rock-wallaby has not been recorded on the Atlas of NSW Wildlife but was detected from fresh scats near Faulconbridge Point during a specifically targeted survey for the species in 2003 (Rummery *et al.* 2003). The status of this species within the study area remains unclear yet it is feasible, considering the amount of available habitat in the area and the apparent low abundance of Foxes, that it still occurs. Due to the likelihood of its continued occurrence the species has been included in the inventory totals provided in this report. Brush-tailed Rock-wallaby is listed as Endangered under the TSC Act and will be discussed further in Section 4.

Plate 6: Spotted-tail Quoll print recorded from a rocky overhang near Linden Ridge © N. Williams/DECC

Spotted-tailed Quoll is listed as Vulnerable under the TSC Act, but its population status in the study area is also poorly known. Individuals are intermittently reported from the reserve and surrounding locality. Tracks of an individual were found near a rocky overhang along a creekline in the Linden Ridge area during the systematic surveys (Plate 6). The species has also been observed by members of the public in the Linden Ridge area, as well as occasionally from the suburb of Bowen Mountain which adjoins the eastern boundary of the park (D. Monahan pers. comm.). The Spotted-tailed Quoll is an elusive species whose population

status is difficult to assess without targeted dedicated surveys which were outside the scope of 2007-08 project. This species is also discussed further in Section 4.

Swamp Wallabies were the most commonly encountered of the native terrestrial mammals and are widespread across the study area. Long-nosed Bandicoots have also been encountered on occasion, particularly in Burralow Swamp and in Heath communities. Bush Rats, Swamp Rats and Brown Antechinus however are much more cryptic and have only been detected by Elliot trapping. There are anecdotal records of Platypus occurring in the Grose River with one confirmed record on the Atlas of NSW Wildlife.

There are records of Dingo/Wild Dog in the study area, yet the purity or degree of hybridisation has not been determined. Although regarded as a pest under the Rural Lands Protection Act (1998), Dingoes play an important ecological role as a top-order predator and in mesopredator suppression of introduced mammals such as Foxes and Feral Cats (Glen and Dickman 2005). Therefore any Wild Dog management in the park needs to be carefully balanced against the conservation needs of the Dingo. The degree of hybridisation between Dingo and Wild Dog in Blue Mountains NP is an area that requires further investigation.

Most of terrestrial native mammal species, especially smaller mammals, are nocturnal, shy and generally hard to detect without dedicated targeted survey. Surveying for terrestrial small mammals is generally greatly enhanced through the analysis of predator scats and owl pellets. However, during the 2007-08 surveys few scats were collected despite dedicated searches, possibly due to them being washed away by the recent and regular heavy rain. Owl pellets too were generally hard to come across, despite surveyors undertaking searches for them in rocky overhangs or caves. Therefore it is feasible that additional species such as Common Dunnart or possibly even Water Rat could have gone undetected in the study area to date.

3.2.7 Bats

Within north-eastern Blue Mountains NP a total of sixteen species of bat were recorded during the BSP 2007-08 surveys, six for the first time. Amongst the species are the Grey-headed Flying-fox and fifteen species of small insectivorous microbats. The micro-bat fauna is comprised of both tree dwelling and cave roosting species. Eight species of microbats were detected using harp traps, while seven species (with some overlap) were detected by the Anabat system. Amongst this bat fauna, six species are listed as Vulnerable under the TSC Act, being the Grey-headed Flying-fox, East-coast Freetail-bat, Large-eared Pied Bat, Eastern False Pipistrelle, Eastern Bentwing-bat and Greater Broad-nosed Bat. These species will each be discussed in Section 4.

Plate 7: Little Forest Bat © A. Kwok

The composition of the microbat fauna is largely typical of Sydney Basin hinterland plateau at moderate elevations. The most commonly captured species were the Little Forest Bat (Plate 7) and Large Forest Bat (each captured at 75 % of harp trap sites) followed by Gould's Long-eared Bat (72 % of sites) and Chocolate and Gould's Wattled Bats (50 and 42 % of sites respectively). The abundance and frequency at which these bats, particularly the Forest Bats, were captured is chiefly attributable to their habitat and roosting preferences as well as their foraging strategy. Forest Bats and Wattled Bats predominantly roost in tree hollows, and Long-eared Bats will additionally roost under exfoliating bark, which are available throughout the landscape. Consequently these species are not strongly restricted in their distribution by the availability of roost sites. In addition these species, particularly the Forest Bats, are readily caught in harp traps because of their tendency to fly below the tree canopy and make use of flight paths along roads which form ideal trapping sites.

Species such as White-striped Freetail-bat and Eastern False Pipistrelle tend to fly high within or above the canopy and hence are not regularly captured in harp traps (Churchill 1998). The Anabat system is an important tool in detecting these species and highlights the need for a variety of techniques in order to effectively sample bats from an area. Greater Broad-nosed Bat, Eastern Broad-nosed Bat, Eastern

Bentwing-bat, Eastern False Pipistrelle, East-coast Freetail-bat and Eastern Freetail-bat were each only detected from their ultrasonic calls.

Three of the microbat species occurring within the study area roost in caves, being the Eastern Bentwing-bat, Eastern Horseshoe-bat and Large-eared Pied Bat. Eastern Horseshoe-bat and Large-eared Pied Bat prefer to roost in sandstone overhangs and the twilight areas of caves whereas Eastern Bentwing-bat makes use of deeper caves (Churchill 1998). The latter species was infrequently detected as its distribution and abundance is restricted by suitable roost site availability.

There is uncertainty about the occurrence of four additional microbat species in the study area, which were all identified to the 'possible' level of identification accuracy during the BSP surveys. Large-footed Myotis (*Myotis adversus*), which was 'possibly' recorded near Bowen Mountain in January 2008 has never been captured in north-eastern Blue Mountains NP, but has been recorded on several occasions in the last decade in the Cumberland Plain and lower Blue Mountains, including in Grose Wold just east of the Vale of Avoca. It is highly likely that Large-footed Myotis would forage along permanent water bodies in the study area, including the Grose River and Blue Gum Swamp Creek. The occurrences of Little Bentwing-bat (*Miniopterus australis*), Golden-tipped Bat (*Kerivoula papuensis*) and Eastern Cave Bat (*Vespadelus troughtoni*) are more questionable, particularly as the latter two species are very difficult to identify from ultrasound recordings. Little Bentwing-bat has rarely been recorded in the region (preferring more coastal environments), while the latter two species have never been recorded in the region (Golden-tipped Bat requiring complex moist forest and Eastern Cave Bat only recorded as far south as Wollemi and northern Yengo NPs (DECC 2007c)). The records for these three species remain unconfirmed and at this stage it is considered they are unlikely to occur in north-eastern Blue Mountains NP.

3.3 INTRODUCED SPECIES

3.3.1 Introduced mammals

Only three species of feral ground mammal have to date been recorded from north-eastern Blue Mountains NP. Wild Dogs are the most frequently recorded predator, readily detected by their scats, tracks and on a number of occasions from their calls. The Fox and Feral Cat however, have only infrequently been recorded from the park. Though the distribution and abundance of Cats is difficult to assess due to their cryptic nature, the scarcity of Fox records suggests the species may only occur at comparatively low densities. Despite this it is likely that Foxes and Cats have a significant accumulated negative impact on a number of native fauna species, such as ground nesting birds and small to medium sized mammals including Spotted-tailed Quoll. Predation by both the Fox and the Feral Cat are listed as Key Threatening Processes under the TSC Act. The three feral ground mammal species will be discussed further in Section 4.

Records currently exist for Rabbit and Horse just outside the boundary of the park, such as at Grose Wold. Horses are unlikely to become feral within the study area, and habitat for Rabbits is restricted to the perimeters of the park, and thus these species are unlikely to be having a significant impact on native fauna. The occurrence of Deer is a more severe potential threat to native flora and fauna species and communities. Though not recorded on the Atlas of NSW Wildlife for the study area to date, sightings have been reported from the northern boundary by residents who have suggested that Deer may have escaped from hobby farms. Fallow Deer have reported been killed on the road in the vicinity of Bilpin (C.H. Barker pers. comm.). Fallow Deer are known to occur in south-eastern Wollemi NP and southern Yengo NP. Feral Deer are an emerging pest in NSW (West and Saunders 2007) that cause environmental degradation through dispersing weeds, accelerating soil erosion, fouling water bodies and overgrazing. They also have the potential to carry and spread disease, attract illegal hunting, cause traffic hazards, damage fencing, and impact on agriculture (DEC 2006a). The occurrence of Deer within the park should be further investigated and if individuals are discovered they should be quickly controlled, and then monitored, in order to prevent a feral population becoming established. In addition, community education about the potential impacts of Deer on the environment and follow-up of any further sightings made by the public are recommended.

3.3.2 Introduced birds

Two species of introduced bird have been recorded in north-eastern Blue Mountains NP, the Spotted Turtle-dove and Common Myna. In addition, Little Corella can be considered as an introduced species as it is not native to the study area. Of these, only the Common Myna is likely to pose a significant threat to native fauna and even then the impact is restricted in extent. Spotted Turtle-dove has only been recorded on the

periphery of the park, including near Bowen Mountain, Vale of Avoca and Blue Gum Swamp Creek (Map 10). There is no suitable habitat for the species in the park proper, and consequently the species is not currently of management concern.

The occurrence of Common Myna is currently limited to the peripheries of the reserve including Blue Gum Swamp Creek and the grassy woodlands along the edge of the park near the Vale of Avoca. These transition woodlands are of conservation importance as they support habitat for many threatened fauna species. Common Mynas are known to steal hollows from native birds and mammals, evict native birds from their nests and kill chicks (TAMS 2007). This species has the potential to be a real pest in the reserve, as will be discussed further in Section 4.

3.4 ADDITIONAL SPECIES THAT HAVE THE POTENTIAL TO OCCUR

The systematic fauna surveys undertaken between 1997 and 2008 have provided a comprehensive base line data set on fauna species occurrence within north-eastern Blue Mountains NP. However, some species may have as yet gone undetected on the Atlas of NSW Wildlife, due to their cryptic nature or remaining gaps in survey coverage. Table 7 presents species that have been recorded within a five kilometre radius of north-eastern Blue Mountains NP that are considered likely to also occur within it, but have gone unrecorded to date. In addition, the Vulnerable Rosenberg's Goanna (*Varanus rosenbergi*) is considered to potentially occur as habitat is present and the species is known to exist in south-eastern Wollemi NP and Parr SCA (DECC 2008b). Interestingly, however, Rosenberg's Goanna has only rarely been recorded within a twenty kilometre radius of the study area, suggesting it may only occur at very low abundance, if at all. Another threatened species considered likely to occur is the Yellow-bellied Glider (*Petaurus australis*). This species is usually easy to detect due to its loud and distinctive gurgling call, such that the reason for the absence of records from the study area is mysterious. Suitable habitat occurs in gully lines supporting tall wet forests such as Lower Blue Mountains Wet Forest.

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

Scientific name	Common name	Reason it is considered likely to occur
Litoria latopalmata	Broad-palmed Frog	Frequently recorded immediately east of the study area. Potential habitat occurs, particularly around the Vale of Avoca or in fire dams.
Uperoleia laevigata	Smooth Toadlet	Frequently recorded immediately east of the study area and also to the west at Berambing (C.H. Barker pers. comm.). Potential habitat occurs, particularly around the Vale of Avoca or in fire dams.
Ctenotus robustus	Robust Ctenotus	Potential habitat occurs and species can easily go undetected when at low abundance.
Tiliqua scincoides	Eastern Blue-tongue	Potential habitat occurs and species can easily go undetected when at low abundance.
Cacophis squamulosus	Golden-crowned Snake	Potential habitat occurs and species can easily go undetected.
Alectura lathami	Australian Brush-turkey	Recorded at Lawson Ridge (just west of study area) and in south-eastern Wollemi NP. Suitable habitat present in moister forest types.
Geopelia humeralis	Bar-shouldered Dove	Frequently recorded immediately east of the study area. Potential habitat occurs, particularly around the Vale of Avoca.
Tachyglossus aculeatus	Short-beaked Echidna	Frequently recorded in region and potential habitat widespread.
Phascolarctos cinereus	Koala	As this species has not been accurately recorded within the study area it was removed from the species list provided in Appendix B. However, records exist for just outside of the park boundary and potential habitat occurs within. It is considered highly likely to occur at low densities in the study area and hence has been afforded a species profile in Section 4.1.
Vombatus ursinus	Common Wombat	Frequently recorded in region and potential habitat widespread.
Cercartetus nanus	Eastern Pygmy-possum	Suitable habitat occurs, particularly in the Blue Mountains Heath communities. Species is very cryptic and may easily go undetected.
Myotis adversus	Large-footed Myotis	As mentioned in Section 3.2.7 an unconfirmed record of this species was collected in 2008. It is considered likely to utilise permanent water bodies in the study area, such as along the Grose River.

4 PROFILES OF THREATENED AND PEST SPECIES

This section provides a profile of each of the threatened fauna species and key pest species that are known to occur within north-eastern Blue Mountains NP. The aim of these profiles is to provide: a background on the species biology; a summary of threats to the species; an assessment of how well the species is protected in the region; a map of known records of the species in the study area and the surrounding five kilometres (as at 15th May 2008); and an appraisal of the distribution and status of the species in north-eastern Blue Mountains NP and the surrounding area. Due to the spatial inaccuracy of records from the first Birds Australia atlas, these records have not been included on the species distribution maps contained herein. Similarly, records with a low reliability of identification have not been included on the maps.

4.1 THREATENED SPECIES

GIANT BURROWING FROG

Species Profile

The Giant Burrowing Frog (*Heleioporus australiacus*) is a large rotund ground-dwelling frog. Its powerful limbs are used to excavate burrows where it can stay for long periods of time during unfavourable conditions. This species has a large black tadpole with a purple ventral surface that takes up to eleven months to metamorphose (Anstis 2002). The species has two disjunct populations, with one restricted to sandstone geology of the Sydney Basin as far south as Jervis Bay, and the other to the south between Narooma and eastern Victoria (NPWS 2001a). It has been suggested that this disjunct distribution may reflect two separate species, though at present evidence is inconclusive (Penman *et al.* 2004).

Plate 8: Giant Burrowing Frog © N. Williams/DECC

Threats

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

Local and Regional Conservation Status

The Giant Burrowing Frog is listed as Vulnerable under the TSC Act and the EPBC Act. The Sydney Basin population is thought to have declined considerably, with tadpoles being encountered far less frequently than in the past (Anstis 2002). The species has been recorded within a number of Sydney Sandstone reserves including Royal, Ku-ring-gai Chase, Garigal and Brisbane Waters NPs and across the Woronora Plateau. Fewer records have been obtained in Blue Mountains, Nattai, Wollemi and Yengo NPs and Bargo SCA. Penman *et al.* (2004) consider the Giant Burrowing Frog to be well represented within the reserve system in the Sydney Basin Bioregion.

The Giant Burrowing Frog was recorded for the first time in north-east Blue Mountains NP during the BSP surveys, including in both breeding and non-breeding sites. One male was heard calling from near the headwaters of a tributary leading into Linden Creek in December 2008, and approximately ten tadpoles were found in a small clear pool formed by a seepage line associated with a hanging swamp in March 2008 (Map 5). Further hanging swamps and creek headwaters located in the park are likely to also afford suitable habitat and pools for the development of tadpoles. In addition to the breeding habitat, one individual was sighted on a ridgetop along Donna's Track in the lower northern half of the study area (Map 5). The frogs would use such habitats extensively during and after rainy periods, and thus a large proportion of the reserve can be considered potential habitat for this species.

North-eastern Blue Mountains NP lies towards the western limit of the species distribution in the Sydney Basin, which is formed by the western edge of the Blue Mountains Plateau (DECC 2008b). Conservation of the species within this and surrounding reserves is therefore important. The species currently appears to be secure in this reserve system, and no specific management actions are required at this stage. Management may be required in the future if Chytrid fungus is discovered to be affecting populations, or if scientific research confirms that feral predators and/or frequent fire pose a significant threat to the species in wilderness areas.

STUTTERING FROG

Species Profile

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

Plate 9: Stuttering Frog © N. Williams/DECC

Threats

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

Local and Regional Conservation Status

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

Within north-eastern Blue Mountains NP the Stuttering Frog has not been recorded since the mid 1960s, when specimens were collected by the Australian Museum from localities near 'Faulconbridge' and 'Linden' (DECC 2008b). The Stuttering Frog was not recorded during the BSP surveys, despite a limited amount of specifically targeted survey. There is sadly likelihood that the Stuttering Frog is now locally extinct from north-eastern Blue Mountains NP. Within the whole of Blue Mountains NP, the Stuttering Frog is currently only still known to occur in the Mt Werong area (DEC 2004b). The closest recent record of the species to the study area is at Victoria Falls, with the last confirmed sighting occurring there in February 2002 (K. Madden pers. comm.). However, consequent follow up surveys at Victoria Falls have failed to locate the species (A. White pers. comm.).

Further surveys of sheltered creek headwaters and associated rock pools within warm temperate rainforest would be required to confirm whether the species persists in the study area or not. Such surveys should be undertaken in spring or summer, particularly after rain, when individuals are most vocal and active and should include visitation to remote sheltered gorges and canyons, where the species is most likely to persist undiscovered. Any targeted frog surveys would need to be undertaken with strict adherence to frog hygiene protocols to ensure diseases were not spread between populations or catchments. Should a population be discovered it would hold extremely high conservation significance. The greatest threat to the survival of the Stuttering Frog in the reserve system is infection by Chytrid fungus. Testing for Chytrid fungus should therefore be incorporated into any targeted surveys for the species.

RED-CROWNED TOADLET

Species Profile

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

Plate 10: Red-crowned Toadlet © N. Williams

Threats

Development of ridgetop land and creek headwaters is the primary threat to the Red-crowned Toadlet. Other threats may include habitat alteration due to frequent fire, bush rock removal, water pollution and Chytrid fungus (NPWS 2001b). The species may also be impacted upon by the removal of dead wood and trees and by habitat alteration due to longwall mining (NSW Scientific Committee 2003a, 2005a).

Local and Regional Conservation Status

The Red-crowned Toadlet is listed as Vulnerable under the TSC Act. Suitable habitat for this species is widespread across the sandstone plateaux of the Sydney Basin Bioregion, with major populations occurring in the upper Blue Mountains, around the mouth of the Hawkesbury River and on the Woronora Plateau extending to Royal National Park. Throughout its range it has been recorded in numerous reserves, from Yengo and Wollemi National Parks in the north to Barren Grounds Nature Reserve in the south (DECC 2008b), including some within the Sydney urban area, such as Lane Cove National Park (DEC 2004a).

The Red-crowned Toadlet has been recorded from 40 locations within north-eastern Blue Mountains NP, all but one of which is south of the Grose River (Map 5). In most cases this small frog was heard calling from underneath leaf litter at the edge of pools or seepage areas on first and second order creeks and drainage channels. This species has been found in such locations in a range of aspects, and would have gone unrecorded in many more throughout the study area, including the more inaccessible areas of the Devils Wilderness. The Red-crowned Toadlet appears to currently be relatively abundant within the study area. The species was especially common along Linden Ridge Firetrail during December 2007 when males were heard calling extensively from both the ridgetops and along many of the drainage channels leading down into the creeks. A number of rocky pools along first order creeks also had tadpoles in them.

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

BROAD-HEADED SNAKE

Species Profile

Plate 11: Broad-headed Snake © A. Dudley

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

Threats

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

Local and Regional Conservation Status

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

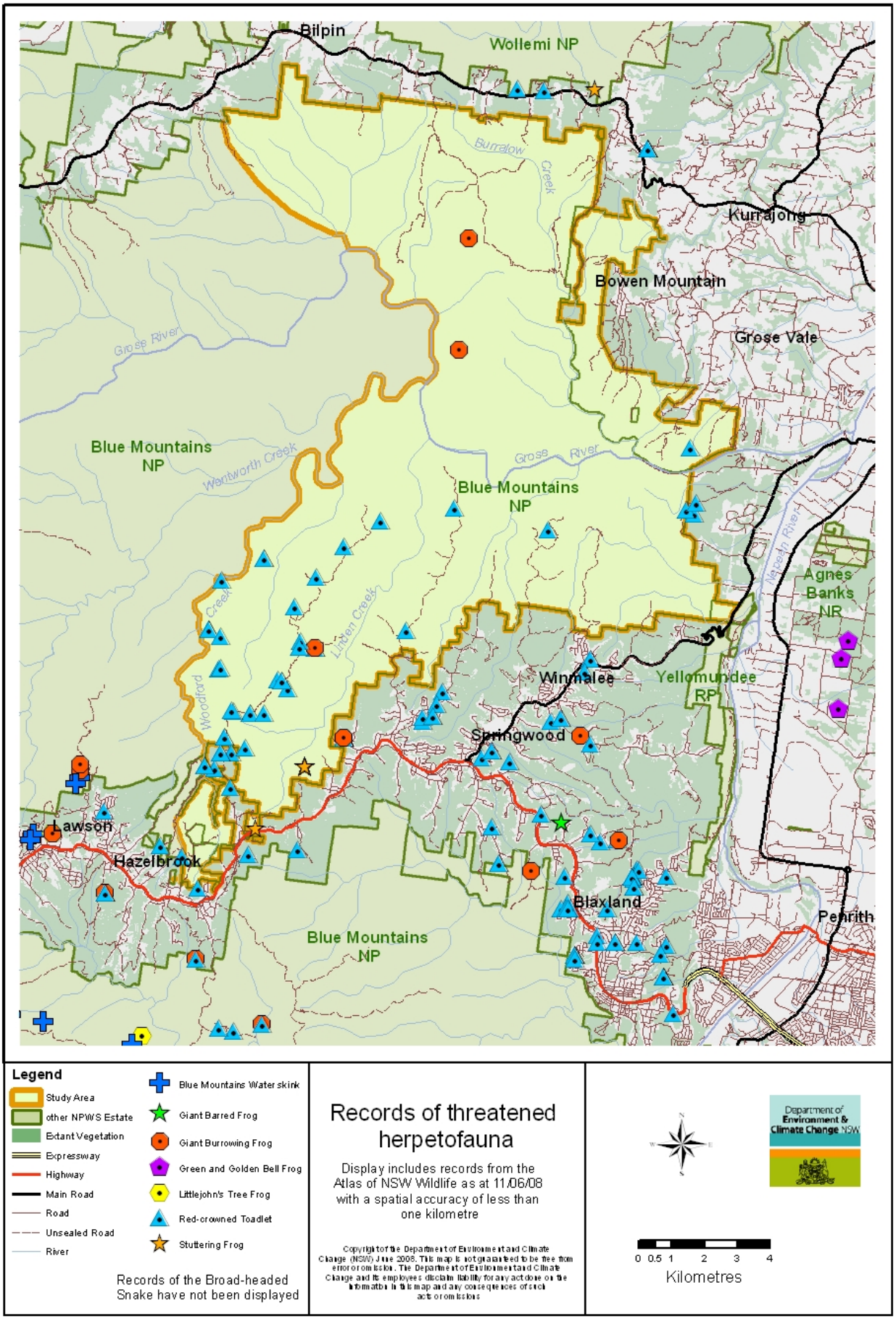
The Broad-headed Snake has been observed on four occasions within the study area. Two sightings were made during the BSP surveys, the first of a snake basking on a rocky sandstone outcrop near Linden Ridge in mid-December. This snake was observed in the same spot on three consecutive days, an observation which compliments published literature as individual snakes are known to return to specific locations and not to move large distances (Webb and Shine 1998). The observation of Broad-headed Snake under rock in summer is interesting, as the species is understood to primarily inhabit tree hollows at this time of year. The second sighting occurred during mid-March along the Tabaraga Ridge Firetrail, when an individual was seen at night during a spotlighting census as it emerged from a tree hollow 15 meters above the ground. The hollow was located in a Sydney Peppermint tree. The other two records are old Australian Museum specimens collected during the early 1980s and 90s from Linden Ridge and the Mount Macleod Morgan area.

The recent sighting of Broad-headed Snake in north-eastern Blue Mountains NP holds high conservation significance, as it officially confirms that this rarely recorded species persists in the study area. The species is likely to also persist in other parts of the Hawkesbury Sandstone plateau where suitable habitat features abound, particularly remote sections located far from roads and access points. Further survey would be required to accurately determine the current status of the Broad-headed Snake in the study area. The species is known to still occur in other parts of the Blue Mountains (to the west and south of the study area) as well as being recently sighted in southern Wollemi NP (DECC 2008c).

The greatest threats to the Broad-headed Snake in north-eastern Blue Mountains NP are the removal or disturbance of bush rock, removal of dead wood, and stealing of specimens by reptile collectors. These threats are most concentrated around roads and access points, such as along the firetrails that lead north from the suburbs lining the Great Western Highway. Evidence of recent rock disturbance, in the form of broken and missing rock plates and crushed invertebrates, is present in the study area particularly along Linden Ridge. As the recent sightings were made in accessible localities, these illegal activities currently pose an imminent threat to the species. Remote sections of the park are less vulnerable to human disturbance, and may therefore provide a refuge for the species. Whether Broad-headed Snake actually persists in more remote areas is currently not known. The species would still be subject to threats in more remote sections of the park, including predation by introduced carnivores and potentially frequent high intensity wildfire.

The key management actions required for Broad-headed Snake in north-eastern Blue Mountains NP are to limit access to known key habitat areas, and initiate a public education program for local residents, amateur herpetologists and potential reptile collectors that focuses on highlighting the critical importance of undisturbed bushrock in natural systems. The study area could also be considered for incorporation into the research programme currently underway trialling the introduction of replacement bush rock to previously disturbed areas. Active management of the Broad-headed Snake in the park should be undertaken in consultation with the species recovery coordinator. Until more efficient survey protocols are identified for this species, further survey is not considered a high management priority. In the absence of more data, any potential Broad-headed Snake habitat located in north-eastern Blue Mountains NP, particularly extensive areas of outcropping and exfoliating rock and adjacent wooded areas supporting hollows should be considered of high conservation significance.

Map 5: Threatened herpetofauna records within five kilometres of north-eastern Blue Mountains NP



GANG-GANG COCKATOO

Species Profile

Plate 12: Gang-gang Cockatoo © K. Madden/DECC

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

Threats

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

Local and Regional Conservation Status

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

Records of Gang-gang Cockatoo are widely scattered across north-eastern Blue Mountains NP (Map 6) and the species is likely to occur throughout the study area. Records have been collected during various times of the year, including spring, summer, autumn and winter, suggesting that the study area provides habitat for the cockatoo all year round. Of the known potential threats to this species, the only ones relevant to the study area are reduced availability of tree hollows from previous logging operations, and potentially climate change.

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

GLOSSY BLACK-COCKATOO

Species Profile

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

Plate 13: Glossy Black-cockatoo © N. Williams/DECC

Threats

The major threat appears to be habitat destruction for agricultural or residential development, causing the removal of nesting and feeding sites and also increased competition from more open habitat species such as Galahs. Because many *Allocasuarina* species are fire sensitive, inappropriate burning regimes may affect food supplies (NSW Scientific Committee 2000a). In addition, the removal of dead wood and dead trees is a Key Threatening Process that may impact on this species (NSW Scientific Committee 2003a), as is competition from Feral Honeybees (*Apis mellifora*) (NSW Scientific Committee 2002b). In addition, DEH (2004a) lists the Glossy Black-cockatoo as a species that has exhibited symptoms of Psittacine Circoviral (Beak and Feather) Disease.

Local and Regional Conservation Status

The Glossy Black-cockatoo is listed as Vulnerable under the TSC Act. Being a large, conspicuous species there are numerous records in the coastal third of the state, though it is also found on the western slopes and an apparently isolated population occurs in the Narrandera-Lake Cargelligo area of the Riverina (NSW Scientific Committee 1999b). Relatively large areas of the Sydney Basin provide suitable habitat for the species and there are a large number of records throughout the Bioregion (DECC 2008b). Feeding habitat is well protected, occurring in numerous DECC reserves, including Morton, Nattai, Blue Mountains, Ku-ring-gai Chase, Yengo and Wollemi NPs.

The Glossy Black-cockatoo has been recorded on 30 occasions within north-eastern Blue Mountains NP, including thirteen Birds Australia records from prior to 1981 (not on Map 6) and seventeen more spatially accurate records (presented in Map 6). Just two of these latter records derive from evidence of feeding activity (in the form of chewed *Allocasuarina* cones) while the remainder represent animals that were directly seen or heard. The records are widely scattered across the study area, though sightings have most frequently been made in sheltered locations in habitats where Forest Oak (*Allocasuarina torulosa*) commonly forms a component of the small tree layer.

North-eastern Blue Mountains NP contributes to the extensive area of high quality Glossy Black-cockatoo habitat that is reserved in the Blue Mountains. The Glossy Black-cockatoo is well protected across the sandstone environments of the Sydney Basin, and appears to have few threats acting upon it within the reserve system. Therefore no management actions are currently required for the Glossy Black-cockatoo in the study area. Fire management may be necessary in the future if research indicates that burning regimes are reducing the abundance or distribution of *Allocasuarina* species.

SWIFT PARROT

Species Profile

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

Plate 14: Swift Parrot © DEC

Threats

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

Local and Regional Conservation Status

The Swift Parrot is listed as Endangered under the TSC Act the EPBC Act. A national recovery plan has been implemented in order to identify and protect key habitat and reverse population declines (Swift Parrot Recovery Team 2001). The majority of records in NSW occur in the three coastal Bioregions and the NSW South West Slopes Bioregion. Most of the records of Swift Parrots in the Sydney Basin Bioregion are in coastal habitats, particularly the Central Coast. The species has also been regularly recorded in drier areas of the Hunter and Capertee Valleys and the Cumberland Plain. Few records occur within reserves, though important sites include Nattai and Werakata National Parks. Intensive surveys in recent years have greatly increased the understanding of habitat usage by Swift Parrots in their wintering grounds in NSW (D. Saunders pers. comm.).

The Swift Parrot has been recorded at a single location in north-eastern Blue Mountains NP, when eleven birds were observed on Shaws Creek in July 2002 and 50 birds were seen in the same spot later that month (DECC 2008b). The observation included one dead Swift Parrot which is suspected to have been caused by a collision with power lines (DECC 2008b). These observations were made in Sydney Hinterland Transition Woodland. It is possible that other sections of the park that support this vegetation community, or Cumberland Shale Sandstone Transition Forest, form further components of the winter feeding habitat for Swift Parrot within the region, even though they may only be visited on occasion. These habitats are concentrated in the east and south-eastern corner of the park, on transition soils between the Cumberland Plain and the Sandstone plateau.

North-eastern Blue Mountains NP supports only a small amount of somewhat peripheral habitat for the Swift Parrot; the majority of the study area does not provide suitable habitat. However, due to the fact that large amounts of Swift Parrot winter foraging habitat have been cleared in the past for agriculture, or are still under threat from urban and industrial development, all habitat that is conserved in reserves has high conservation value. The study area therefore provides a small yet significant contribution to the conservation of the species. Any further sightings of the Swift Parrot within the park should immediately be reported to the species Recovery Team. Management of the transitional woodlands in the east of the park should ensure that essential habitat features for the Swift Parrot are retained, particularly that winter-flowering eucalypts are not felled during fire management operations.

BLACK-CHINNED HONEYEATER (EASTERN SUBSPECIES)

Species Profile

Plate 15: Black-chinned Honeyeater © P. Mahoney

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

Threats

The eastern subspecies of the Black-chinned Honeyeater is one of a suite of woodland birds that have declined throughout their range due to habitat clearance (Reid 1999). They are threatened by clearance and fragmentation of woodland habitat and do not appear to use small remnants less than 200 hectares in area (NSW Scientific Committee 2001b). The species appears to occur naturally at low densities (NSW Scientific Committee 2001b). The species is likely to experience high levels of competition from aggressive honeyeater species associated with smaller fragments and may suffer increased nest predation from such species as the Pied Currawong (NSW Scientific Committee 2001b).

Local and Regional Conservation Status

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

The Black-chinned Honeyeater was recorded for the first time in north-eastern Blue Mountains NP during the BSP surveys, when two individuals were observed during a systematic diurnal bird census west of Stoney Fire Trail in January 2008 (Map 6). The site was located in a patch of Cumberland Shale Sandstone Transition Forest dominated by Broad-leaved Ironbark (*Eucalpytus fibrosa*). This is typical habitat for the species, which moves around the landscape in response to local flowering events. Black-chinned Honeyeaters are likely to utilise the extent of Cumberland Shale Sandstone Transition Forest and potentially Sydney Hinterland Transition Woodland as part of their foraging habitat.

Though the amount of habitat available to the Black-chinned Honeyeater in north-eastern Blue Mountains NP is very limited in extent, the area never-the-less plays a significant role in regional conservation of the species. The species is sporadically recorded on the Cumberland Plain, but much suitable habitat in that area is under continued threat of habitat degradation and fragmentation. Recent surveys of southern Yengo NP revealed a significant amount of Black-chinned Honeyeater habitat in that park, but still the majority of habitat in the region is on unreserved lands. Hence any habitat protected within north-eastern Blue Mountains NP holds high conservation significance. Current threats to the Black-chinned Honeyeater in the reserve are not known, but may include competition with aggressive native honeyeater species such as Noisy Miner.

REGENT HONEYEATER

Species Profile

The Regent Honeyeater (*Xanthomyza phrygia*) is a medium-sized honeyeater with striking black and yellow plumage. It typically favours Box-Ironbark woodland, though it also utilises River Oak forests and coastal habitats such as Swamp Mahogany (*Eucalyptus robusta*) or Spotted Gum (*Corymbia maculata*) dominated forest. The species is semi-nomadic and seems to undertake complex movements, generally dependent on where flowering food trees are available. It feeds on nectar, lerps and insects and nests in the crown of eucalypts where it usually lays two or three eggs. It is endemic to south-eastern Australia, formerly occurring between central Queensland and South Australia. It is now rare in Queensland and probably extinct in South Australia, with a general contraction of range in the other two states (Higgins *et al.* 2001). There is thought to be only a single population of approximately 1500 individuals remaining, with numbers considered to be still decreasing (Garnett and Crowley 2000).

Plate 16: Regent Honeyeater © DECC

Threats

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

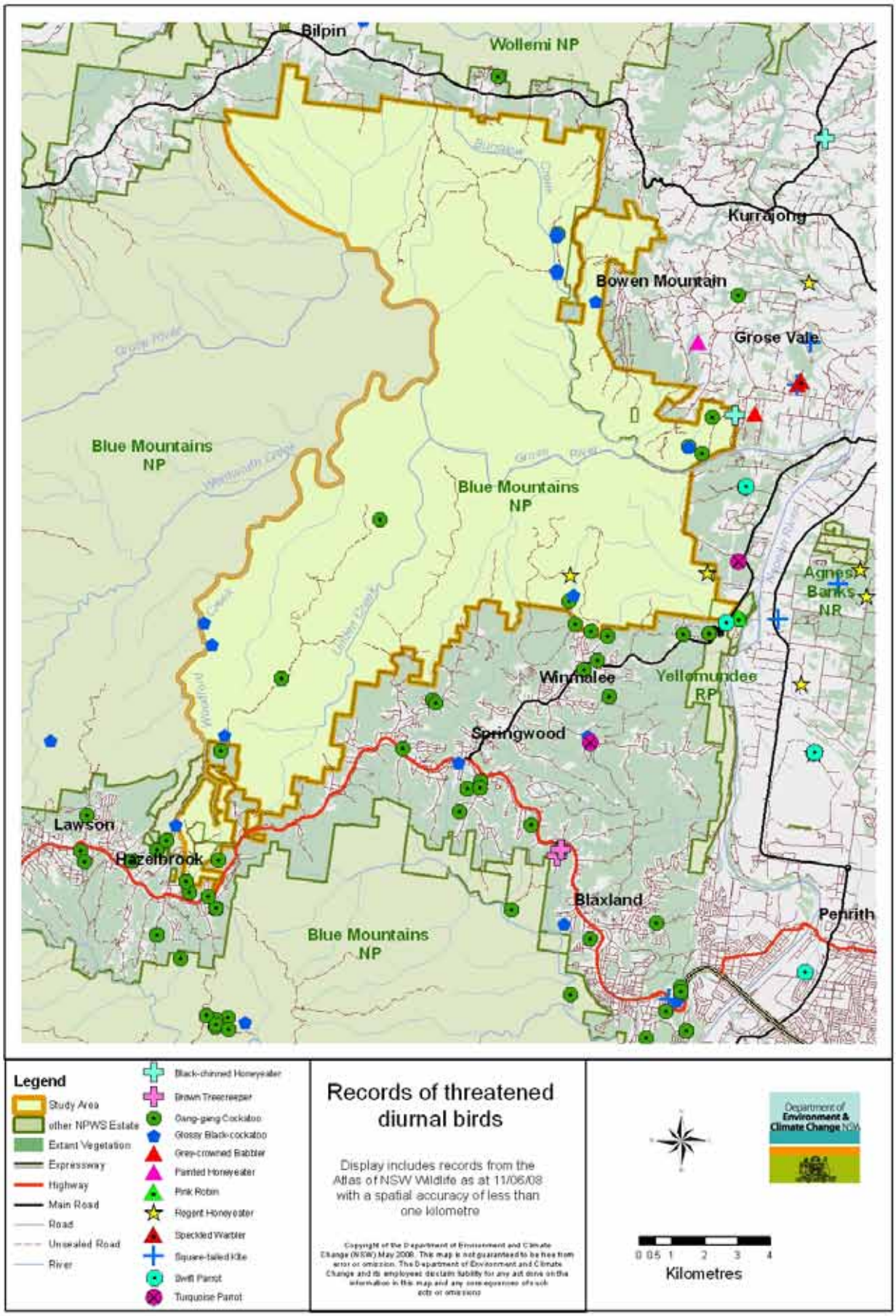
Local and Regional Conservation Status

The Regent Honeyeater is listed as Endangered under the TSC Act and as Endangered under the EPBC Act. Within NSW the greatest numbers occur in the Sydney Basin, Nandewar and New England Tableland Bioregions (DECC 2008b). Important areas in the Sydney Basin are the Capertee and lower Hunter Valleys, the northern Cumberland Plain and the Central Coast. The species is primarily observed outside of reserves, although a small number of parks are regularly used, including Goulburn River and Nattai NPs, Munghorn Gap Nature Reserve, and occasionally Wollemi NP (DECC 2008b).

The Regent Honeyeater was recorded on three occasions during the first Birds Australia atlas, but the exact locations of these sightings are not known and therefore have not been shown on Map 6. In 1970 an individual was banded on Lynch's Creek and in 1987 four individuals were seen on a tributary of Blue Gum Swamp Creek (Map 6). Both of these sightings were made in Hinterland Sandstone Gully Forest, a vegetation community not typical for the Regent Honeyeater, but each was also in close vicinity to Sydney Hinterland Transition Woodland, which is more typical of peripheral habitat for the species. In the vicinity of the study area in the last decade the Regent Honeyeater has most frequently been sighted on the Cumberland Plain between Castlereagh NR and Blue Mountains NP as well as once just north of Richmond (DECC 2008b).

North-eastern Blue Mountains NP supports only a small amount of marginal habitat for this Endangered species, with greater quality habitat occurring on the shale soils of the Cumberland Plain proper. Though it has not been seen in the study area for over twenty years, it remains possible that the Regent Honeyeater visits the eastern and south-eastern peripheries of the park on rare occasions when trees are in heavy flower or food is limited elsewhere. As most of the remaining high quality habitat within the region is fragmented and continues to be degraded or under pressure from development, any habitat that is preserved within the reserve system has high conservation significance. Though the study area contains only a small amount of peripheral habitat, it may none-the-less play an important role as part of the network of foraging resources available to the Regent Honeyeater in the region. Management actions should be focussed on targeted surveys during peak flowering periods of favoured food trees, over several years, in order to ascertain the extent to which the species currently utilises the study area, if at all.

Map 6: Threatened diurnal bird records within five kilometres of north-eastern Blue Mountains NP



POWERFUL OWL

Species Profile

Plate 17: Powerful Owl © N. Williams

The Powerful Owl (*Ninox strenua*) is the largest owl in Australia and is distinguished by its relatively small, round head and long tail. It is dark brown above with prominent off-white barring, and paler underneath with diagnostic dark chevrons. It inhabits various forest habitats, though it usually breeds and roosts in dense forest types, including rainforest and wet sclerophyll forest. It hunts in more open forests, where it feeds mainly on arboreal mammals, particularly Common Ringtail Possums and Greater Gliders (Kavanagh 2002a). This species usually nests in a hollow in a eucalypt within or below the canopy, and normally lays two eggs. It usually maintains a territory of between 300 and 1500 hectares, with size dependent on habitat quality and prey density. The species is endemic to eastern Australia, being recorded between Eungella (Queensland) to near the South Australia-Victoria border (Higgins 1999).

Threats

Past land clearance for agriculture has reduced the area of habitat available for the Powerful Owl (Garnett and Crowley 2000), particularly the availability of nest sites. The owl can, however, survive in areas with some levels of disturbance, such as in selectively logged forests (Kavanagh 1997) and suburban areas of Brisbane, Sydney and Melbourne (Garnett and Crowley 2000, DECC 2008d). Two of the determining factors for the species persistence in disturbed areas are the presence and suitable abundance of prey species (Chafer 1992) and suitable nesting/roosting sites (Debus and Chafer 1994). Other factors that may affect this species include predation of fledglings by Foxes and secondary poisoning, though neither is thought to be a significant cause of mortality (DEC 2006c). In addition, the foliage roosts of the Powerful Owl are vulnerable to regular hazard reduction burning (DEC 2006c).

Local and Regional Conservation Status

The Powerful Owl is listed as Vulnerable under the TSC Act. Within NSW, the majority of records occur within the three coastal Bioregions, but occasional sightings have also been made further west, particularly in the South Eastern Highlands Bioregion. It is regularly recorded throughout the Sydney Basin Bioregion, from the rural-urban fringes of the Sydney Metropolitan area to west of the Dividing Range onto the Central Tablelands. Recent work within the Sydney Catchment Authority Special Areas (Woronora and Warragamba) has found Powerful Owls to be in higher densities and more widespread within the sandstone country of the Sydney Basin than previously thought (DECC 2007b). Most reserves within the Sydney Basin Bioregion support known territories of this species, though they are at lower densities in the drier environments of the north-west.

The Powerful Owl has been recorded at six locations within north-eastern Blue Mountains NP (Map 7). These records are scattered across the area as habitat for the species is widespread in the taller forests which occur in more sheltered environments such as sheltered slopes and creeklines. In total the species responded to four (15 %) nocturnal call playback surveys undertaken in the last decade. This suggests that, though widespread, the Powerful Owl only occurs at relatively moderate density. The distribution of the species across the park is likely to be determined by the presence of tree hollows and the abundance of preferred prey species such as Common Ringtail Possum or Greater Glider.

The expanse of suitable habitat for Powerful Owl in north-eastern Blue Mountains NP plays an important role as part of the wider system of reserves that connect coastal habitats and populations to those on the Great Dividing Range. The Powerful Owl is considered to be relatively secure when located in protected areas and no management actions are currently required for this species in the study area. However, known locations and habitats should be considered during fire management planning, to ensure that the quality of canopy foliage is not altered by regular hazard reduction burning. Management of the owl across the region should be undertaken in accordance with the state-wide recovery plan (DEC 2006c).

MASKED OWL

Species Profile

Plate 18: Masked Owl © R. Jackson

The Masked Owl (*Tyto novaehollandiae*) is a large owl that is distinguished from the similar Barn Owl by its larger size, more thickset and hunchbacked appearance, fully feathered legs and larger feet (Higgins 1999). It inhabits a wide range of open forest and woodland habitats, requiring large hollows for roosting and nesting and open areas for hunting. It feeds mostly on ground-dwelling mammals such as rats and Antechinus, and occasionally on diurnal birds, Sugar Gliders and insects (Kavanagh 2002a). It appears to forage near ecotones, either at the boundary of forests of different structural composition or at the forest edge, and may thus benefit from the mosaic of burnt-unburnt patches in the landscape after fire (DEC 2006c). The owl has a home range of 800 to 1200 hectares (Kavanagh 2002b). It nests in hollow trees, usually eucalypts, where two to three eggs are the normal clutch (Higgins 1999). The nominate subspecies *novaehollandiae* was formerly found around the southern coast of Australia between Fraser Island (Queensland) and Carnarvon (Western Australia), though its range has contracted, particularly in Western Australia (Garnett and Crowley 2000). Other subspecies occur in Tasmania, northern Australia and in New Guinea and adjoining islands, some of which are sometimes considered separate species (Higgins 1999).

Threats

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

Local and Regional Conservation Status

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

Two records of Masked Owl exist within north-eastern Blue Mountains NP, though only one of these is associated with accurate spatial information and is therefore displayed on Map 7. The latter individual responded to a nocturnal call playback census conducted just within the eastern boundary of the study area near Tabaraga Ridge in August 1997. In total Masked Owl responded to just 4 % of nocturnal call playback censuses undertaken in the study area in the last decade, suggesting it to have a very restricted distribution or density. Habitat for the Masked Owl is indeed limited in extent, as the species prefers drier open forests and woodlands on soils of mild to high fertility (DECC 2007b). Potential habitat occurs in the Cumberland Shale Sandstone Transition Forest and potentially Sydney Hinterland Transition Woodland in the east of the study area, though interestingly the single record for the species existing on the park occurs in Hinterland Sandstone Gully Forest.

The habitat within north-eastern Blue Mountains NP is likely to be of only secondary quality for the Masked Owl, with higher quality habitat occurring on the Cumberland Plain including within Agnes Banks and Mulgoa Nature Reserves (DECC 2008b). Never-the-less, as north-eastern Blue Mountains NP is subject to fewer pressures than most of the primary habitat, it may play an important auxiliary role to the long term survival of the species in the region. No specific actions can be recommended for the species at this time, but management of the owl in the region should be undertaken in accordance with the state-wide recovery plan (DEC 2006c).

SOOTY OWL

Species Profile

The Sooty Owl (*Tyto tenebricosa*) is a medium to large 'barn' owl, with sooty grey plumage that is finely spotted and flecked with white. It is found in tall wet forests, including wet sclerophyll and rainforest, where it is often first detected by its distinctive 'falling bomb' call. It roosts and breeds in tree hollows (often located in old emergent trees) as well as in deep sandstone overhangs or dark caves (DEC 2006c). It is usually located within 100 metres of a stream (Kavanagh 1997). Pairs probably maintain permanent territories that are between 200 and 800 hectares in area, depending on the availability of prey (Higgins 1999). The species feeds on a wide range of arboreal and terrestrial mammals (Kavanagh 2002a). In Australia the subspecies *tenebricosa* is distributed along the east coast between Queensland and Victoria. A smaller subspecies (*arfaki*) occurs in New Guinea (Higgins 1999).

Plate 19: Sooty Owl © R. Jackson

Threats

Garnett and Crowley (2000) list the main threat as habitat clearance for agriculture and urban development, along with additional fragmentation or degradation caused by logging, burning and dieback. The exact impacts of logging remain unclear (Higgins 1999). Where the species is at the margins of its ecological tolerance, frequent fire may threaten its occurrence when it results in the replacement of mesic plants with fire tolerant species and impacts on nest and roost sites. The Sooty Owl is a highly specialised species occupying a narrow range of habitats, which makes it particularly vulnerable to climate change (NSW Scientific Committee 2000b).

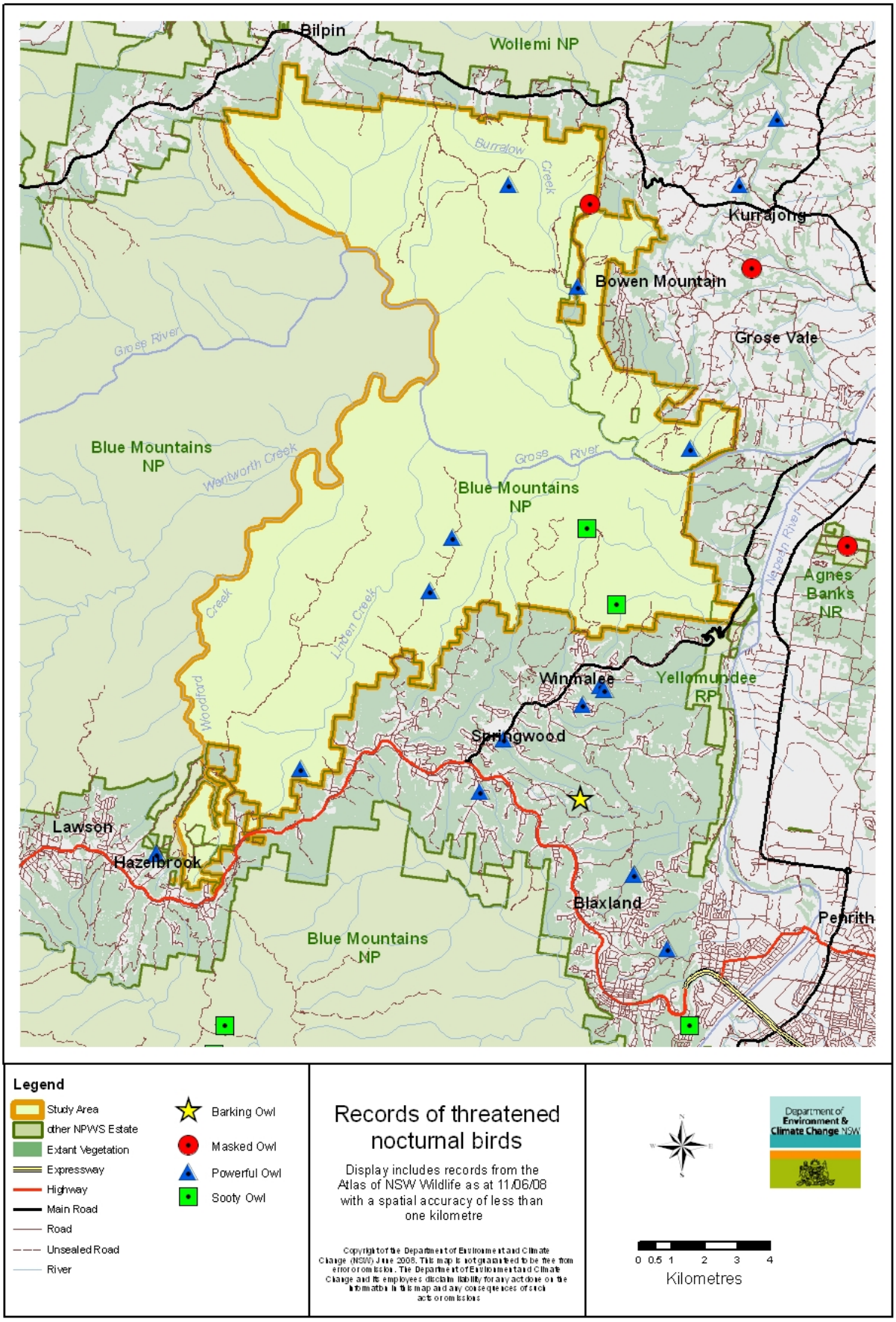
Local and Regional Conservation Status

The Sooty Owl is listed as Vulnerable under the TSC Act. Within NSW it is largely restricted to the three coastal Bioregions, with a few records in the extreme east of the South Eastern Highlands Bioregion. The distribution of this species in the Sydney Basin Bioregion is strongly tied to the presence of wet sclerophyll forests and rainforests. The Illawarra escarpment behind Wollongong and the Watagan Ranges between the Central Coast and Newcastle support the largest areas of high quality habitat (NPWS 2002a). In these areas it has been most often recorded in Illawarra Escarpment and Jilliby State Conservation Areas, with other records in Royal, Blue Mountains and Bouddi National Parks (DECC 2008b).

The Sooty Owl was first recorded on the Atlas of NSW Wildlife in 1986, somewhere in the vicinity of the Grose River, though due to low spatial accuracy this record has not been included in Map 7. During the BSP surveys Sooty Owl were confirmed to occur along Blue Gum Swamp Creek and Shaws Creek, where at each location an individual responded to nocturnal call playback surveys (Map 7). Habitat for the Sooty Owl is widespread in the study area, in areas of rainforest or moist forest with a mesic understorey such as occur in the more sheltered gully lines. The species is predicted to be more widespread than records indicate, potentially occurring along sheltered sections of north-south orientated drainage lines such as Faulconbridge Creek, Cabbage Tree Cree, lower Linden Creek and parts of the Grose River.

Habitat for the Sooty Owl is relatively well represented in conservation reserves in the region, including in south-eastern Wollemi NP (DECC 2008c) and elsewhere in Blue Mountains NP. North-eastern Blue Mountains NP plays an important role as part of the wider system of reserves that connect coastal habitats and populations to those on the Great Dividing Range. The greatest threat to the Sooty Owl within this reserve system is likely to be changes in vegetation characteristic resulting from frequent fire and climate change, leading to a reduction in the availability of suitable mesic habitat. To reduce the potential for this to occur, fire management practices should aim to ensure at least some sections of mesic and rainforest vegetation are always left in a long unburnt state. In general, management of the owl in the region should be undertaken in accordance with the state-wide recovery plan (DEC 2006c).

Map 7: Threatened nocturnal bird records within five kilometres of north-eastern Blue Mountains NP



SPOTTED-TAILED QUOLL

Species Profile

Plate 20: Spotted-tailed Quoll © N. Fenton/DECC

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

Threats

The main problems confronting the Spotted-tailed Quoll are believed to be habitat loss, degradation and fragmentation (Belcher 2004). Other threats include: predation and competition by introduced predators such as Feral Cat, Fox and Wild Dog; disease such as toxoplasmosis; road mortality; and direct mortality at the hands of humans (Mansergh 1984). Quolls were heavily persecuted as killers of domestic fowl, and have been hunted and trapped to extinction in many parts of eastern Australia. In recent years evidence has been collected to suggest that baiting using 1080 (sodium monoflouroacetate) has significant negative impacts on Quoll populations (Belcher 2004, Murray and Poore 2004), however other research contradicts this (e.g. Kortner and Watson 2005). Wild Dog/Dingo control also has the potential to indirectly impact on Quolls as it can result in greater numbers of Foxes and/or Feral Cats (Glen and Dickman 2005). The Spotted-tailed Quoll has been listed as a species affected by the following Key Threatening Processes: removal of dead wood and dead trees (NSW Scientific Committee 2003a); high frequency fire (NSW Scientific Committee 2000a); and removal of bushrock (NSW Scientific Committee 1999c).

Local and Regional Conservation Status

The Spotted-tailed Quoll is listed as Vulnerable under the TSC Act and as Endangered under the EPBC Act. The southern populations are believed to have contracted in range by up to 50 percent in recent years (Maxwell *et al.* 1996). Within NSW the species has been most frequently recorded in the NSW North Coast, Sydney Basin and South East Corner Bioregions (DECC 2007b). There are few recent records for the Sydney Basin Bioregion, though it is still seen with some regularity on the Central Coast between Hornsby and Newcastle, in the upper Blue Mountains and to a lesser extent in the Kangaroo Valley (DECC 2007b). It may have recently become extinct in other areas. The species has been recorded in a number of conservation reserves in the Sydney Basin Bioregion, most recently within Blue Mountains, Brisbane Water, Popran and Wollemi National Parks (DECC 2007b).

The Spotted-tailed Quoll is a very cryptic species. Where it occurs in low density, it is difficult to trap and can require an immense effort to detect using standard survey techniques (Lunney and Matthews 2001). The majority of recent records for the species in the Sydney Basin come from traces left by the animals (such as tracks, remains or scats), road kills and opportunistic sightings. This behaviour is reflected in the low number of Spotted-tailed Quoll records from within north-eastern Blue Mountains National Park, where it has been definitely recorded on the Atlas of NSW Wildlife on just three occasions between 1994 and 2004 (Map 8). The species was detected during the BSP surveys in December 2007, when tracks of an individual were found in a rocky overhang along a creekline in the Linden Ridge area (Map 8). Potential habitat for the Spotted-tailed Quoll is widespread across the sandstone plateau, particularly within moister vegetation types on gully lines and sheltered lower slopes.

In addition to these records there are sporadic reports of Quolls from the greater local area. Many residents living adjacent to the park, in particular in the suburbs aligning both sides of the Great Western Highway, occasionally sight Quolls. There are scattered records from the Bells Line of Road, and the species is commonly sighted around Bowen Mountain (D. Monahan pers. comm.). Most Spotted-tailed Quoll observations recorded on the Atlas of NSW Wildlife from within five kilometres of the study area are of individuals moving across roads or animals raiding chicken coups. In late January 2008, two individuals appear to have been killed by vehicles in the local area, including a mature male found dead on the road near North Richmond and a younger male found near Kurrajong Heights (D. Monahan pers. comm.). It is not surprising that the dead individuals were both males, as males tend to be more mobile and have larger home ranges (Edgar and Belcher 1995). These recent observations suggest that north-eastern Blue Mountains NP remains an important refuge for the Spotted-tailed Quoll and possibly is a source from which individuals can disperse into the greater local area. Despite these sightings the current distribution, abundance and status of the species within the body of the park remains unknown.

Management actions for the Spotted-tailed Quoll would ideally commence with gaining a better understanding of the species current distribution and status. However, due to the difficulty in surveying this species, further surveys would be very expensive and likely to provide little return. Until more efficient survey protocols are identified for this species, further surveys are therefore not recommended. Management should instead focus on mitigation of threatening processes that continue to act within the reserve system including competition and predation from Foxes, Feral Cats and Wild Dogs, and potentially high intensity or high frequency fire. The impact of Fox and Wild Dog predation and competition is still being researched, but likely to be significant on already stressed Quoll populations. Ironically, Fox and Wild Dog control programs also have the potential to negatively impact Quolls. Management of the species in the reserves should consider interactions between Quolls, Dingoes and Foxes and the potential impact of 1080 baiting, with the results of latest research incorporated into any feral animal control programmes. Killing of Spotted-tailed Quolls adjacent to the park boundary, either on roads or when animals are found raiding chicken coups, is also likely to be having a significant impact on the population. Priority should be given to increasing public awareness of the Spotted-tailed Quoll, its identification and conservation status, and to encouraging neighbours and park visitors to report any sightings, together with accurate location information. There is also a need for increased community awareness about the potential impact of road mortality on Quoll populations, and possibly for the erection of signage in the local area to encourage drivers to slow down in areas frequented by threatened wildlife. Landholders should be encouraged to affectively protect their domestic chickens from predators to negate the threat posed by Spotted-tailed Quolls.

KOALA

Species Profile

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

Plate 21: Koala © P. Madden

Threats

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

Local and Regional Conservation Status

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

The single record of Koala in north-eastern Blue Mountains NP appears to be a database error, but a profile has been included for the species as records occur just outside the boundary of the park (Map 8) and the species is considered to have the potential to occur within. The species is most likely to inhabit the east and south-east of the study area where enriched soils occur, particularly as both Sydney Hinterland Transition Woodland and Cumberland Shale Sandstone Transition Forest support Grey Gum, a known favoured tree for the Koala in the region. Potential habitat also occurs in the small patches of Sydney Swamp Forest such as along Shaws Creek. However, Koala are readily detected when they occur in high numbers, such as they do in neighbouring southern Wollemi NP and Parr SCA. Since Koala were not seen or heard calling during the BSP surveys, if they do occur in the park it is likely to be only at very low abundance. This is likely to be due to the absence of preferred feed trees from most of north-eastern Blue Mountains NP.

The status of Koala in north-eastern Blue Mountains NP is not currently known, and hence an assessment of the value of the area to regional conservation of the species cannot be made at this stage. Given the absence of records it can be assumed to be low until further survey proves otherwise. Never-the-less, forests and woodlands in wider alluvial valleys and on transitional soils in the east and south-east should be managed as if they support the species, particularly in relation to fire management practices. Fuel reduction burning in these areas should be conducted outside of the spring/summer period when Koalas are breeding, and crown scorch and crown burns should be avoided. Preferred feed trees, including Red Gums and Grey Gum should not be felled during mop-up operations or construction of fire breaks in potential habitat areas. Another key to management of the Koala in north-eastern Blue Mountains NP is likely to be retaining connectivity with habitat areas to the east, by working with adjacent landholders to conserve Koala habitat and prioritise reserve acquisitions towards lands that support high quality Koala habitat.

SQUIRREL GLIDER

Species Profile

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

Plate 22: Squirrel Glider © N. Williams

Threats

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

Local and Regional Conservation Status

The Squirrel Glider is listed as Vulnerable under the TSC Act. It occurs patchily throughout the eastern Bioregions of NSW, and is only recorded regularly in the NSW North Coast, Nandewar and Sydney Basin (DECC 2008b). Across its range, habitat for the Squirrel Glider occurs primarily outside of public lands (Kavanagh 2004). In the Sydney Basin Bioregion the dry woodlands of the Central Coast provide very high quality habitat and is a stronghold for the species (Smith and Murray 2003). Elsewhere in the Bioregion the species has only been patchily recorded at very low densities, including in a small number of reserves such as Yengo, Wollemi, Blue Mountains, Dharug, Goulburn River and Werakata NPs (DECC 2008b).

The Squirrel Glider has been recorded on two occasions in the Atlas of NSW Wildlife: one record from 1977 along Blue Gum Swamp Creek; and one Australian Museum specimen collected within 10 kilometres of Bowen Mountain in 1996 (Map 8). However, appropriate habitat for the species does not appear to occur at the former location, and the latter record could pertain to habitat on transitional soils on the edge of the Cumberland Plain, to the east of the study area. The status of Squirrel Glider in north-eastern Blue Mountains NP is therefore currently unknown, with no recent records that confidently confirm the species presence. A small amount of potential habitat does occur in the far east and south-east of the study area in Cumberland Shale Sandstone Transition Forest and to a lesser extent Sydney Hinterland Transition Woodland. In the last decade the species has been recorded in the vicinity of Grose Wold on several occasions, including less than two kilometres to the east of the park (Map 8). This suggests the species may also persist within the study area although it is only likely to occur in very low numbers. The majority of the park does not provide suitable habitat.

North-eastern Blue Mountains NP supports only a small fraction of marginal habitat for the Squirrel Glider. However, as much of the remaining habitat in the Cumberland Plain, Hunter Valley and Central Coast is still under threat from further fragmentation and development, all habitat that is conserved has high conservation value. North-eastern Blue Mountains NP may therefore provide a small yet significant contribution to the regional conservation of the species. The Squirrel Glider is subject to ongoing threats even within the reserve system, including predation by Fox and Feral Cat. Management of the Squirrel Glider in the study area will require further survey to determine the species status, and potentially targeted management of introduced predators in areas where the Glider is discovered.

BRUSH-TAILED ROCK-WALLABY

Species Profile

Plate 23: Brush-tailed Rock-wallaby © E. Holland/DECC

The Brush-tailed Rock-wallaby (*Petrogale penicillata*) is a medium-sized macropod, characterised by its distinctive facial markings, black paws, and long thickly furred tail which has a distinctive brush-like appearance near the tip (NSW Scientific Committee 2003b, NPWS 2002b). Habitats occupied by this species tend to take one of three forms: loose piles of large boulders containing a maze of subterranean holes and passageways; cliffs (usually over fifteen metres high) with many mid level ledges covered by overhangs; or isolated rock stacks, usually sheer sided and often girdled with fallen boulders (NPWS 2002b). Most sites where it still occurs have a northerly aspect (Eldridge and Close 2008). Vegetation forms a vital component of the habitat, especially as refugia near major rock outcrops. The Brush-tailed Rock-wallaby was once abundant and ubiquitous throughout the mountainous country of south-eastern Australia, from the Grampians in western Victoria to Nanango in south-east Queensland (Short and Milkovits 1990). This wallaby has declined significantly in the west and south of its former range, and populations have become more fragmented throughout (NSW Scientific Committee 2003b).

Threats

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

Local and Regional Conservation Status

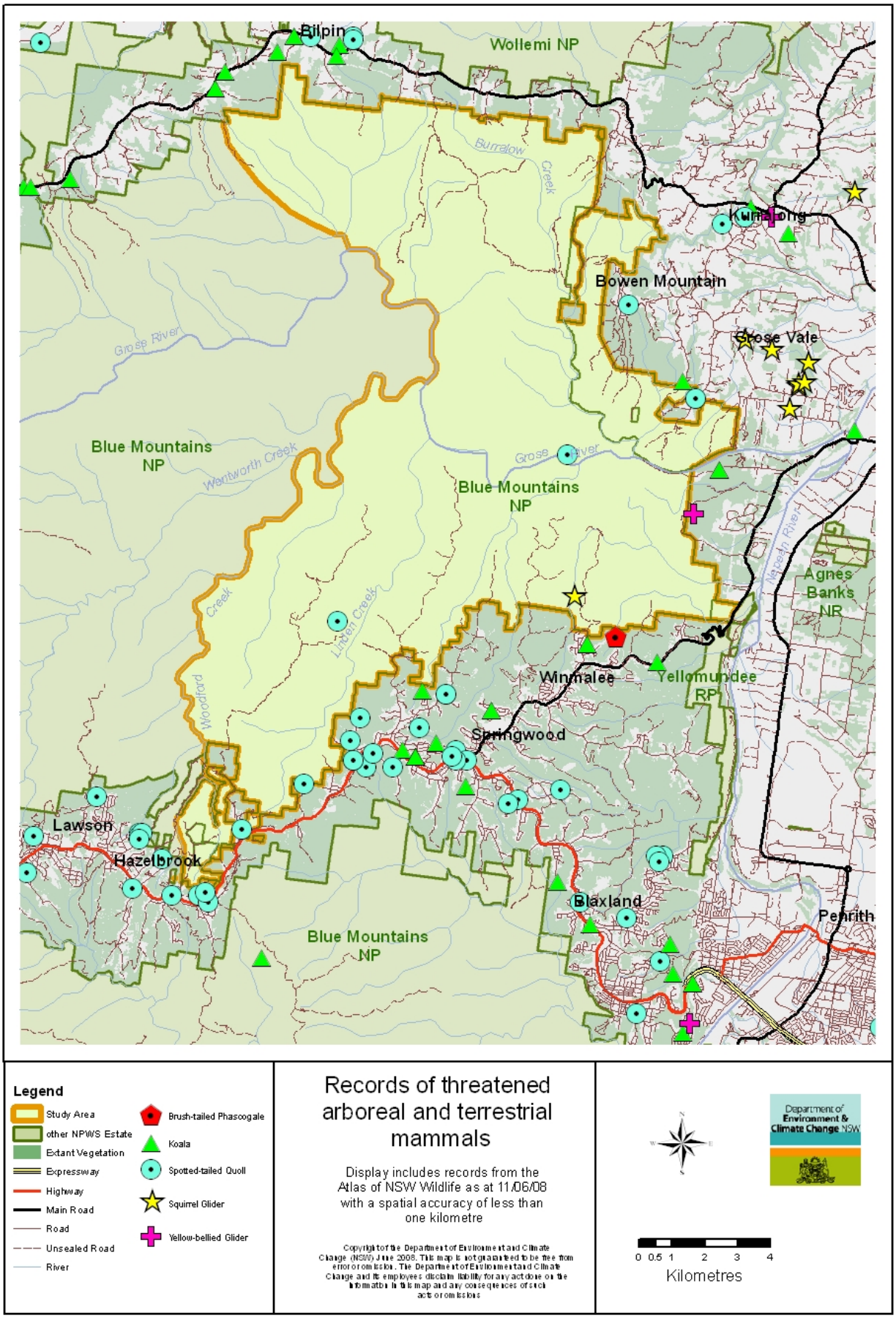
The Brush-tailed Rock-wallaby is listed as Endangered under the TSC Act and as Vulnerable under the EPBC Act. In the Sydney Basin Bioregion the species forms part of one of the three Evolutionary Significant Units (ESU) that summarise genetically distinctive groups on the basis of DNA. The nominate ESU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

The Brush-tailed Rock-wallaby has not been recorded for the study area on the Atlas of NSW Wildlife. However, the surveys undertaken in 2003 by Rummery *et al.* led to the discovery of a colony of the species along cliff lines just north of Faulconbridge Point Lookout. The colony was considered extant at the time of survey, with an estimated six individuals occupying the area searched (Rummery *et al.* 2003). This was the only extant colony located in the lower Blue Mountains during the survey. Within the last decade in the vicinity of the study area the species has also been observed near Yarramundi (in 1999) (Map 8) and near Wheeny Creek in southern Wollemi NP (DECC 2008b). It is possible that the species persists undetected at remote locations in the study area, such as north-facing cliff lines south of the Grose River.

The status of Brush-tailed Rock-wallaby in north-eastern Blue Mountains NP is not currently understood. Management of the species in the park would ideally commence with gaining a better understanding of the species current distribution and status. However, surveys for Brush-tailed Rock-wallaby are labour intensive and expensive. At a minimum it is recommended that the sites at Faulconbridge Point be revisited to determine whether the species currently persists in that area. Surveys could also be extended further east along the cliff lines north-east of Grose Mountain Lookout. Surveys should be conducted by personnel experienced in identifying Brush-tailed Rock-wallaby habitat and scats.

The primary threat to the persistence of Brush-tailed Rock-wallabies in north-eastern Blue Mountains NP is likely to be predation by Foxes. The likely small size of any extant colonies would also make them susceptible to intense wild fire. Continued survival of the Brush-tailed Rock-wallaby in north-eastern Blue Mountains NP and adjacent areas will require active targeted management and is a matter of the highest conservation priority. Management of the Brush-tailed Rock-wallaby must be coordinated with management of the species across the state, the key being to maintain regular communication with the NSW Brush-tailed Rock-wallaby recovery team.

Map 8: Threatened arboreal and ground mammal records within five kilometres of north-eastern Blue Mountains NP



GREY-HEADED FLYING-FOX

Species Profile

The Grey-headed Flying-fox (*Pteropus poliocephalus*) is a large fruit bat that has dark grey body fur, a slightly paler grey head and a russet collar. It is the largest bat in the study area, with a wingspan of up to one metre. It is a highly mobile species and numbers roosting at specific camps may vary depending on season and food availability. It feeds on nectar and pollen of various trees including *Eucalyptus, Melaleuca* and *Banksia* as well as fruits, originally of rainforest species, but now including commercial and garden crops. The species can travel up to twenty kilometres to a food source, and is an important pollinator and disperser of native plants. The Grey-headed Flying-fox is endemic to eastern Australia, between Melbourne, Victoria and Bundaberg in Queensland, though it formerly ranged as far north as Rockhampton (NPWS 2001c).

Plate 24: Grey-headed Fliying-fox © N. Williams

Threats

The main threats to the Grey-headed Flying-fox are: destruction of habitat, particularly of foraging habitat, by clearing for urban development and agriculture; disturbance at roosting sites, particularly of pregnant females; unregulated shooting, particularly when feeding on commercial crops or close to residential developments; electrocution on power lines, particularly in urban areas; and accumulation of pollutants and pesticides (NPWS 2001c, Duncan *et al.* 1999). This species is also commonly entangled on barbwire fences and in nets draped over fruit trees in backyards.

Local and Regional Conservation Status

The Grey-headed Flying-fox is listed as Vulnerable under both the TSC Act and the EPBC Act. The species is regularly recorded in all three coastal bioregions (DECC 2008b). It primarily occurs along the eastern coastal plain, east slopes and tablelands, although regular movements occur over the Great Dividing Range to the western slopes in northern NSW (NPWS 2001c). The species has been recorded foraging in numerous conservation reserves, including Royal, Lane Cove, Dharug, Blue Mountains, Wyrrabalong, Yengo and Werakata National Parks (DECC 2008b), as well as southern and eastern Wollemi National Park. However, a greater number of records occur off reserve, including within parks and gardens in metropolitan areas between Sydney and Newcastle. Eby *et al.* (1999) estimated that there are approximately sixteen camps within the Sydney Basin Bioregion. However, few camps are located on conservation reserves within the region.

The Grey-headed Flying-fox was recorded on the Atlas of NSW Wildlife for the first time within north-eastern Blue Mountains NP in January 2008 when seven individuals were seen feeding on blossoms of Narrow-leaved Stringybark (*Eucalyptus sparsifolia*) south of Little Bowen Road (Map 9). In the vicinity of the study area in the last decade the species has most often been recorded to the east on the Cumberland Plain, including within Agnes Banks Nature Reserve and near the lower reaches of the Grose River (Map 9). Scattered records also exist for the townships along the Great Western Highway. It is not known how often Grey-headed Flying-fox visit north-eastern Blue Mountains NP, but the area would form a component of the foraging habitats on which Grey-headed Flying-foxes in the northern half of the Sydney Basin depend. Large numbers are likely to congregate only when an abundance of eucalypts are in heavy flower, or when food resources are limited elsewhere. There is no indication of a Grey-headed Flying-fox camp in the study area.

North-eastern Blue Mountains NP contributes to the regional system of large reserves (also including Yengo, Wollemi and the remainder of Blue Mountains NPs) that provide a natural foraging area for Grey-headed Flying-foxes in spring and summer, and therefore holds small but significant conservation significance to the species. No specific management actions are currently required for this species within the study area.

EAST-COAST FREETAIL-BAT

Species Profile

Plate 25: East-coast Freetail-bat © N. Williams/DECC

The East-coast Freetail-bat (*Mormopterus norfolkensis*) is a member of a genus of bats that remains in a state of considerable taxonomic uncertainty. Within this group the species can be distinguished by its long forearm, upright ears and robust build (Parnaby 1992a; Churchill 1998; Hoye *et al*. 2008). Reinhold *et al.* (2001) describes the ultrasonic call as "a pattern of alternating pulses", making it unique among *Mormopterus*, though it can also call without this pattern. This is a poorly known species that appears to be restricted to east of the Great Dividing Range from south-eastern Queensland to the Pambula area on the far south coast of NSW (Parnaby 1992a; Duncan *et al.* 1999). Habitat preferences are not well understood, but the species appears to favour dry eucalypt forest and woodland. However, it has also been captured in rainforest and wet sclerophyll forest (Churchill 1998; DECC 2007b). It usually roosts within the hollow spouts of large mature eucalypts either within larger forest remnants or paddock trees and remnant vegetation in cleared land adjacent to forest patches (Hoye *et al*. 2008). It has also been recorded roosting in the roof of a hut and under the metal caps of telegraph poles (Churchill 1998).

Threats

The threats to this species are poorly known, though it is suspected that urbanisation and clearing for agriculture, and forest harvesting have serious impacts (Duncan *et al*. 1999; NPWS 2002c). It has also been suggested that pesticide use may be a problem for this species (NPWS 2002c). Threats may be heightened because the species' entire known distribution lies within an area of concentrated population density. The core habitat for this species is the Grassy Box Woodlands of the coastal plains, such as the Cumberland Plain and lower Hunter Valley, which continue to face pressure from development (DECC 2007b). The impact of Feral Honeybees and introduced hollow-nesting birds, particularly the Common Starling are further potential threats to this bat. The East-coast Freetail-bat is listed as threatened by the Key Threatening Process removal of dead wood and trees (NSW Scientific Committee 2003a).

Local and Regional Conservation Status

The East-coast Freetail-bat is listed as Vulnerable under the TSC Act. Most records for the species in NSW occur within the NSW North Coast, South East Corner and Sydney Basin Bioregions. Within these bioregions it appears to prefer the coastal plains and larger incised valleys of the Dividing Range, with relatively large numbers of records from the Cumberland Plain, Central Coast and Hunter Valley (DECC 2008b). The majority of records for the species within the Sydney Basin Bioregion occur outside of reserves. However, it has been detected within Nattai, Blue Mountains, Dharug, Wollemi, Yengo and Marramarra National Parks and Western Sydney Regional Park (DECC 2008b).

The East-coast Freetail-bat was recorded once during CRA surveys and twice during BSP surveys, each time from ultrasonic call analysis. Known localities for the species now include the Vale of Avoca and Burralow Swamp (Map 9). The mapped vegetation community at these locations are Tableland Swamp Meadow, Hinterland Sandstone Gully Forest and Cumberland Shale Sandstone Transition Forest. The East-coast Freetail-bat has never been captured in a harp trap within the study area, which is a typical result for this species as it generally flies high or ranges widely through more open habitats where it is difficult to capture, and sometimes is even beyond the range of Anabat detectors. The low number of records within the study area itself makes it difficult to assess distribution, but extrapolating patterns elsewhere the species is likely to be most closely tied to alluvial areas and more fertile transitional soils in the far east of the study area. The majority of north-eastern Blue Mountains NP is likely to provide only peripheral habitat. The East-coast Freetail-bat has been recorded more frequently, both in by harp trapping and Anabat detectors, to the east of the study area particularly on the Cumberland Plain between the Grose River and Kurrajong as well as in Agnes Banks Nature Reserve (Map 9).

Though the amount of habitat available to the East-coast Freetail-bat in north-eastern Blue Mountains NP is limited in extent, the area never-the-less plays a significant role in regional conservation of the species. Much suitable habitat in the region is under continued threat of habitat degradation and fragmentation and therefore any habitat protected within north-eastern Blue Mountains NP holds high conservation significance. Current threats to the species in the park are not known, but may include use of pesticides near the park boundary and competition for hollows with introduced species. Management actions should include prevention of removal of hollow-bearing trees during mop-up operations and retaining connectivity with habitat areas on more fertile soils to the east of the study area.

LARGE-EARED PIED BAT

Species Profile

Plate 26: Large-eared Pied Bat © N. Williams/DECC

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

Threats

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

Local and Regional Conservation Status

The Large-eared Pied Bat is listed as Vulnerable under the TSC Act and also as Vulnerable under the EPBC Act. The Sydney Basin is extremely important to the species, holding a large proportion of overall records. Only scattered records occur to the north, south and west of the Bioregion (DECC 2008b). There is a concentration of records across the Blue Mountains plateau, particularly within Nattai and Blue Mountains National Parks, as well as in the upper Hunter Valley in Yengo, Wollemi and Goulburn River National Parks (DECC 2008b). However these concentrations are likely to reflect the locations of recent DECC survey effort. Records are scattered throughout the Bioregion, including southern Wollemi, Kanangra-Boyd, Royal, Gardens of Stone and Morton National Parks (DECC 2008b). However, despite this wide distribution the species is infrequently detected, suggesting that it only occurs at low abundance. At this stage there is no information available on the locality and type of maternity roost sites in the Sydney Basin Bioregion.

The Large-eared Pied Bat was recorded for the first time in north-eastern Blue Mountains NP during the BSP surveys, when a total of six individuals were captured in harp traps at five different locations (Map 9). One of these individuals was trapped in Blue Mountains Heath and the other five in Coastal Sandstone Ridgetop Woodland. No roost sites have been located in the study area, but may occur in deep sandstone overhangs and holes in cliff faces. Maternity roost requirements for the species are poorly understood, but are located within deeper cave systems, which are comparatively rare in the study area. In contrast to the results obtained for the greater southern Sydney region the Large-eared Pied Bat has not been detected along valley floors or the more fertile environments in the east of the study area.

Systematic surveys conducted in northern Wollemi, Yengo and Goulburn River NPs and Parr SCA between 2002 and 2007 have shown the reserves that lie between the upper Hunter Valley and the Colo River to be a stronghold for the species (DEC 2008a). Surveys conducted through north-eastern Blue Mountains NP and south-eastern Wollemi NP in 2007-08 resulted in a lower rate of detection of the Large-eared Pied Bat (the species was captured in twelve per cent of harp trap sites overall), though still revealed the area to play a significant role in the ongoing conservation of the species in the northern half of the Sydney Basin. The Large-eared Pied Bat is more frequently detected in these sandstone reserves than in the plains of the

Hunter Valley, Central Coast or north-western edge of the Cumberland Plain (DECC 2008b) and appears to be well protected. The primary threat to the species in the study area at this stage is likely to be predation by feral animals and possibly wildfires that scorch roost and maternity caves. If any maternity caves are discovered they should become a focus of feral predator and wildfire control programmes. In the mean time, however, no immediate management action is thought to be required for this species in the study area.

EASTERN FALSE PIPISTRELLE

Species Profile

Plate 27: Eastern False Pipistrelle © L. Broome/DEC

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) is a relatively large (up to 70 millimetres) bat that is similar to the Greater Broad-nosed Bat (*Scoteanax rueppellii*). It is distinguished by the possession of two pairs of upper incisors, a gap between the incisors and the canines, and larger ears (Parnaby 1992a; Churchill 1998). Its ultrasonic call pattern can be easily confused with various species of *Scotorepens* and the Greater Broad-nosed Bat, though good quality calls can be distinguished (Reinhold *et al.* 2001). It is patchily distributed throughout its range in south-eastern Australia, between south-east Queensland and western Victoria, and Tasmania. It appears to prefer wet forested habitats, particularly riparian or high rainfall areas, with large trees (taller than 20 metres) (Menkhorst and Lumsden 1995). It may be more common at high elevations (Phillips 1995, Law *et al.* 2008), though it has been recorded between sea level and 1500 metres in Victoria (Menkhorst and Lumsden 1995) and Tasmania (M. Schulz pers. comm.). It usually roosts in hollows in *Eucalyptus*, though it has been recorded in caves (Churchill 1998) and buildings (Law *et al.* 2008). It may hibernate over winter and has been known to travel at least twelve kilometres from its roost site (Churchill 1998).

Threats

Threats to the species are poorly known, but appear to comprise: disturbance to winter roosting and breeding sites, including loss of hollow-bearing trees; loss of trees for foraging; and application of pesticides in or adjacent to foraging areas (DEC 2005a). The Eastern False Pipistrelle is listed as impacted by the Key Threatening Process removal of dead wood and trees (NSW Scientific Committee 2003a).

Local and Regional Conservation Status

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

The Eastern False Pipistrelle has never been captured or otherwise directly observed in north-eastern Blue Mountains NP, as recorded on the Atlas of NSW Wildlife. However, it has been confidently identified at two locations by its ultrasonic call, including once during CRA surveys on Tabaraga Ridge and once during BSP surveys on Linden Ridge (Map 9). Unless a long sequence is recorded, the ultrasonic call of this species is easily confused with those of the Eastern Broad-nosed Bat (*Scotorepens orion*) and Greater Broad-nosed Bat (*Scoteanax ruepellii*) (Pennay *et al.* 2004). This has led to the 'possible' identification of Eastern False Pipistrelle at two further locations including further south on Linden Ridge and adjacent to the eastern boundary of the park in the Vale of Avoca area (Map 9). The vegetation community occurring at the 'definite' localities is Hinterland Sandstone Gully Forest, Coastal Sandstone Ridgetop Woodland (elevation 320 and 350 metres asl), while that in the 'probable' localities is Coastal Sandstone Ridgetop Woodland and Cumberland Shale Sandstone Transition Forest (elevation 460 and 40 metres asl). The Eastern False Pipistrelle has been captured to the east of the study area near Londonderry, and identified from ultrasonic call to the west including near townships of the middle and upper Blue Mountains (DECC 2008b).

As with many other bat species, a better understanding of habitat requirements and further harp trapping surveys are required in order to accurately assess the distribution and conservation status of the Eastern False Pipistrelle in north-eastern Blue Mountains NP and the surrounding region. The species is likely to be more common in higher elevation areas of the Blue Mountains NP, with the study area perhaps providing only lower quality habitat. No specific management actions can be recommended for this species within the study area at this time.

EASTERN BENTWING-BAT

Species Profile

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

Plate 28: Eastern Bentwing-bat © S. Eberhard

Threats

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

Local and Regional Conservation Status

The Eastern Bentwing-bat is listed as Vulnerable under the TSC Act. The species is widely distributed in the eastern third of NSW, with the number of records decreasing with distance from the coast (DECC 2008b). Records are widespread within the Sydney Basin Bioregion, but strong clusters are present in the Lower Hunter and Central Coast, Cumberland Plain, Woronora Plateau and across the southern Blue Mountains. Individuals have been recorded flying through a diverse range of habitats in a number of reserves including Royal, Nattai, Kanangra-Boyd, Blue Mountains and Wollemi National Parks (DECC 2008b). However, roost sites for the species, particularly maternity roosts, are much less frequently recorded and poorly reserved.

The Eastern Bentwing-bat has only been detected in north-eastern Blue Mountains NP by its ultrasonic call, including at five locations during the BSP surveys and one location during CRA surveys (Map 9). The records on Burralow Creek, Paterson Ridge and near Bowen Mountain are confirmed, however those on Tabaraga Ridge and Linden Ridge are uncertain as the calls could only be identified to the 'probable' level of identification accuracy. The reason for the concentration of records in the north-east of the study area is unknown, as the bat is known to forage in a wide range of vegetation types and would be expected to utilise much of the study area as foraging habitat. Eastern Bentwing-bats are infrequently captured in harp traps due to their habit of flying above the tree canopy, and hence the density of records may be an underestimate of the species actual occurrence in the area. Perhaps surprisingly, however, no temporary roost sites were located during the BSP or CRA surveys, despite active searching. No maternity roost locations are known for the area, but it is expected that temporary roost sites would occur in rocky overhangs and caves along the sandstone escarpments.

Though the density of Eastern Bentwing-bat records in the study area is relatively low, the reserve never-the-less makes up an important component of the matrix of foraging and temporary roost site habitat for the species in the region. As urban and industrial expansion continues to place pressure on off-reserve roost sites, any roost sites that are located in reserves will take on increasing conservation importance. Any roost sites discovered in the future, especially any maternity or hibernation sites, should be managed to minimise disruption from visitation and fire. In the mean time, however, no specific management actions can currently be recommended for this species in the study area.

GREATER BROAD-NOSED BAT

Species Profile

The Greater Broad-nosed Bat (*Scoteanax rueppellii*) is a large microchiropteran bat usually found in gullies draining east from the Great Dividing Range between south-eastern New South Wales and north Queensland (Atherton Tablelands). The species can readily be confused with the Eastern False Pipistrelle from which it can be distinguished by its single pair of upper incisors and its smaller ears (Parnaby 1992a). It feeds primarily on beetles and other slow-flying insects; although it has been recorded eating a variety of smaller bat species when caught in harp traps. The Greater Broad-nosed Bat utilises creeks and forest clearings for hunting below 500 metres in altitude (Churchill 1998; Hoye and Richards 2008). It usually roosts in tree hollows, in cracks and fissures in trunks or under exfoliating bark, though it may also utilise old buildings (Churchill 1998; Hoye and Richards 2008). The ultrasonic call of the Greater Broad-nosed Bat is easily confused with other species of *Scotorepens* and with the Eastern False Pipistrelle (Pennay *et al.* 2004).

Plate 29: Greater Broad-nosed Bat © N. Williams/DECC

Threats

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

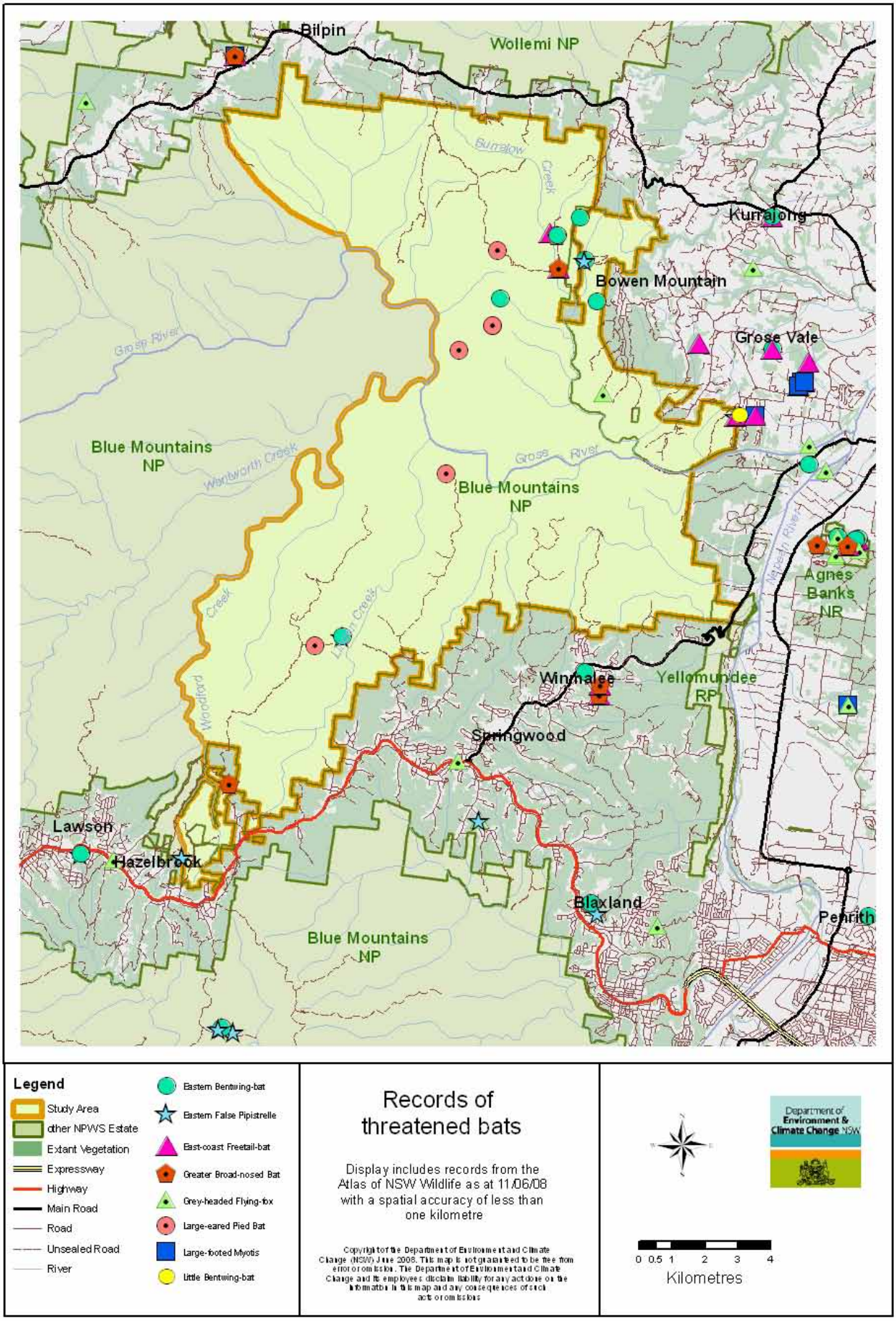
Local and Regional Conservation Status

The Greater Broad-nosed Bat is listed as Vulnerable under the TSC Act. The majority of records for the species in NSW occur in the NSW North Coast, South East Corner and Sydney Basin, with some records in the New England Tableland Bioregion and South-eastern Highlands Bioregion (DECC 2008b). Within the Sydney Basin the species is mainly restricted to the eastern half of the Bioregion, with the greatest density of records on the Central Coast, and to a lesser extent the Cumberland Plain and the southern Blue Mountains. The species is reasonably well reported from DECC reserves within the Sydney Basin, including Nattai, Kanangra-Boyd, Blue Mountains and Wollemi National Parks (DECC 2008b).

There has been some uncertainty about the occurrence of Greater Broad-nosed Bat in north-eastern Blue Mountains NP as the species has never been captured or otherwise directly observed therein. As mentioned above, unless a long sequence is recorded, the ultrasonic call of this species is easily confused with those of the Eastern Broad-nosed Bat and Eastern False Pipistrelle (Pennay *et al.* 2004). A single Anabat call recorded during the BSP surveys has been identified to the 'definite' level of certainty, near the southern end of Linden Ridge (Map 9). Anabat call recording also led to the identification of the species to the 'probable' level of certainty at Burralow Creek during the BSP and CRA surveys. Despite the low level of identification accuracy these latter records have been presented in Map 9 for reference, as the species is likely to occur in this location. The closest point on the Atlas of NSW Wildlife at which Greater Broad-nosed Bat have been captured is just under five kilometres to the east near Agnes Banks (Map 9), as well as other scattered records from the Cumberland Plain. These results align somewhat with findings of surveys undertaken in the greater southern Sydney region and through southern Yengo NP and Parr SCA where the species was most frequently detected in tall forest types particularly more fertile flats and lower slopes (DECC 2008a, DECC 2007b).

Recent systematic surveys between the Hawkesbury and the Hunter Rivers have found the Greater Broad-nosed Bat to be only sparsely scattered through the sandstone reserves, suggesting much of the sandstone plateaux provide only marginal habitat for the species. However, the Greater Broad-nosed Bat remains a poorly understood species and is thought to be only sparsely scattered across its entire range (Parnaby 1992b). Continued scientific survey and research of the species is crucial to guiding its conservation management. Targeted management actions are not immediately required for the species within the reserve, but ongoing survey in the region, and eventually habitat modelling, will lead to a greater understanding of the conservation requirements of this species in the future.

Map 9: Threatened bat records within five kilometres of north-eastern Blue Mountains NP



4.2 INTRODUCED SPECIES

SPOTTED TURTLE-DOVE

Species Profile

Plate 30: Spotted Turtle-dove © M. Schulz/DECC

The Spotted Turtle-dove is a grey-brown dove with a long strongly graduated tail and diagnostic black half-collar that is spotted with white (Higgins and Davies 1996). It is a native to south-east Asia between China and India and was probably introduced to Australia in the 1860s and 1870s for aesthetic reasons (Long 1981). By 1960 it was abundant in most coastal settled areas in NSW, but was rare west of the Great Dividing Range (Long 1981). In Australia, this species is widely associated with urban and suburban environments, using parks, gardens and around homesteads. It is rarely found in native vegetation, though it is sometimes seen in coastal scrub and mangroves, particularly if disturbance has occurred nearby (Higgins and Davies 1996). The species builds an untidy platform of sticks on a limb of native or introduced trees and shrubs, usually in dense foliage, in which they lay two eggs (Higgins and Davies 1996). The Spotted Turtle-dove feeds on the ground, usually on seeds, though in urban areas it will also feed on waste and handouts (Higgins and Davies 1996).

Impacts

The Spotted Turtle-dove is mainly restricted to urban areas and hence impacts are likely to be confined to these habitats. It may compete for food and habitat with native pigeons, such as the Bar-shouldered Dove (*Geopelia humeralis*) (Harrison and Congdon 2002). Other impacts are generally on human activities, where it eats germinating seedlings and chicken feed, and may spread the stickfast flea (*Echidnophaga galinaceae*), a parasite of chickens (Long 1981, Higgins and Davies 1996).

Local and Regional Status

The Spotted Turtle-dove is listed as unprotected under the National Parks and Wildlife Act (1974) (NP&W Act). The frequency with which this species has been recorded has increased between 1984 and 2002 (Barrett *et al.* 2003). It is abundant in the three coastal Bioregions in NSW, particularly in the east of the Sydney Basin Bioregion, while there are only occasional records in drier areas such as the upper Hunter Valley and the Mudgee area. In the South Eastern Highlands Bioregion there are populations in Canberra and Bathurst, and it is occasionally recorded elsewhere. Across its distribution, most observations are made outside of conservation reserves, though the Spotted Turtle-dove is abundant within the smaller, urban parks such as Lane Cove and Garigal NPs, Cockle Bay and Newington NRs and Western Sydney RP, and on the edges of larger reserves that abut urban or agricultural areas.

The Spotted Turtle-dove has only been recorded near the peripheries of north-eastern Blue Mountains NP including along Blue Gum Swamp Creek, the Vale of Avoca and south of Bowen Mountain (Map 10). Undisturbed vegetation does not provide suitable habitat for this species and it is therefore not considered to pose a significant threat to native fauna in the study area. The Spotted Turtle-dove is significantly more common in the highly modified environments of the Cumberland Plain and in the townships of the Blue Mountains (Map 10). This species is rated as a low priority pest species and does not currently require management within north-eastern Blue Mountains NP.

COMMON MYNA

Species Profile

The Common or Indian Myna is a medium-sized, chocolate brown bird with a black head and neck and distinctive yellow beak, eyepatch and legs (Pizzey and Knight 1999). It was introduced to Australia in the 1860s, primarily to control insect pests in agricultural areas. By the 1960s it was common in many metropolitan areas in the east and south-east of the country (Long 1981). In Australia, the Common Myna is closely associated with human habitation, though they do occur in rural and bushland areas in open grassy woodlands (Pell and Tidemann 1997). It nests in hollows, cliffs, buildings or other structures, or in a thick tangle of vegetation, raising two broods of chicks per year (IUCN 2005). Mynas will roost communally choosing thick, exotic vegetation, such as Canary Island Date Palms (*Phoenix canariensis*), Mediterranean Cypress (*Cupressus sempervirens*) or Ivy (*Hedera* spp.) (Pell and Tideman 1997). They will feed on almost anything, including invertebrates, fruits and vegetables, chicks, eggs, lizards and food scraps (IUCN 2005). The Common Myna is aggressive in nature, often seen bullying their own and other species for food, nesting sites or territories.

Impacts

The Common Myna has been listed as among the 'World's Worst Invaders' (IUCN 2005) and it is the most frequently reported bird in urban Sydney (Parsons and Major 2004). It is formally recognised as a conservation problem only in the ACT (ANU 2005). The primary impact is competition for nesting sites, particularly in woodland areas. Common Myna will evict native birds, including Parrots and Dollarbirds (*Eurystomus orientalis*) from their nests, before dumping out their eggs or chicks (Environment ACT 2004). It will also out compete mammals that depend on tree hollows, such as Sugar Gliders (*Petaurus breviceps*), White-striped Freetail-bats (*Nyctinomus australis*) and even Common Brushtail Possums (*Trichosurus vulpecula*) (Environment ACT 2004, M. Schulz, pers. comm.). There is also evidence that the species is spreading into rural areas, increasing the potential impact on threatened woodland species, such as the Superb Parrot (*Polytelis swainsonii*) and Brown Treecreeper (*Climacteris picumnus*) (Environment ACT 2004).

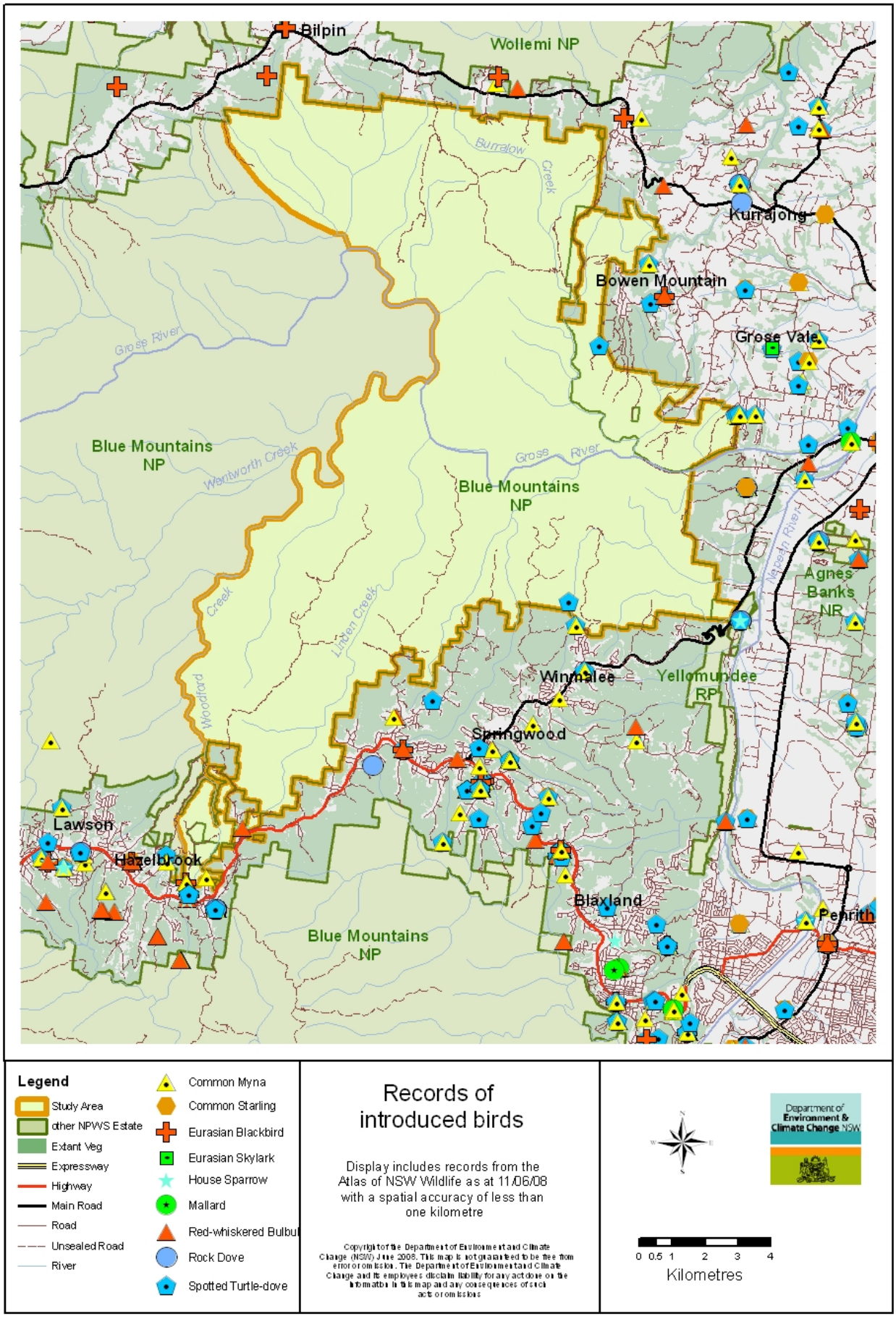
Local and Regional Status

The Common Myna is listed as unprotected under the NP&W Act. Nationwide, the frequency of recordings of this species has increased between 1984 and 2002 (Barrett *et al.* 2003). In the NSW North Coast and Nandewar Bioregions they have increased over the last ten years. Within the Sydney Basin Bioregion the density of records is strongly correlated with areas of human habitation. It is abundant within the smaller urban parks, such as Sydney Harbour and Werakata NPs and Western Sydney RP and on the edges of larger reserves that abut urban or agricultural areas.

The Common Myna has only been recorded near the peripheries of north-eastern Blue Mountains NP including just north of Woodford, on Blue Gum Swamp Creek and in the Vale of Avoca area (Map 10). The most recent sightings in the Vale of Avoca area are of the greatest concern as six individuals were seen within the park, and fifteen heard nearby during the BSP surveys in January 2008. The occurrence of this pest here is very limited in extent however, restricted to the more open woodlands of the Cumberland Shale Sandstone Transition Forest vegetation community, and is unlikely to invade further into the park. The occurrence of Common Myna here is primarily of concern because this vegetation community also provides habitat for several threatened species, including some with which it may compete such as Regent Honeyeater, Black-chinned Honeyeater and East-coast Freetail-bat.

At this stage the distribution and potential impact of Common Myna is not likely to be significant enough to warrant active removal of the species in north-eastern Blue Mountains NP. However, if the species is found to invade further into the park or to be having a significant direct impact on high priority threatened species more active management in the form of localised targeted control could be considered.

Map 10: Introduced bird records within five kilometres of the north-eastern Blue Mountains NP



FERAL DEER

Species Profile

The Fallow Deer (*Dama dama*) was the first species of deer to become widely naturalised in Australia, with populations established in all States except Western Australia (Bentley 1995a). It is native to the Middle East and Europe. Red Deer (*Cervus elephus*), which is native to Eurasia, North Africa and North America, also became established soon after European Settlement but has not spread as widely as other deer species (Bentley 1995b). Rusa Deer (*Cervus timoriensis*) is native to the southern islands of Indonesia, with the main population in NSW descended from a herd of Javan deer that escaped into Royal National Park in 1907 (Bentley 1995c). Deer farms became popular in the 1970s and 1980s, and since this period many deer species have become established from escapees (Moriarty 2004). Between 2002 and 2004/05 Feral Deer have been reported to increase in abundance and range in NSW more than any other pest species (West and Saunders 2007) and hence are an emerging pest animal management issue.

Impacts

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

Local and Regional Status

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

No species of Deer have officially been recorded on the Atlas of NSW Wildlife for north-eastern Blue Mountains NP, however sightings have been reported from the northern boundary by residents who have suggested that Deer may have escaped from hobby farms. In addition, residents around Kurrajong Heights, Grose Vold and Castlereagh have reported seeing Feral Deer (Map 11) and there are reports of Fallow Deer being killed on the road near Bilpin (C. H. Barker pers. comm.). Though many deer sightings are not identified to the species level, Fallow Deer are the most commonly reported in the region, including in southern Wollemi and southern Yengo NPs.

The current impact of Feral Deer on biodiversity in north-eastern Blue Mountains NP is not known. Based on the recent spread of Fallow Deer in other parts of the Sydney Basin (DECC 2007b) the pest is considered to have the potential to increase in density and distribution in the region if not addressed. Priority should be given to increasing public awareness of the potential impact Feral Deer can have on natural systems, and to encouraging neighbours and park visitors to report any sightings together with accurate location information. Any new reports of Feral Deer in the park should be immediately followed up with targeted survey with the aim of determining the extent and approximate size of the population. The Hawkesbury Area and Yango Area offices of DECC currently cooperatively manage Feral Deer in south-eastern Wollemi NP and southern Yengo NP, a programme which should be extended to north-eastern Blue Mountains NP if the pest is found to be established in this area also. Monitoring and management of this emerging issue is a high conservation priority.

FERAL CAT

Species Profile

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

Plate 31: Feral Cat © M. Schulz

Impacts

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

Local and Regional Status

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

The distribution and abundance of the Feral Cat in north-eastern Blue Mountains NP remains very poorly understood. Only one record for the park exists in the Atlas of NSW Wildlife, being an individual seen on Blue Gum Swamp Creek in April 2000 (Map 11). The Feral Cat is a very elusive animal and because scats are typically buried and difficult to locate, it is much less frequently detected than Fox or Wild Dog/Dingo. Therefore the lack of records does not necessarily indicate an absence of the species. Outside of the reserve Feral Cats have been recorded with some regularity around the townships of the middle and upper Blue Mountains as well as at Kurrajong Heights and further east in bushland remnants on the Cumberland Plain (Map 11). However, these records give little indication as to the size and distribution of the Feral Cat population in the region. It is likely that the species occupies most habitats in north-eastern Blue Mountains NP and neighbouring areas at a low density, with concentrations around disturbed areas and the urban-bushland interface. This would only be confirmed by further survey and reporting of sightings. DECC staff and other visitors to north-eastern Blue Mountains NP should be encouraged to accurately report all Feral Cat sightings, for entry in the Atlas of NSW Wildlife. The control of Feral Cats is extremely difficult, and it is not feasible to eradicate the species from the reserve, at least in the medium term.

WILD DOG

Species Profile

Plate 32: Wild Dog © G. Steenbeeke/DECC

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

Impacts

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

Local and Bioregional Conservation Status

Wild Dogs are not protected under the NP&W Act. Wild Dogs are widespread throughout the Bioregions of the Dividing Range and some coastal areas.

Of the seventeen records of Wild Dog/Dingo within north-eastern Blue Mountains NP, five derive from hearing or seeing individuals and the remainder from tracks or scats. These records are sparsely scattered across the park, from Woodford Dam in the south-west along Linden Ridge and north-east to Tabaraga Ridge (Map 11). It is not possible to determine the relative percentage of Wild Dog or Dingo heritage from these records, and hence records in Map 11 are presented as 'Wild Dog/Dingo' to indicate that the sightings may represent either subspecies. The Wild Dog/Dingo complex occurs in a range of habitat types, from Sandstone Scarp Warm Temperate Rainforest through to Blue Mountains – Shoalhaven Hanging Swamps. Records are concentrated along tracks which represents a bias in sampling effort rather than true habitat preferences. Never-the-less, Wild Dog/Dingo is known to travel along trails (J. Betteridge pers. obs.), which may increase the ease of incursion for the species into remote areas.

Blue Mountains National Park is a Schedule 2 area for Dingo conservation, meaning that management of the Wild Dog must be balanced against the need to conserve the Dingo (NPWS *et al.* 2000, DEC 2005). Furthermore, control of Wild Dogs must also be balanced against evidence that their presence confers a marked benefit to small mammals and reptiles and reduces the abundance of Foxes and large herbivores (M. Letnic in prep). The primary threatened species vulnerable to predation by the Wild Dog is thought to be Brush-tailed Rock-wallaby. Control may be deemed necessary around extant Brush-tailed Rock-wallaby colonies in the future, after an assessment of the size and condition of the colonies and the level of threat imposed upon them. Minimising roads, tracks and other cleared access ways into remote areas may help to control the incursion of Wild Dogs into the centre of the park. Any control of Wild Dogs in the future should focus on the peripheries of the reserve to manage impacts on adjoining landholders and protect Dingoes that may occur in more remote areas. Any control programmes must be undertaken in conjunction with Fox management and employ a cooperative cross-tenure approach. Aerial baiting is not recommended for this area due to the lack of imperative from sheep graziers, the Spotted-tailed Quoll and Dingo populations and the important role that Dingoes are likely to play in regulating the ecosystems of south-eastern Wollemi NP.

Fox

Species Profile

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

Plate 33: Fox © N. Williams

Impacts

Predation by the Fox is listed as a Key Threatening Process under the TSC Act and EPBC Act and it is also listed as a pest species under the RLP Act (NSW Scientific Committee 1998, Environment Australia 1999b). It is known to impact on a range of native species by either preying on them or competing with them for food and other resources. In particular medium sized mammals, ground-dwelling and semi-arboreal mammals, ground-nesting birds and chelid tortoises are thought to be affected (Dickman 1996b, NPWS 2001d). As pests in an agricultural landscape, Foxes are known to prey on lambs and domestic fowl and can be a significant problem in some areas. Foxes have been shown to have a role in regulating the populations of some of their prey species, including Eastern Grey Kangaroo (*Macropus giganteus*) (Banks *et al.* 2000).

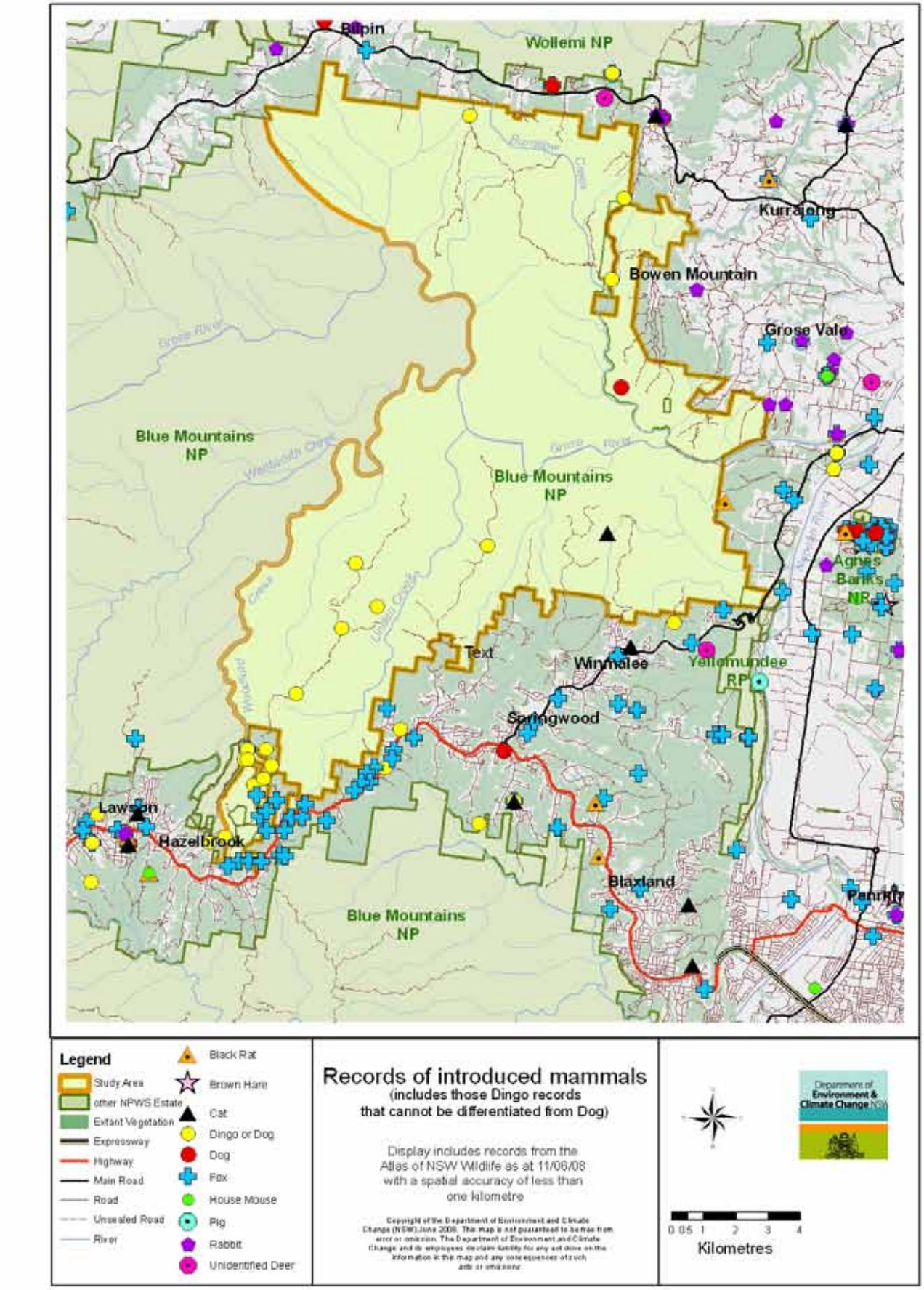
Local and Regional Status

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

Somewhat surprisingly the Fox has not been recorded from the majority of north-eastern Blue Mountains NP. Fox records for the study area are concentrated in the far south-western corner, as a survey of neighbours in this area resulted in the reporting of a number of Fox sightings (DECC 2008b, Map 11). Though highly cryptic and rarely seen directly in bushland areas, the species is easy to detect from other signs such as scats and tracks. The reason for the scarcity of records is not known, but suggests the species may only occur at low densities in comparison to other recently surveyed natural areas such as south-eastern Wollemi NP and Parr SCA. Alternatively, the heavy rainfall events over the summer of 2007-08 washed away previously existing Fox tracks and scats before the surveyors could record them. The Fox is much more frequently recorded outside of the study area, including around townships of the Blue Mountains and urban areas of the Cumberland Plain (Map 11), though this surely relates to the density of human habitation in these areas translating to a higher sighting and reporting rate. The Fox is known to occur in a wide variety of landscapes and habitats, with recent modelling in the greater southern Sydney region showing the species to prefer areas with moderate to high rainfall, including the upper and mid Blue Mountains (DECC 2007b). Given this the Fox can be assumed to occur throughout north-eastern Blue Mountains NP, though perhaps only at low densities.

Foxes are unlikely to ever be eradicated from Blue Mountains NP and particularly given the absence of records from the study area active Fox control is not considered a high priority at this time. Recent research in arid areas has shown Fox numbers, and their impacts, are dramatically reduced where Dingoes are present (M. Letnic in prep). While further research needs to be conducted in forested environments, it is highly likely that where Dingoes can be protected, such as the Blue Mountains wilderness, they will be an effective and labour-free tool to control Foxes. Based on research elsewhere, fauna species in the study area thought to be most at risk from Fox predation are Brush-tailed Rock-wallaby and Spotted-tailed Quoll, while potential habitat for susceptible species including Speckled Warbler occurs in the far east. If any extant Brush-tailed Rock-wallaby colonies are found within the study area, a Fox control programme employing baiting may be deemed worthwhile. Hawkesbury Area should receive regular updates on the findings of Fox TAP research programs, particularly as they relate to Brush-tailed Rock-wallaby management, to enable efficient take-up of management actions as appropriate. Ultimately Fox control would not be successful without the adoption of a multi-faceted approach including cooperative cross-tenure programmes and consideration of the competitive interactions with other mammalian carnivores.

Map 11: Introduced mammal records within five kilometres of north-eastern Blue Mountains NP



5 PRIORITIES FOR FAUNA CONSERVATION AND MANAGEMENT

5.1 THREATENED SPECIES CONSERVATION MANAGEMENT PRIORITIES

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

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

Highest: Species that are likely to become extinct from the study area in the short to medium term without action, and for which the study area may play an important role in the regional conservation of the species. This includes species that may already be locally extinct, but if they are found to occur would require active management to increase their chance of survival. These species require management at a site by site level.

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

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

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

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

Priority for Management in the Study Area	Species	Number of Confirmed Records in the Study Area [1]	Key Locations in the Study Area	Potential Key Threats in the Study Area	Significance of the Study Area to Regional Conservation of the Species
Highest Priority Require targeted management at a site level	Brush-tailed Rock-wallaby	No records on Atlas of NSW Wildlife but colony found in 2003.	Faulconbridge Point. Also potentially north-facing cliff lines south of the Grose River.	Predation by and disease transmission from feral carnivores and potentially hot wildfire at rocky refuge sites.	Unknown but potentially high.
	Stuttering Frog	2 records from the 1960s. No recent confirmed sightings.	May be locally extinct. Habitat occurs in sheltered creek headwaters with rainforest elements, including tributaries of Dawes and Linden Creeks and Wilderness Brook and in the vicinity of Atkinsons Gullies.	It is not known whether Chytrid fungus occurs, but would present a highly significant threat to this species if it does.	Unknown but would be high if species is re-discovered.
High Priority Require further survey and/or management of key habitats and key threats	Broad-headed Snake	4	Rock outcrops with exfoliating sandstone on ridgelines and upper slopes and nearby forest with hollow-bearing trees.	Removal and disturbance of winter shelter sites (bush rock), collection of specimens by reptile collectors, removal of dead wood, and potentially low density of hollow-bearing trees in gully lines.	High
	Regent Honeyeater	2	Habitats within and adjacent to Cumberland Shale Sandstone Transition Woodland and Sydney Hinterland Transition Woodland.	Competition from more aggressive honeyeater species, fire (including hazard reduction burns) during nesting periods, ongoing fragmentation and development of primary habitat to the east of the study area and elsewhere.	Low
	Swift Parrot	2	Habitats within and adjacent to Cumberland Shale Sandstone Transition Woodland and Sydney Hinterland Transition Woodland.	One individual is thought to have been killed by collision with power lines, which may be a threat to the few individuals that do visit the perimeters of the park. The primary threat to the species occurrence is ongoing fragmentation and development of winter habitat to the east of the study area and elsewhere.	Low
	Spotted-tailed Quoll	4	Would range through the whole park but particularly in moister vegetation types on sheltered slopes, gully lines and riparian zones.	Predation and competition by feral carnivores, potentially high frequency fire and baiting for Foxes or Wild Dogs.	Moderate

Priority for Management in the Study Area	Species	Number of Confirmed Records in the Study Area [1]	Key Locations in the Study Area	Potential Key Threats in the Study Area	Significance of the Study Area to Regional Conservation of the Species
	Squirrel Glider	1	Unknown. Potential habitat occurs in Cumberland Shale Sandstone Transition Forest and Sydney Hinterland Transition Woodland.	Predation by Fox and Feral Cat, competition from introduced and native aggressive honeyeaters and potentially Feral Honeybees, frequent fire and removal of dead wood and dead trees in Transitional Forests and Woodlands, ongoing fragmentation and development of habitat to the east of the study area.	Low
	East-coast Freetail-bat	3	Alluvial areas and more fertile transitional soils in the far east of the study area.	Unknown. Potentially application of pesticides adjacent to the park, competition with introduced birds and Feral Honeybees, and removal of dead wood and dead trees from Transitional Forests and Woodlands.	Low
	Grey-headed Flying-fox	1	Potential foraging habitat widespread.	None known. Potentially fire during times of heavy eucalypt flowering and land use management practices on adjacent private lands including shooting.	Low
Moderate Priority Require management of key habitats and key threats	Masked Owl	1	Not well understood but likely to be more open forests and woodlands along riparian zones on soils of mild to high fertility such as the Vale of Avoca area and Burralow Creek area.	Unknown. Potentially frequent fire and removal of dead wood and dead trees in Transitional Forests and Woodlands and competition with introduced birds or Feral Honeybees.	Low
	Black-chinned Honeyeater	1	Areas of Cumberland Shale Sandstone Transition Forest and potentially Sydney Hinterland Transition Woodland, especially where dominated by Ironbark species.	Competition from more aggressive honeyeater species, frequent fire in Transitional Forests and Woodlands, ongoing fragmentation and development of primary habitat to the east of the study area.	Low
	Sooty Owl	3	Sheltered areas where mesic vegetation with rainforest elements occurs, particularly Blue Gum Swamp Creek, Shaws Creek and potentially Wilderness Brook, lower Burralow Creek and Faulconbridge Creek and some minor sheltered tributaries of the Grose River.	Possibly low density of hollow-bearing trees due to past logging practices. Potentially future changes in vegetation characteristics and prey species abundance resulting from frequent fire and climate change.	Moderate

Priority for Management in the Study Area	Species	Number of Confirmed Records in the Study Area [1]	Key Locations in the Study Area	Potential Key Threats in the Study Area	Significance of the Study Area to Regional Conservation of the Species
	Koala	1 record that appears to be a database error	Status in the study area unknown. Most likely to occur in habitat types supporting Grey Gum or Red Gum including Sydney Hinterland Transition Woodland, Cumberland Shale Sandstone Transition Woodland and Sydney Swamp Forest	Unknown. Potentially predation from Wild Dogs or large scale wild fire resulting in loss of unburnt refuge habitat.	Unknown
	Greater Broad-nosed Bat	1 definite and 2 probable	Taller forest types particularly more fertile flats and slopes.	Unknown. Potentially application of pesticides adjacent to the park, competition with introduced birds and Feral Honeybees, and removal of dead wood and dead trees from Transitional Forests and Woodlands.	Low
	Eastern False Pipistrelle	2 definite and 2 probable	Taller forest in higher altitude areas including Linden Ridge, Tabaraga Ridge and potentially Shaws Ridge.	Unknown. Potentially application of pesticides adjacent to the park and hollow competition from Feral Honeybees.	Low
Lower Priority Do not currently require management actions	Large-eared Pied Bat	5	Widespread through a range of habitat types particularly sandstone ridgetops and escarpment lines.	Unknown. If roost sites occur within the study area these are vulnerable to disturbance by hot wildfire.	Moderate
	Red-crowned Toadlet	40	Widespread south of the Grose River. Breed in first and second order creeklines and sometimes pools on ridgetops. Key areas include Linden and Dawes Ridges.	No threats currently identified. It is not known whether Chytrid fungus occurs, but may significantly affect this species if it does break out.	High
	Giant Burrowing Frog	3	Potential habitat widespread. Breed in the headwaters of minor drainage channels or on larger creeklines with alluvial sand and rocky pools.	It is not known whether Chytrid fungus occurs, but may significantly affect this species if it does break out.	Moderate
	Powerful Owl	6	Habitat widespread in taller forests such as sheltered slopes and creeklines.	Possibly low density of hollow-bearing trees due to past logging practices. Regular hazard reduction burning may damage foliage roosts and alter the abundance of prey species.	Moderate

Priority for Management in the Study Area	Species	Number of Confirmed Records in the Study Area [1]	Key Locations in the Study Area	Potential Key Threats in the Study Area	Significance of the Study Area to Regional Conservation of the Species
	Eastern Bentwing-bat	4 definite and 2 probable	Foraging habitat widespread.	Not known but potentially application of pesticides adjacent to foraging areas. If roost sites occur within the study area these are vulnerable to disturbance by hot wildfire and caving and predation by Feral Cats.	Low
	Gang-gang Cockatoo	19	Widespread. Primarily taller forests along gully lines and sheltered slopes.	Possibly low density of hollow-bearing trees due to past logging practices. Climate change may be a significant future threat.	Moderate
	Glossy Black-cockatoo	17	Widespread. Sheltered forest that includes Forest Oak in the small tree layer, particularly the eastern half of the study area.	Possibly low density of hollow-bearing trees due to past logging practices. Climate change may be a significant future threat if it results in altered fire regimes that reduce the abundance of *Allocasuarina* species.	Moderate

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

5.2 THREATENING PROCESSES

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

Table 9: Relative Priority and Key Locations of Key Threatening Processes

Key Threatening Process	Key current locations of threat and areas to target for abatement/management
Predation by the European Red Fox	Though Foxes have not been recorded through much of the study area, occurrence is never-the-less expected to be widespread. The extent of impact on animal populations is not well understood. Foraging efficiency seems to be maximal in habitats with an open understorey (Environment Australia 1999b). Total eradication is not feasible. Baiting for Fox in the study area is not currently recommended, but if monitoring/control is determined to be worthwhile key areas include locations and habitats of Brush-tailed Rock-wallaby and areas of Cumberland Shale Sandstone Transition Forest.
Ecological consequences of high frequency fire	The Vale of Avoca area is particularly at risk as it is used as an asset protection zone and subject to regular hazard reduction burning which has the potential to impact on several high priority threatened fauna species. Fauna in the Linden Ridge area is also at risk from regular hazard reduction burning. The entire study area is potentially at risk from high frequency wildfire, especially sections of the north and south that have burnt more than three times in the last 20 years including in the north between Burralow Creek and Browns Ridge and west of Faulconbridge Ridge. Current impacts on native fauna are not well understood, but further research may confirm that this threat is currently having a significant impact on biodiversity in the park.
Bushrock removal and disturbance	Ridgelines in the vicinity of tracks and trails, most notably Linden Ridge. Options for abatement and management are currently being coordinated by the Metro Biodiversity Conservation Section.
Removal of dead wood and dead trees	Areas adjacent to human settlement at risk due to illegal collection of firewood as well as regular hazard reduction burning. The Vale of Avoca area is particularly at risk as removal of dead wood and dead trees has the potential to impact on several threatened fauna species.
Loss of hollow-bearing trees	Historical logging operations removed timber from Browns Ridge, Wilderness Ridge, Paterson Ridge, Springwood Creek and Linden Creek (Macqueen 1997), while Burralow Creek was formerly cleared for Cattle grazing. These practices would have resulted in a lower density of large, old hollow-bearing trees in these areas. These forests will mature naturally with no active management currently required to address this issue.
Predation by Feral Cats	Distribution unknown and significance of impact on animal populations not well understood. Occurrence likely to be widespread but concentrated around the perimeters of the park. Habitats most likely to be affected include Blue Mountains-Shoalhaven Hanging Swamps and Blue Mountains Heath, as birds nest close to the ground, as well as potential habitat for Speckled Warbler including Cumberland Shale Sandstone Transition Forest.
Infection of frogs by amphibian Chytrid fungus	Occurrence and distribution is not known. Headwaters of minor drainage channels and sheltered creeklines with mesic vegetation are the highest priority for research.
Competition from Feral Honeybees	Distribution and abundance not known. Potential impacts may be exaggerated in areas where logging or clearing has occurred in the past resulting in a reduced availability of tree hollows.
Invasion of native plant communities by exotic perennial grasses	Distribution not well understood by author, but vegetation on transitional soils in the far east of the study area (Vale of Avoca area) are at most risk.

Key Threatening Process	Key current locations of threat and areas to target for abatement/management
Herbivory and environmental degradation caused by Feral Deer	Entire area at risk, especially the north, south and east in proximity to urban and agricultural areas. Current existence of Feral Deer in the park is not confirmed, and hence impacts on biodiversity are not known. If Deer currently occur, or are introduced to the study area in the future, they have the potential to become a significant threat if left unchecked.
Human-caused climate change	Potential impact on fauna species poorly understood at this stage. Several studies currently being undertaken will inform the management of this impending threat.
Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations	Not currently known from study area.

Table 10: Other threatening processes acting in north-eastern Blue Mountains NP

Process	Key locations of threat
Predation by Wild Dogs and hybridisation between Wild Dogs and Dingoes	Records of the Wild Dog/Dingo complex are widespread throughout the reserve. The presence of Dingo may reduce Fox numbers and their impacts. The key areas of threat are the peripheries of the reserve (where Dogs may invade the park and hybridise with Dingoes) and potentially in the vicinity of extant Brush-tailed Rock-wallaby colonies, though the latter requires further research before any control action is taken.
Very high intensity fire	This is a threat anywhere in the study area where no unburnt refugia are left, particularly where mesic vegetation-dependant species such as Sooty Owl, Powerful Owl and Spotted-tailed Quoll occur and in the vicinity of rocky refugia of any extant Brush-tailed Rock-wallaby colonies.
Competition for hollows from Common Myna	Known areas of occurrence are adjacent to townships along the Great Western Highway, Blue Gum Swamp Creek and the Vale of Avoca. Of greatest concern is the occurrence of the species in Cumberland Shale Sandstone Transition Forest at the eastern extremity of the Vale of Avoca area.
Collection of individual specimens of Broad-headed Snake	Rocky outcrops on ridges and exposed slopes adjacent to trails.
Application of pesticides in neighbouring farmlands	Extent of practice and level of impact on threatened fauna is not known. Potential problem areas are the northern and eastern boundaries of the study area adjacent to agricultural properties such as orchards.
Firetrail and firebreak construction and maintenance that alters local hydrology or destroys road-side ditches	All ridgelines and upper slopes.
Invasion of waterways by Willow (*Salix* spp.) and Lantana (*Lantana camara*)	Willows are known to occur along the Grose River, threatening riparian species such as Platypus and Large-footed Myotis. This problem, and other weed issues, are currently being actively addressed by community and bushcare groups in cooperation with the DECC Hawkesbury Area.
Reduction in water quality in the Grose River	The townships of the Blue Mountains and a colliery lie within the catchment of the Grose River. These have an impact on the water quality of the river, for example potentially leading to elevated levels of zinc (C. Isaacs pers. comm.). Changes to water quality could threaten riparian vertebrate species such as frogs, Platypus and Large-footed Myotis.

5.3 RELATIVE PRIORITY OF FAUNA HABITATS

The Information and Assessment Section is currently working towards undertaking modelling of habitat for threatened and regionally significant species across the northern half of the Sydney Basin. In the interim, an assessment has been made for this project of the habitats and corresponding vegetation communities in north-eastern Blue Mountains NP that are occupied by highest, high and moderate priority threatened fauna species. In addition, habitats that support a highly rich assemblage of vertebrate fauna species in relation to the area they occupy within the park have been highlighted. This assessment has been used to derive several high priority fauna habitats, the management of which will lead to the greatest benefit for conservation of fauna diversity in the study area. The high priority fauna habitats nominated as a result of this project are summarised in Table 11 and discussed below.

The forests and woodlands on transitional soils in the eastern quarter of the study area, particularly in the Vale of Avoca area, provide habitat for a number of high and moderate priority threatened fauna species, as listed in Table 11. Furthermore these vegetation communities, in particular the Cumberland Shale Sandstone Transition Woodland, are subject to several past and ongoing threatening processes including high frequency fire, loss of hollow-bearing trees, invasion by feral species, weed invasion and potentially removal of dead wood and dead trees. In recognition of the ongoing threats acting upon Cumberland Shale Sandstone Transition Woodland, and its poor representation in conservation reserves, this community is recognised as threatened under the TSC Act. The forests and woodlands on transitional soils in the east of the study area are therefore considered the **highest priority fauna habitat**.

It is currently not known whether Stuttering Frog is extant within north-eastern Blue Mountains NP. However, habitat for this species occurs in the more sheltered creeklines in higher rainfall areas and the discovery of the species would have extremely high conservation significance. Vegetation communities that comprise this habitat type also potentially support Sooty Owl, Spotted-tailed Quoll and Powerful Owl. Rainforests are limited in extent in the study area, and may be subject to threatening processes in the future including climate change, ecological consequences of high frequency fire and infection of stream-dwelling frogs with Chytrid fungus. Potential habitat for the Stuttering Frog is therefore considered to be **high priority fauna habitat**.

Habitat for the Brush-tailed Rock-wallaby and Broad-headed Snake is not well delineated by mapped vegetation communities, but rather determined by the occurrence of specific habitat features, as described for each species in Section 4. However, potential habitat for these species would also form **high priority fauna habitat**. In the absence of adequate habitat mapping for these species, the area around all known extant and historic Brush-tailed Rock-wallaby colonies is considered to be high priority fauna habitat (see Map 9), as are known and historic localities of Broad-headed Snake (see Map 4) and corresponding extensive areas of outcropping and exfoliating rock.

During the 2007-08 BSP surveys, upland swamps and heaths were found to support a high diversity of fauna species, particularly snakes, skinks and frogs. These vegetation communities also support potential habitat for the Broad-headed Snake, although this species also occurs in rocky areas of ridgetop woodland and gully forest. Other threatened species recorded in this habitat type (though again not exclusively) are Red-crowned Toadlet, Giant Burrowing Frog, Glossy Black-cockatoo, Large-eared Pied Bat and Gang-gang Cockatoo. Upland swamps and heaths are very restricted in extent, and for their size contribute a proportionately large amount to the vertebrate fauna diversity in north-eastern Blue Mountains NP. These vegetation communities are therefore considered a **priority fauna habitat**.

Table 11: Summary of priority fauna habitats within north-eastern Blue Mountains NP

Habitat Type	Highest, high and moderate priority threatened fauna species for which potential habitat occurs	Correlating vegetation communities within north-eastern Blue Mountains NP
Transitional Forests and Woodlands	Regent Honeyeater Swift Parrot Squirrel Glider East-coast Freetail-bat Grey-headed Flying-fox Masked Owl Black-chinned Honeyeater Greater Broad-nosed Bat Speckled Warbler Koala	Cumberland Shale Sandstone Transition Forest Sydney Hinterland Transition Forest (more shale-influenced areas)
Heaths and Upland Swamps	Broad-headed Snake These habitats also support regionally significant species such as Southern Emu-wren and Beautiful Firetail and contain a high diversity of reptiles and frogs.	Blue Mountains Shoalhaven Hanging Swamps Blue Mountains Heath Coastal Sandstone Plateau Heath
North-facing escarpment lines and rocky slopes and adjacent vegetation, creeklines.	Brush-tailed Rock-wallaby	Not well delineated by vegetation type
Vegetation with mesic and rainforest elements on sheltered slopes and sheltered creek headwaters.	Stuttering Frog Sooty Owl Spotted-tailed Quoll	Lower Blue Mountains Wet Forest Sandstone Scarp Warm Temperate Rainforest

6 SUMMARY OF MANAGEMENT RECOMMENDATIONS

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

6.1 INTRODUCED SPECIES

In order to guide management of pest species in north-eastern Blue Mountains NP, the following notes and recommendations are made. These recommendations are made primarily with regards to pest species impacts on fauna biodiversity and threatened fauna species.

6.1.1 Fox

- The absence of Fox records from the Atlas of NSW Wildlife is puzzling as there is no obvious reason as to why the species would not be widespread as it is through other sandstone wilderness areas such as Wollemi and Yengo NPs. Despite the lack of records it can be assumed that the species does occur, though maybe only at low density. The extent of impact on native fauna is not well understood.

- In order to improve the understanding of Fox distribution and predation in north-eastern Blue Mountains NP it is recommended that wherever possible predator scats be collected by DECC staff and sent to an expert for identification and prey analysis. Occupied Brush-tailed Rock-wallaby habitat, Heaths and Uplands Swamps, and transitional woodlands and forests should be targeted for predator scat collection and analysis. Results, together with accurate location information, should be entered into the Atlas of NSW Wildlife in order to build up a database of the prey composition of predators in different parts of the reserves and the impact they are likely to be having on fauna species in particular habitats.

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

- Given the widespread occurrence of Fox through adjacent lands, it is unlikely that the species will ever be eradicated from the reserve. Given this, the current sparsity of records within the study area, and the potential for Fox control to impact on non-target species, Fox control is not considered a high priority at this time.

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

- The Transitional Forests and Woodlands provide habitat for a number of threatened species vulnerable to Fox predation. Heaths and Upland Swamps provide habitat for a number of ground and shrub-frequenting birds as well as small to medium-sized mammals that shelter in dense vegetation at ground level and hence are highly vulnerable to predation by Foxes. If a programme of Fox control is undertaken within the reserve these priority habitats should also be considered for inclusion.

- Foxes readily utilise roads, tracks and other cleared access ways through denser vegetation or complex topography (Environment Australia 1999c). One option to minimise Fox impacts in the study area is to reduce such access points to a minimum.

6.1.2 Feral Cat

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

6.1.3 Wild Dog

- Analysis of predator scats in other parts of the Blue Mountains World Heritage Area have shown that Wild Dogs consume fewer types of species than the Fox, and generally larger, more common species such as Swamp Wallaby (DECC 2007b). Therefore, in terms of impacts on overall biodiversity Wild Dogs are potentially less important than Foxes. It is recommended that wherever possible predator scats be collected by DECC staff and sent to an expert for identification and prey analysis. Results, together with accurate location information, should be entered into the Atlas of NSW Wildlife in order to build up a database of the prey composition of predators in different parts of the reserve and the impact they are likely to be having on fauna species in particular habitats.

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

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

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

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

6.1.4 Feral Deer

- The distribution and status of Feral Deer is currently unknown. Feral Deer have the potential to have a significant impact on biodiversity if they are, or become, established in the reserve. Gaining an understanding of the extent of occurrence of Feral Deer within north-eastern Blue Mountains NP is therefore a high management priority.

- Surveys for Feral Deer could include: survey/interviews of neighbouring landholders to establish precise details of recent sightings; aerial survey undertaken in conjunction with work in south-eastern Wollemi and southern Yengo NP; searching for tracks, scats and other signs of Deer activity in areas where sightings have been recently reported. All confirmed records of Feral Deer should be entered into the Atlas of NSW Wildlife.

- If a population(s) of Feral Deer is confirmed to occur, a control programme should be swiftly developed in consultation with experts on the species. The sooner such a programme is implemented the higher the chance that the pest can be successfully eradicated from north-eastern Blue Mountains and adjacent reserves.

6.1.5 Common Myna

- The occurrence of Common Myna in north-eastern Blue Mountains NP is currently limited in extent but has the potential to impact on several high and moderate priority threatened species including Squirrel Glider, East-coast Freetail-bat, Masked Owl, Sooty Owl and Greater Broad-nosed Bat. At this stage, active removal of Common Myna from the park is not considered necessary given the density of occurrence on the Cumberland Plain, the high potential for the species to recolonise, and the fact that impacts do not currently extend far into the park boundary. However, should the species be found to markedly increase in numbers, to invade further into the park, or to be having a highly significant impact on high priority threatened fauna species, then active management should be considered.

6.1.6 Feral Honeybee

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

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

6.2 FIRE MANAGEMENT AND FAUNA

The impact of wildfire and controlled burning on fauna remains poorly understood. Research currently being undertaken by DECC is one of few studies comparing fauna composition in long unburnt vegetation to vegetation that has undergone extensive and severe wildfire. Findings of that study will aid in understanding the impacts of severe wildfire on fauna in north-eastern Blue Mountains NP.

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

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

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

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

- Fire planning should recognise the crucial role that unburnt refugia play in the recolonisation of burnt landscapes, particularly after extensive and intense wildfire. When only small areas are left

unburnt these should remain in an unburnt state for as long as possible, at the very least for five years.

- Avoid burning areas that provide habitat for declining woodland birds during the nesting season, namely the Transitional Forests and Woodlands priority fauna habitat group. For most species this is primarily between the months of July and January (Higgins *et al.* 2001; Higgins and Peter 2002).

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

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

- Fire regimes in the Transitional Forests and Woodlands should be managed to ensure key habitat features are maintained and enhanced, including: diversity of native grasses; moderate density of shrub thickets; fallen logs and standing or fallen dead trees; hollow-bearing trees.

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

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

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

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

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

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

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

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

- If any cave roost sites of Large-eared Pied Bat or Eastern Bentwing-bat are located in the park, particularly maternity roosts, high intensity wildfire should be excluded, where possible.

6.3 HABITAT MANAGEMENT

A number of threats identified in Table 9 warrant active management, particularly in more accessible areas of the reserve such as neighbouring private lands and in the vicinity of tracks and trails.

- Bushrock removal and disturbance, and collection of specimens, is an ongoing threat to frogs and reptiles, particularly in accessible and well known areas such as Linden Ridge. DECC

Hawkesbury Area should work cooperatively with the Metro Biodiversity Conservation Section to mitigate these threats. Approaches being trialled in other areas include: placement of signage along major highways in the region to notify the public of the illegality and sensitivity of bush rock disturbance and specimen collection; use of artificial rock as alternative shelter sites; and education of the local public regarding the importance of undisturbed bushrock in natural systems.

- Removal of dead wood and dead hollow-bearing trees is a potential threat to the ecological integrity of vegetation communities near the peripheries of the park, particularly the Transitional Forests and Woodlands, as it dramatically reduces the value of the habitat to numerous fauna species including several high and moderate priority species. Illegal collection of firewood from the park should be actively discouraged at every opportunity. One possible approach is the placement of signs on the eastern and south-eastern boundary of reserve where Transitional Forests and Woodlands occur, advising the public of the important role dead wood on the ground and standing dead trees play in the conservation of native fauna, and the illegality of collection from the reserve.

6.4 OFF-RESERVE CONSERVATION

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

- Helping the community to become aware of the conservation value of particular habitats within and adjacent to north-eastern Blue Mountains NP. High conservation value habitats include: mapped areas of vegetation that constitute the Transitional Forests and Woodlands, both within and outside of the reserve; any extant Brush-tailed Rock-wallaby colonies; Heaths and Upland Swamps; and vegetation with a rainforest element along sheltered slopes and creeklines.

- Helping the community become aware of the threat that actions they take can pose to fauna both on and off reserve. Landholders should be encouraged to prevent the progress of relevant threatening processes, which entails: in situ retention of fallen wood, dead trees, live hollow-bearing trees and bush rock; avoiding planting of exotic plant species, particularly exotic grasses; avoiding the use of pesticides in lands adjacent to the park boundary wherever possible; and never releasing Deer, Dogs, Cats or other non-native species into the park due to their potential to become feral. Neighbours should also be encouraged to adequately protect domestic chickens from predators to lessen the threat posed by Spotted-tailed Quolls.

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

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

6.5 LAND ACQUISITION PRIORITIES FOR FAUNA

In terms of vertebrate fauna, priorities for land acquisition are areas that contain significant intact amounts of the high priority fauna habitats described in Section 5.3. Transitional Forests and Woodlands are poorly represented in the reserve system and are the highest priority for addition to Blue Mountains National Park, particularly where remnant vegetation is present and contiguous with larger areas of native vegetation. Previously disturbed lands remain worthy of addition to the reserve system if they hold enough ecological integrity to naturally regenerate in the long term. Vegetation communities that are a high priority for inclusion in the reserves are: Cumberland Shale Sandstone Transition Forest and Sydney Hinterland Transition Forest (particularly more shale influenced areas).

6.6 FURTHER SURVEY AND MONITORING

The systematic fauna surveys undertaken in 1997-98 and 2007-08 have resulted in an adequate level of understanding of the occurrence of most fauna species, and there is now comprehensive documentation of the fauna characteristics of north-eastern Blue Mountains NP. The key priorities for further survey and analysis now lie in gaining a more detailed understanding of particular species not well sampled during the systematic survey process, as well as developing information systems that detail the relative quality of habitats and areas for particular threatened species and hence help guide the assessment of habitats sensitive to threatening processes such as fire and feral pests.

6.6.1 Individual species projects

Brush-tailed Rock-wallaby – High Priority

Brush-tailed Rock-wallaby have only been recorded just north of Faulconbridge Point Lookout in 2003 (Rummery *et al.* 2003). This location has not been re-visited in recent years and it is unknown whether the colony is extant. A follow-up survey of this location is a high priority. The easiest technique to employ would be searches for fresh scats. The surveys should be undertaken by personnel experienced in identifying potential Brush-tailed Rock-wallaby habitat on the ground, and identifying scats and individuals. If the colony is found to be extant it should be subject to a broad scale assessment of threats, particularly search and collection of predator scats, and search for Feral Goat scats. The surveys should be undertaken in consultation with the species recovery coordinator.

Potential habitat for Brush-tailed Rock-wallaby also occurs in more remote locations, such as north-facing cliff lines south of the Grose River. Habitat modelling to be completed by the Information and Assessment Section will aim to identify areas of high quality Brush-tailed Rock-wallaby habitat in the park. Survey in remote areas is labour intensive and expensive, but considered worthwhile particularly if the colony at Faulconbridge Point Lookout is found to be extant.

Stuttering Frog – High Priority

The Stuttering Frog is known to have disappeared from numerous protected areas, and reservation of habitat alone will not guarantee its survival. Though habitat is present it is not currently known whether the species persists within north-eastern Blue Mountains NP, and therefore the extent to which the study area contributes to conservation of this Endangered species. Targeted survey for Stuttering Frog is a high priority, particularly as only one location was visited 1999-2000 regional Mixophyes surveys. The following programs are highly recommended:

- Targeted survey of sheltered creek headwaters and associated rock pools and sheltered slopes within warm temperate rainforest. Surveys should be undertaken in spring or summer, particularly after rain, when individuals are most vocal and active and should include visitation to remote sheltered gorges and canyons, where the species is most likely to persist undiscovered. The surveys should include passive listening, call playback and searches for tadpoles, and follow the standard techniques being developed by the species recovery team when they are finalised. Surveys must be undertaken by personnel experienced in the identification of adult frogs (including the call), identification of tadpoles, and assessment of habitat value. Additionally the surveyors must be willing to access remote and difficult terrain, possibly with the assistance of climbing equipment. Suggested locations for survey are tributaries of Dawes and Linden Creeks and Wilderness Brook, and sheltered slopes in the vicinity of and to the east of Atkinsons Gullies in the Grose River Valley.
- Survey for Chytrid fungus in potential habitat areas. This should involve swabbing of adults and tadpoles, of Stuttering Frog or other frog species, by experienced personnel. The swabs are placed in sterilised containers and then sent for testing. If both Chytrid fungus and Stuttering Frogs are located, an assessment of the level of infection and the impact on the populations should follow. In particular, it would be vital to assess whether Chytrid infection is significantly suppressing recruitment of frogs to the adult stage.
- These surveys must be undertaken with strict adherence to frog hygiene protocols to ensure diseases are not spread between populations or catchments.

Feral Deer – High Priority

As outlined above surveys for Feral Deer could include: survey/interviews of neighbouring landholders to establish precise details of recent sightings; aerial survey undertaken in conjunction with work in south-eastern Wollemi and southern Yengo NP; searching for tracks, scats and other signs of Deer activity in areas where sightings have been recently reported.

Regent Honeyeater and Swift Parrot – Moderate Priority

Targeted survey work is required to determine the relative importance of north-eastern Blue Mountains to conservation of the Regent Honeyeater and regional conservation of the Swift Parrot. It is recommended that surveys be undertaken during peak flowering periods over several years, in order to ascertain the extent to which these species utilise the study area, if at all. Key areas for survey are the Transitional Forests and Woodlands and adjacent areas in the east of the park. Such surveys need to be undertaken by experienced observers familiar with the species calls. The occurrence of other declining woodland bird species, such as Black-chinned Honeyeater and Speckled Warbler, should also be searched for and noted as part of these surveys.

Dingo – Incidental/Low Priority

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

6.6.2 Other future work

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

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

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

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

Survey for Chytrid fungus and long term monitoring of frogs in the Linden Ridge area – Lower Priority

The 2007-08 BSP surveys confirmed the Linden Ridge area to support a high diversity of frog and reptile species, including Red-crowned Toadlet and Giant Burrowing Frog. Though both of these species is currently considered to be secure in the reserve system the potential for spread of Chytrid in these species and the resulting impact on populations is not known. Linden Ridge area, and associated first and second order drainage channels, is an ideal candidate area to assess the potential occurrence and impact of Chytrid fungus on these and other frog species over the long term. This study could be undertaken in association with a university or other government body as it is essential that it be designed in a scientifically rigorous manor in order to obtain useable results. Surveys could involve bi-annual assessment of population numbers, level of habitat occupation, and presence/extent of Chytrid fungus infection. Any such surveys must be undertaken with strict adherence to frog hygiene protocols to ensure diseases are not spread between populations or catchments.

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APPENDIX A – LOCATION OF SURVEY SITES

Tabulated below is the location of systematic fauna survey sites in north-eastern Blue Mountains NP and the techniques undertaken at each site, as at 17th June 2008. All sites are located in Zone 56, using Australian Geodatum 66.

Survey program	Site number	Easting	Northing	Vegetation Community (Tozer *et al.* 2006)	Diurnal bird census	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping
BSP Survey	KRR001H	274111	6277228	Blue Mountains Heath	1	1	1	1				
BSP Survey	KRR002H	276058	6285926	Blue Mountains - Shoalhaven Hanging Swamps		1						
BSP Survey	KRR003H	273273	6286875	Blue Mountains - Shoalhaven Hanging Swamps	1	1						
BSP Survey	KRR004O	273269	6285615	Coastal Sandstone Ridgetop Woodland	1	1						
BSP Survey	KRR005W	278850	6279646	Coastal Sandstone Ridgetop Woodland	1	1	1	1				
BSP Survey	KRR006W	278744	6281081	Sydney Turpentine Ironbark Forest	1	1						
BSP Survey	KRR007W	278667	6282431	Sydney Turpentine Ironbark Forest	1	1	1	1	1			
BSP Survey	KRR008W	278687	6280815	Coastal Sandstone Ridgetop Woodland				1				
BSP Survey	KRR009W	281601	6278667	Cumberland Shale Sandstone Transition Forest	1	1						
BSP Survey	KRR010W	282542	6278128	Cumberland Shale Sandstone Transition Forest	1	1	1	1			1	
BSP Survey	KRR011W	280943	6277657	Coastal Sandstone Ridgetop Woodland	1	1		1				
BSP Survey	KRR012W	282891	6278953	Cumberland Shale Sandstone Transition Forest	1	1	1	1	1			
BSP Survey	KRR014O	277456	6284435	Hinterland Sandstone Gully Forest					1		1	
BSP Survey	KRR015S	277267	6284541	Tableland Swamp Meadow	1	1	1		1			1
BSP Survey	KRR016O	278166	6284967	Coastal Sandstone Ridgetop Woodland	1	1	1		2			
BSP Survey	KRR017O	278376	6283736	Hinterland Sandstone Gully Forest	1	1	1	1				
BSP Survey	KRR018H	275936	6283189	Blue Mountains Heath	1	1	1					
BSP Survey	KRR019W	274518	6280964	Coastal Sandstone Ridgetop Woodland	1	1	1	1			1	
BSP Survey	KRR020S	274811	6284341	Blue Mountains - Shoalhaven Hanging Swamps	1	1						
BSP Survey	KRR021O	275071	6285968	Coastal Sandstone Ridgetop Woodland		1	1	1				
BSP Survey	KRR022W	273721	6287817	Coastal Sandstone Ridgetop Woodland		1	1					
BSP Survey	KRR023W	275739	6287670	Shale-Basalt Sheltered Forest		1						
BSP Survey	KRR024W	275508	6281711	Coastal Sandstone Ridgetop Woodland				1				
BSP Survey	KRR025W	276027	6283072	Coastal Sandstone Ridgetop Woodland				1				
BSP Survey	KRR026W	277346	6283289	Hinterland Sandstone Gully Forest				1	1			
BSP Survey	KRR027O	277555	6283558	Hinterland Sandstone Gully Forest				1				
BSP Survey	KRR028W	273749	6288435	Coastal Sandstone Ridgetop Woodland				1				
BSP Survey	KRR029W	275677	6283995	Coastal Sandstone Ridgetop Woodland				1				
BSP Survey	KRR030W	275730	6282515	Coastal Sandstone Ridgetop Woodland			1		1			

Survey program	Site number	Easting	Northing	Vegetation Community (Tozer *et al.* 2006)	Diurnal bird census	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping
BSP Survey	KRR031O	278403	6279546	Coastal Sandstone Ridgetop Woodland							1	
BSP Survey	KTM016W	267080	6268256	Hinterland Sandstone Gully Forest	1	1	1					
BSP Survey	KTM017H	267373	6269233	Blue Mountains Heath	1	1	1					
BSP Survey	KTM018O	268005	6268893	Sandstone Scarp Warm Temperate Rainforest	1		1			1		
BSP Survey	KTM019C	268228	6268253	Sandstone Scarp Warm Temperate Rainforest	1							
BSP Survey	KTM020O	267183	6271293	Hinterland Sandstone Gully Forest	1	1						
BSP Survey	KTM021W	267405	6272326	Coastal Sandstone Ridgetop Woodland	1	1						
BSP Survey	KTM022O	267830	6273150	Coastal Sandstone Ridgetop Woodland		1						
BSP Survey	KTM023H	267659	6270000	Blue Mountains Heath			1					1
BSP Survey	KTM025O	266988	6271985	Hinterland Sandstone Gully Forest	1	1						
BSP Survey	KTM026O	266889	6272485	Sandstone Scarp Warm Temperate Rainforest	1	1	1			1	1	
BSP Survey	KTM027W	266803	6272919	Sandstone Scarp Warm Temperate Rainforest	1	1						
BSP Survey	KTM028W	266828	6268532	Blue Mountains - Shoalhaven Hanging Swamps	1							
BSP Survey	KTM030W	267396	6267408	Coastal Sandstone Ridgetop Woodland	1	1	1					
BSP Survey	KTM031H	267543	6269860	Blue Mountains Heath				1				
BSP Survey	KTM032O	267540	6267805	Coastal Sandstone Ridgetop Woodland				1	1			
BSP Survey	KTM033W	266667	6269976	Coastal Sandstone Ridgetop Woodland							1	
BSP Survey	KTM034W	267087	6266202	Coastal Sandstone Ridgetop Woodland							1	
BSP Survey	SPR019O	268569	6269956	Hinterland Sandstone Gully Forest	1	1						
BSP Survey	SPR020O	269101	6270931	Coastal Sandstone Ridgetop Woodland	1	1	1					
BSP Survey	SPR021O	270121	6271905	Hinterland Sandstone Gully Forest	1	1	1		1			
BSP Survey	SPR022H	269502	6273163	Blue Mountains - Shoalhaven Hanging Swamps	1	1				1		
BSP Survey	SPR023W	270158	6274073	Coastal Sandstone Ridgetop Woodland	1	1	1				1	
BSP Survey	SPR024O	270819	6274537	Hinterland Sandstone Gully Forest	1	1						
BSP Survey	SPR025H	271271	6274987	Blue Mountains Heath	1	1						
BSP Survey	SPR026H	272099	6275782	Blue Mountains - Shoalhaven Hanging Swamps	1	1						
BSP Survey	SPR027C	268748	6268400	Sandstone Scarp Warm Temperate Rainforest	1							
BSP Survey	SPR028O	269200	6268585	Lower Blue Mountains Wet Forest	1	1						
BSP Survey	SPR029O	270339	6272538	Sandstone Scarp Warm Temperate Rainforest	1							
BSP Survey	SPR030C	270829	6272730	Sandstone Scarp Warm Temperate Rainforest		1						
BSP Survey	SPR031O	271523	6272657	Hinterland Sandstone Gully Forest		1						
BSP Survey	SPR032O	268578	6274649	Blue Mountains Heath		1						
BSP Survey	SPR033O	277988	6272643	Hinterland Sandstone Gully Forest	1	1	1	1		1	1	
BSP Survey	SPR034W	269373	6271268	Coastal Sandstone Ridgetop Woodland								1
BSP Survey	SPR035O	270941	6272268	Coastal Sandstone Ridgetop Woodland					1			
BSP Survey	SPR036H	269665	6271961	Coastal Sandstone Ridgetop Woodland					1			

Survey program	Site number	Easting	Northing	Vegetation Community (Tozer *et al.* 2006)	Diurnal bird census	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping
BSP Survey	SPR037W	270140	6272014	Coastal Sandstone Ridgetop Woodland				1				
BSP Survey	SPR038W	269708	6272110	Coastal Sandstone Ridgetop Woodland				1				
BSP Survey	SPR039O	269347	6271170	Coastal Sandstone Ridgetop Woodland				1				
BSP Survey	SPR040O	268629	6270456	Coastal Sandstone Ridgetop Woodland				1				
BSP Survey	SPR041O	274534	6275165	Coastal Sandstone Ridgetop Woodland		1						
BSP Survey	SPR042H	273628	6274115	Blue Mountains Heath	1	1						
BSP Survey	SPR043W	273150	6273148	Hinterland Sandstone Gully Forest	1	1						
BSP Survey	SPR044H	272375	6272460	Blue Mountains Heath	1	1						
BSP Survey	SPR045O	278861	6274272	Sydney Hinterland Transition Woodland	1	1						
BSP Survey	SPR046O	278403	6275587	Hinterland Sandstone Gully Forest	1	1	1	1			2	
BSP Survey	SPR047W	277212	6275520	Hinterland Sandstone Gully Forest		1						
BSP Survey	SPR048W	277065	6273973	Coastal Sandstone Ridgetop Woodland		1						
BSP Survey	SPR049O	279300	6273253	Sydney Swamp Forest		1	1				1	
BSP Survey	SPR050O	272891	6272471	Coastal Sandstone Ridgetop Woodland			1	1				
BSP Survey	SPR051W	273565	6273576	Blue Mountains Heath				1				
BSP Survey	SPR052W	274245	6274624	Coastal Sandstone Ridgetop Woodland				1				
BSP Survey	SPR053O	274417	6276574	Coastal Sandstone Ridgetop Woodland				1			1	
BSP Survey	SPR054O	277915	6273713	Hinterland Sandstone Gully Forest	1			1				
BSP Survey	SPR055O	269680	6268287	Coastal Sandstone Ridgetop Woodland			1				1	
BSP Survey	SPR056W	269109	6271787	Coastal Sandstone Ridgetop Woodland							1	
BSP Survey	SPR057W	276711	6274405	Coastal Sandstone Ridgetop Woodland							1	
BSP Survey	SPR058W	277238	6275693	Coastal Sandstone Ridgetop Woodland		1						
CRA Survey	S-F-SYD-55-001	278500	6283800	Hinterland Sandstone Gully Forest	1					1	1	
CRA Survey	S-F-SYD-55-002	278300	6283700	Hinterland Sandstone Gully Forest	1				1			
CRA Survey	S-F-SYD-55-003	278200	6283200	Coastal Sandstone Ridgetop Woodland	1							
CRA Survey	S-F-SYD-55-004	278300	6282980	Coastal Sandstone Ridgetop Woodland	1							
CRA Survey	S-F-SYD-55-020	277525	6283450	Hinterland Sandstone Gully Forest					1		1	
CRA Survey	S-F-SYD-55-021	277510	6283190	Hinterland Sandstone Gully Forest	1							
CRA Survey	S-F-SYD-55-022	277590	6283090	Hinterland Sandstone Gully Forest	1							
CRA Survey	S-F-SYD-55-026	276100	6283500	Coastal Sandstone Ridgetop Woodland		1						
CRA Survey	S-F-SYD-55-027	278600	6283700	Coastal Sandstone Ridgetop Woodland		1						
CRA Survey	S-F-SYD-55-028	278300	6283850	Hinterland Sandstone Gully Forest		1						
CRA Survey	S-F-SYD-55-029	277350	6283350	Hinterland Sandstone Gully Forest		1						
CRA Survey	T-F-SYD-50-066	278500	6285400	Hinterland Sandstone Gully Forest							1	
CRA Survey	T-F-SYD-50-067	278100	6282900	Hinterland Sandstone Gully Forest							1	
CRA Survey	T-F-SYD-50-068	275900	6283850	Coastal Sandstone Ridgetop Woodland							1	

Survey program	Site number	Easting	Northing	Vegetation Community (Tozer *et al.* 2006)	Diurnal bird census	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping
CRA Survey	T-F-SYD-50-069	275075	6286075	Coastal Sandstone Ridgetop Woodland							1	
CRA Survey	T-F-SYD-50-070	273700	6287980	Hinterland Sandstone Gully Forest							1	
CRA Survey	T-F-SYD-50-071	271600	6272150	Hinterland Sandstone Gully Forest							1	
CRA Survey	T-F-SYD-50-072	274050	6277450	Blue Mountains Heath							1	
CRA Survey	T-F-SYD-50-073	274300	6275300	Hinterland Sandstone Gully Forest							1	
CRA Survey	T-F-SYD-50-074	273600	6273700	Blue Mountains Heath							1	
Mixophyes Survey	F-MIX-039	277900	6272850	Lower Blue Mountains Wet Forest						1		
SCA Survey	KTM007O	265910	6266856	Hinterland Sandstone Gully Forest	1		1					
SCA Survey	KTM009W	266742	6265993	Coastal Sandstone Ridgetop Woodland	1		1					
SCA Survey	KTM013O	266829	6268329	Hinterland Sandstone Gully Forest						1		
Total					**53**	**56**	**29**	**29**	**14**	**7**	**27**	**3**

APPENDIX B – FAUNA SPECIES RECORDED IN NORTH-EASTERN BLUE MOUNTAINS NP

Below is a list of the fauna species recorded within north-eastern Blue Mountains NP on the Atlas of NSW Wildlife (as at 17th June 2008). Taxonomical nomenclature follows that used on the Atlas of NSW Wildlife, with more updated scientific names noted where relevant. Records are derived from DECC systematic surveys (Biodiversity Survey Priorities, Comprehensive Regional Assessment and Special Area Fauna Surveys), licensed data sets (Birds Australia and the Australian Museum) and incidental observations submitted by individuals including park rangers and field officers; catchment officers; bushwalkers and naturalists; scientific researchers working in the area; and other visitors to the park. Introduced species are indicated with the addition of an I.

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA & SCA	Birds Australia	Other Sources
Frogs								
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P		x	x		x
Myobatrachidae	*Heleioporus australiacus*	Giant Burrowing Frog	V	V	x			
Myobatrachidae	*Limnodynastes dumerilii dumerilii*	Eastern Banjo Frog	P		x			
Myobatrachidae	*Limnodynastes peronii*	Brown-striped Frog	P		x			x
Myobatrachidae	*Mixophyes balbus*	Stuttering Frog	E					x
Myobatrachidae	*Pseudophryne australis*	Red-crowned Toadlet	V		x	x		x
Myobatrachidae	*Uperoleia fusca*	Dusky Toadlet	P		x			
Hylidae	*Litoria citropa*	Blue Mountains Tree Frog	P		x	x		x
Hylidae	*Litoria dentata*	Bleating Tree Frog	P		x	x		x
Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog	P		x			
Hylidae	*Litoria lesueuri*	Lesueur's Frog	P			x		x
Hylidae	*Litoria peronii*	Peron's Tree Frog	P		x	x		x
Hylidae	*Litoria phyllochroa*	Leaf-green Tree Frog	P		x	x		x
Hylidae	*Litoria tyleri*	Tyler's Tree Frog	P		x			
Hylidae	*Litoria verreauxii*	Verreaux's Frog	P		x	x		
Hylidae	*Litoria wilcoxii*	Stoney Creek Frog	P		x			
Reptiles								
Gekkonidae	*Diplodactylus vittatus*	Wood Gecko	P		x			
Gekkonidae	*Oedura lesueurii*	Lesueur's Velvet Gecko	P		x	x		x
Gekkonidae	*Phyllurus platurus*	Broad-tailed Gecko	P		x	x		x
Pygopodidae	*Lialis burtonis*	Burton's Snake-lizard	P		x			
Pygopodidae	*Pygopus lepidopodus*	Southern Scaly-foot	P		x			x
Agamidae	*Amphibolurus muricatus*	Jacky Lizard	P		x	x		x
Agamidae	*Physignathus lesueurii*	Eastern Water Dragon	P		x	x		x
Agamidae	*Pogona barbata*	Bearded Dragon	P			x		
Agamidae	*Rankinia diemensis*	Mountain Dragon	P		x	x		x
Varanidae	*Varanus varius*	Lace Monitor	P		x			
Scincidae	*Acritoscincus platynota*	Red-throated Skink	P		x	x		x
Scincidae	*Cryptoblepharus virgatus*	Cream-striped Shinning-skink	P		x			x
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Skink	P		x	x		x
Scincidae	*Cyclodomorphus gerrardii*	Pink-tongued Lizard	P		x			
Scincidae	*Egernia cunninghami*	Cunningham's Skink	P		x			x
Scincidae	*Egernia whitii*	White's Skink	P		x			x
Scincidae	*Eulamprus quoyii*	Eastern Water-skink	P		x	x		x

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA & SCA	Birds Australia	Other Sources
Scincidae	*Eulamprus tenuis*	Barred-sided Skink	P		x			
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P		x	x		x
Scincidae	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink	P		x			x
Scincidae	*Saiphos equalis*	Three-toed Skink	P		x			
Scincidae	*Saproscincus mustelinus*	Weasel Skink	P		x			x
Typhlopidae	*Ramphotyphlops nigrescens*	Blackish Blind Snake	P		x			
Boidae	*Morelia spilota spilota*	Diamond Python	P		x			x
Elapidae	*Acanthophis antarcticus*	Common Death Adder	P					x
Elapidae	*Cryptophis nigrescens*	Eastern Small-eyed Snake	P		x			x
Elapidae	*Demansia psammophis*	Yellow-faced Whip Snake	P		x			x
Elapidae	*Drysdalia rhodogaster*	Mustard-bellied Snake	P		x			x
Elapidae	*Furina diadema*	Red-naped Snake	P					x
Elapidae	*Hoplocephalus bungaroides*	Broad-headed Snake	E	V	x			x
Elapidae	*Notechis scutatus*	Tiger Snake	P		x			x
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	P		x	x		
Birds								
Anatidae	*Anas superciliosa*	Pacific Black Duck	P				x	x
Anatidae	*Chenonetta jubata*	Australian Wood Duck	P			x	x	x
Ardeidae	*Nycticorax caledonicus*	Nankeen Night Heron	P		x		x	
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	P		x	x	x	
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	P		x		x	x
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	P				x	x
Accipitridae	*Aviceda subcristata*	Pacific Baza	P				x	
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	P				x	
Accipitridae	*Haliastur sphenurus*	Whistling Kite	P				x	
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	P				x	
Falconidae	*Falco berigora*	Brown Falcon	P				x	
Falconidae	*Falco cenchroides*	Nankeen Kestrel	P				x	
Falconidae	*Falco peregrinus*	Peregrine Falcon	P		x		x	x
Turnicidae	*Turnix varia*	Painted Button-quail	P		x		x	x
Charadriidae	*Vanellus miles*	Masked Lapwing	P		x	x	x	x
Columbidae	*Columba leucomela*	White-headed Pigeon	P				x	x
Columbidae	*Geopelia placida*	Peaceful Dove	P		x		x	x
Columbidae	*Leucosarcia melanoleuca*	Wonga Pigeon	P		x	x	x	
Columbidae	*Lewinia pectoralis*	Lewin's Rail	P		x			
Columbidae	*Macropygia amboinensis*	Brown Cuckoo-Dove	P		x	x	x	
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	P		x		x	x
Columbidae	*Phaps chalcoptera*	Common Bronzewing	P		x		x	x
Columbidae	*Phaps elegans*	Brush Bronzewing	P		x	x	x	x
Columbidae	*Streptopelia chinensis*	Spotted Turtle-dove [I]	U	U	x		x	x
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	P		x		x	x
Cacatuidae	*Cacatua sanguinea*	Little Corella	P		x		x	
Cacatuidae	*Callocephalon fimbriatum*	Gang-gang Cockatoo	V		x		x	x
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	P		x	x	x	x
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-Cockatoo	V		x	x	x	x
Cacatuidae	*Eolophus roseicapillus*	Galah	P		x		x	x
Psittacidae	*Alisterus scapularis*	Australian King-Parrot	P		x	x	x	x
Psittacidae	*Glossopsitta concinna*	Musk Lorikeet	P				x	

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA & SCA	Birds Australia	Other Sources
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	P		x		x	x
Psittacidae	*Lathamus discolor*	Swift Parrot	E					x
Psittacidae	*Platycercus adscitus eximius*	Eastern Rosella	P		x		x	x
Psittacidae	*Platycercus elegans*	Crimson Rosella	P		x	x	x	x
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	P		x	x	x	x
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P		x	x	x	x
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	P		x		x	
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo	P				x	x
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo	P		x	x	x	x
Cuculidae	*Cuculus pallidus*	Pallid Cuckoo	P				x	
Cuculidae	*Eudynamys orientalis*	Pacific Koel	P		x	x	x	x
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo	P		x		x	
Strigidae	*Ninox boobook*	Southern Boobook	P		x	x	x	x
Strigidae	*Ninox strenua*	Powerful Owl	V		x	x		x
Tytonidae	*Tyto novaehollandiae*	Masked Owl	V			x	x	
Tytonidae	*Tyto tenebricosa*	Sooty Owl	V		x			x
Podargidae	*Podargus strigoides*	Tawny Frogmouth	P		x	x	x	
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	P		x	x	x	
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	P		x	x	x	x
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	P		x		x	x
Alcedinidae	*Alcedo azurea*	Azure Kingfisher	P				x	x
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	P		x	x	x	x
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	P		x		x	x
Meropidae	*Merops ornatus*	Rainbow Bee-eater	P		x	x	x	
Coraciidae	*Eurystomus orientalis*	Dollarbird	P				x	
Menuridae	*Menura novaehollandiae*	Superb Lyrebird	P		x	x	x	x
Climacteridae	*Climacteris erythrops*	Red-browed Treecreeper	P		x		x	x
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P				x	x
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P		x	x	x	x
Maluridae	*Stipiturus malachurus*	Southern Emu-wren	P		x			
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P		x	x	x	x
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	P				x	x
Acanthizidae	*Acanthiza lineata*	Striated Thornbill	P		x	x	x	x
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P		x	x	x	x
Acanthizidae	*Acanthiza reguloides*	Buff-rumped Thornbill	P		x		x	x
Acanthizidae	*Calamanthus pyrrhopygius*	Chestnut-rumped Heathwren	P		x		x	
Acanthizidae	*Gerygone mouki*	Brown Gerygone	P		x	x	x	x
Acanthizidae	*Gerygone olivacea*	White-throated Gerygone	P		x		x	
Acanthizidae	*Origma solitaria*	Rockwarbler	P		x		x	x
Acanthizidae	*Pycnoptilus floccosus*	Pilotbird	P		x	x	x	x
Acanthizidae	*Sericornis citreogularis*	Yellow-throated Scrubwren	P		x	x	x	x
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P		x	x	x	x
Acanthizidae	*Sericornis magnirostris*	Large-billed Scrubwren	P				x	x
Acanthizidae	*Smicrornis brevirostris*	Weebill	P		x		x	x
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P		x	x	x	x
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P		x		x	x
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	P		x	x	x	x
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P		x		x	x

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA & SCA	Birds Australia	Other Sources
Meliphagidae	*Lichenostomus fuscus*	Fuscous Honeyeater	P		x		x	x
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater	P		x		x	x
Meliphagidae	*Lichenostomus melanops*	Yellow-tufted Honeyeater	P				x	x
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P		x		x	x
Meliphagidae	*Manorina melanophrys*	Bell Miner	P		x		x	x
Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater	P		x	x	x	x
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	P		x	x	x	x
Meliphagidae	*Melithreptus gularis gularis*	Black-chinned Honeyeater (eastern subspecies)	V		x			
Meliphagidae	*Melithreptus lunatus*	White-naped Honeyeater	P		x	x	x	x
Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater	P		x		x	x
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	P		x		x	x
Meliphagidae	*Phylidonyris niger*	White-cheeked Honeyeater	P		x		x	x
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P		x	x	x	x
Meliphagidae	*Phylidonyris pyrrhoptera*	Crescent Honeyeater	P		x		x	x
Meliphagidae	*Xanthomyza phrygia*	Regent Honeyeater	E	E			x	x
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P		x	x	x	x
Petroicidae	*Microeca fascinans*	Jacky Winter	P				x	
Petroicidae	*Petroica boodang*	Scarlet Robin	P				x	
Petroicidae	*Petroica rosea*	Rose Robin	P		x	x	x	x
Eupetidae	*Cinclosoma punctatum*	Spotted Quail-thrush	P		x	x	x	x
Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	P		x	x	x	x
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	P		x	x	x	x
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P		x	x	x	x
Pachycephalidae	*Falcunculus frontatus*	Eastern Shrike-tit	P		x	x	x	x
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P		x	x	x	x
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P		x		x	x
Dicruridae	*Grallina cyanoleuca*	Magpie-lark	P		x		x	x
Dicruridae	*Monarcha melanopsis*	Black-faced Monarch	P		x	x	x	x
Dicruridae	*Myiagra rubecula*	Leaden Flycatcher	P		x	x	x	x
Dicruridae	*Rhipidura albiscapa*	Grey Fantail	P		x	x	x	x
Dicruridae	*Rhipidura leucophrys*	Willie Wagtail	P		x		x	x
Dicruridae	*Rhipidura rufifrons*	Rufous Fantail	P		x	x	x	x
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P		x		x	x
Campephagidae	*Coracina papuensis*	White-bellied Cuckoo-shrike	P		x		x	x
Campephagidae	*Coracina tenuirostris*	Cicadabird	P		x		x	
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	P		x		x	
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P		x	x	x	x
Artamidae	*Gymnorhina tibicen*	Australian Magpie	P		x		x	x
Artamidae	*Strepera graculina*	Pied Currawong	P		x	x	x	x
Artamidae	*Strepera versicolor*	Grey Currawong	P		x		x	x
Corvidae	*Corvus coronoides*	Australian Raven	P		x	x	x	x
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough	P		x		x	x
Corcoracidae	*Cormobates leucophaea*	White-throated Treecreeper	P		x	x	x	x
Ptilonorhynchidae	*Ptilonorhynchus violaceus*	Satin Bowerbird	P		x	x	x	x
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P		x	x	x	x
Estrildidae	*Stagonopleura bella*	Beautiful Firetail	P		x		x	x
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	P		x		x	x

Family	Scientific name	Common name	NSW Legal Status	National Legal Status	BSP	CRA & SCA	Birds Australia	Other Sources
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P		x		x	x
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	P		x		x	x
Zosteropidae	*Zosterops lateralis*	Silvereye	P		x	x	x	x
Muscicapidae	*Zoothera lunulata*	Bassian Thrush	P		x		x	
Sturnidae	*Acridotheres tristis*	Common Myna [I]	U	U	x		x	x
Mammals								
Ornithorhynchidae	*Ornithorhynchus anatinus*	Platypus	P					x
Dasyuridae	*Antechinus stuartii*	Brown Antechinus	P		x			x
Dasyuridae	*Antechinus swainsonii*	Dusky Antechinus	P					x
Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	V	E	x			x
Peramelidae	*Perameles nasuta*	Long-nosed Bandicoot	P		x			x
Petauridae	*Petaurus breviceps*	Sugar Glider	P		x	x		x
Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V					x
Pseudocheiridae	*Petauroides volans*	Greater Glider	P		x	x		x
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P		x	x		x
Acrobatidae	*Acrobates pygmaeus*	Feathertail Glider	P		x			x
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	P		x			x
Macropodidae	*Macropus robustus*	Common Wallaroo	P		x			
Macropodidae	*Macropus rufogriseus*	Red-necked Wallaby	P					x
Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-wallaby NB. Not recorded on Atlas of NSW Wildlife	E	V				
Macropodidae	*Wallabia bicolor*	Swamp Wallaby	P		x			x
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	x			
Rhinolophidae	*Rhinolophus megaphyllus*	Eastern Horseshoe-bat	P		x	x		
Molossidae	*Mormopterus norfolkensis*	East-coast Freetail-bat	V		x	x		x
Scincidae	*Mormopterus* species 2 (Adams *et al.* 1988)	Eastern Freetail-bat	P		x			x
Molossidae	*Tadarida australis*	White-striped Freetail-bat	P		x			
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V	x			
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	P		x	x		x
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	P		x	x		x
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V		x	x		x
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V		x	x		
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	P		x			
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat	P		x			
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V	V	x	x		
Vespertilionidae	*Scotorepens orion*	Eastern Broad-nosed Bat	P		x			
Vespertilionidae	*Vespadelus darlingtoni*	Large Forest Bat	P		x	x		x
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	P		x	x		x
Muridae	*Rattus fuscipes*	Bush Rat	P		x			x
Muridae	*Rattus lutreolus*	Swamp Rat	P		x			x
Canidae	*Canis lupus*	Dingo/Wild Dog [I]	U	U	x	x		x
Canidae	*Vulpes vulpes*	Fox [I]	U	U				x
Felidae	*Felis catus*	Cat [I]	U	U				x

APPENDIX C – FAUNA SPECIES RECORDED AROUND (BUT NOT WITHIN) NORTH-EASTERN BLUE MOUNTAINS NP

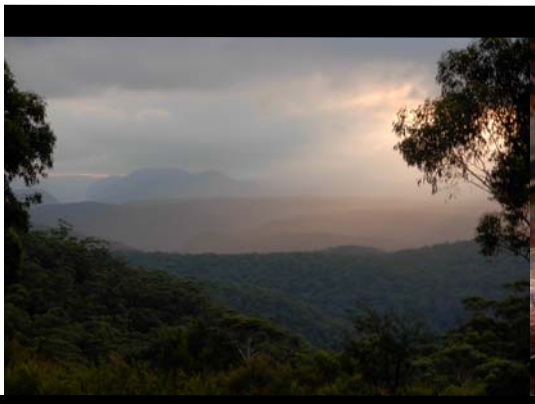
Below is a list of fauna species recorded on the Atlas of NSW Wildlife within a five kilometre radius of the study area boundary, but not recorded from within the study area (as at 17th June 2008). This list includes all records regardless of date, spatial referencing or identification accuracy.

Family	Scientific name	Common name	NSW Legal Status	National Legal Status
Frogs				
Myobatrachidae	*Adelotus brevis*	Tusked Frog	P	
Myobatrachidae	*Limnodynastes ornatus*	Ornate Burrowing Frog	P	
Myobatrachidae	*Limnodynastes tasmaniensis*	Spotted Grass Frog	P	
Myobatrachidae	*Mixophyes fasciolatus*	Great Barred Frog	P	
Myobatrachidae	*Pseudophryne bibronii*	Bibron's Toadlet	P	
Myobatrachidae	*Uperoleia laevigata*	Smooth Toadlet	P	
Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E	V
Hylidae	*Litoria caerulea*	Green Tree Frog	P	
Hylidae	*Litoria ewingii*	Brown Tree Frog	P	
Hylidae	*Litoria freycineti*	Freycinet's Frog	P	
Hylidae	*Litoria jervisiensis*	Jervis Bay Tree Frog	P	
Hylidae	*Litoria latopalmata*	Broad-palmed Frog	P	
Hylidae	*Litoria littlejohni*	Littlejohn's Tree Frog	V	V
Bufonidae	*Bufo marinus*	Cane Toad	U	U
Reptiles				
Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle	P	
Gekkonidae	*Underwoodisaurus milii*	Thick-tailed Gecko	P	
Scincidae	*Ctenotus robustus*	Robust Ctenotus	P	
Scincidae	*Cyclodomorphus michaeli*	Mainland She-oak Skink	P	
Scincidae	*Egernia saxatilis*	Black Rock Skink	P	
Scincidae	*Eulamprus heatwolei*	Yellow-bellied Water-skink	P	
Scincidae	*Eulamprus leuraensis*	Blue Mountains Water skink	E	E
Scincidae	*Hemiergis decresiensis*	Three-toed Earless Skink	P	
Scincidae	*Morethia boulengeri*	South-eastern Morethia Skink	P	
Scincidae	*Pseudemoia pagenstecheri*	Tussock Skink	P	
Scincidae	*Tiliqua nigrolutea*	Blotched Blue-tongue	P	
Scincidae	*Tiliqua scincoides*	Eastern Blue-tongue	P	
Elapidae	*Cacophis squamulosus*	Golden-crowned Snake	P	
Elapidae	*Drysdalia coronoides*	White-lipped Snake	P	
Elapidae	*Hemiaspis signata*	Black-bellied Swamp Snake	P	
Elapidae	*Pseudonaja textilis*	Eastern Brown Snake	P	
Birds				
Megapodiidae	*Alectura lathami*	Australian Brush-turkey	P	
Phasianidae	*Coturnix chinensis*	King Quail	P	
Phasianidae	*Coturnix pectoralis*	Stubble Quail	P	
Phasianidae	*Coturnix ypsilophora*	Brown Quail	P	

Family	Scientific name	Common name	NSW Legal Status	National Legal Status
Phasianidae	*Gallus gallus*	Red Junglefowl	U	U
Anatidae	*Anas castanea*	Chestnut Teal	P	
Anatidae	*Anas gracilis*	Grey Teal	P	
Anatidae	*Anas platyrhynchos*	Mallard	U	U
Anatidae	*Aythya australis*	Hardhead	P	
Anatidae	*Cygnus atratus*	Black Swan	P	
Anatidae	*Dendrocygna eytoni*	Plumed Whistling-Duck	P	
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe	P	
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	P	
Anhingidae	*Anhinga melanogaster*	Darter	P	
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	P	
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant	P	
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant	P	
Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant	P	
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican	P	
Ardeidae	*Ardea alba*	Great Egret	P	
Ardeidae	*Ardea intermedia*	Intermediate Egret	P	
Ardeidae	*Ardea pacifica*	White-necked Heron	P	
Ardeidae	*Bubulcus ibis*	Cattle Egret	P	
Ardeidae	*Egretta garzetta*	Little Egret	P	
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P	
Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill	P	
Threskiornithidae	*Platalea regia*	Royal Spoonbill	P	
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis	P	
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis	P	
Accipitridae	*Accipiter novaehollandiae*	Grey Goshawk	P	
Accipitridae	*Circus approximans*	Swamp Harrier	P	
Accipitridae	*Circus assimilis*	Spotted Harrier	P	
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	P	
Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V	
Accipitridae	*Milvus migrans*	Black Kite	P	
Falconidae	*Falco longipennis*	Australian Hobby	P	
Falconidae	*Falco subniger*	Black Falcon	P	
Rallidae	*Fulica atra*	Eurasian Coot	P	
Rallidae	*Gallinula tenebrosa*	Dusky Moorhen	P	
Rallidae	*Gallirallus philippensis*	Buff-banded Rail	P	
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	P	
Rallidae	*Porzana tabuensis*	Spotless Crake	P	
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	P	
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	P	
Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel	P	
Charadriidae	*Erythrogonys cinctus*	Red-kneed Dotterel	P	
Laridae	*Sterna fuscata*	Sooty Tern	V	
Columbidae	*Columba livia* [I]	Rock Dove	U	U
Columbidae	*Geopelia cuneata*	Diamond Dove	P	
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	P	
Cacatuidae	*Cacatua tenuirostris*	Long-billed Corella	P	
Cacatuidae	*Nymphicus hollandicus*	Cockatiel	P	
Psittacidae	*Neophema pulchella*	Turquoise Parrot	V	

Family	Scientific name	Common name	NSW Legal Status	National Legal Status
Psittacidae	*Psephotus haematonotus*	Red-rumped Parrot	P	
Psittacidae	*Trichoglossus chlorolepidotus*	Scaly-breasted Lorikeet	P	
Cuculidae	*Cuculus saturatus*	Oriental Cuckoo	P	
Centropodidae	*Centropus phasianinus*	Pheasant Coucal	P	
Strigidae	*Ninox connivens*	Barking Owl	V	
Tytonidae	*Tyto alba*	Barn Owl	P	
Apodidae	*Apus pacificus*	Fork-tailed Swift	P	
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill	P	
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill	P	
Acanthizidae	*Acanthiza inornata*	Western Thornbill	P	
Acanthizidae	*Acanthiza nana*	Yellow Thornbill	P	
Acanthizidae	*Aphelocephala leucopsis*	Southern Whiteface	P	
Acanthizidae	*Pyrrholaemus saggitatus*	Speckled Warbler	V	
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater	P	
Meliphagidae	*Epthianura albifrons*	White-fronted Chat	P	
Meliphagidae	*Grantiella picta*	Painted Honeyeater	V	
Meliphagidae	*Lichenostomus ornatus*	Yellow-plumed Honeyeater	P	
Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater	P	
Meliphagidae	*Philemon citreogularis*	Little Friarbird	P	
Petroicidae	*Melanodryas cucullata*	Hooded Robin	V	
Petroicidae	*Petroica phoenicea*	Flame Robin	P	
Petroicidae	*Petroica rodinogaster*	Pink Robin	V	
Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V	
Dicruridae	*Dicrurus bracteatus*	Spangled Drongo	P	
Dicruridae	*Myiagra cyanoleuca*	Satin Flycatcher	P	
Dicruridae	*Myiagra inquieta*	Restless Flycatcher	P	
Campephagidae	*Lalage tricolor*	White-winged Triller	P	
Artamidae	*Artamus cinereus*	Black-faced Woodswallow	P	
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	P	
Artamidae	*Artamus personatus*	Masked Woodswallow	P	
Artamidae	*Artamus superciliosus*	White-browed Woodswallow	P	
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird	P	
Ptilonorhynchidae	*Ailuroedus crassirostris*	Green Catbird	P	
Ptilonorhynchidae	*Sericulus chrysocephalus*	Regent Bowerbird	P	
Alaudidae	*Alauda arvensis* [I]	Eurasian Skylark	U	U
Motacillidae	*Anthus australis*	Australian Pipit	P	
Passeridae	*Passer domesticus* [I]	House Sparrow	U	U
Fringillidae	*Carduelis carduelis* [I]	European Goldfinch	U	U
Fringillidae	*Carduelis chloris* [I]	European Greenfinch	U	U
Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch	P	
Estrildidae	*Taeniopygia guttata*	Zebra Finch	P	
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow	P	
Hirundinidae	*Petrochelidon ariel*	Fairy Martin	P	
Pycnonotidae	*Pycnonotus jocosus* [I]	Red-whiskered Bulbul	U	U
Sylviidae	*Acrocephalus australis*	Australian Reed-Warbler	P	
Sylviidae	*Cincloramphus mathewsi*	Rufous Songlark	P	
Sylviidae	*Cisticola exilis*	Golden-headed Cisticola	P	
Muscicapidae	*Turdus merula* [I]	Eurasian Blackbird	U	U

Family	Scientific name	Common name	NSW Legal Status	National Legal Status
Sturnidae	*Sturnus vulgaris* [I]	Common Starling	U	U
Mammals				
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P	
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus	P	
Dasyuridae	*Phascogale tapoatafa*	Brush-tailed Phascogale	V	
Dasyuridae	*Sminthopsis murina*	Common Dunnart	P	
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	
Vombatidae	*Vombatus ursinus*	Common Wombat	P	
Burramyidae	*Cercartetus nanus*	Eastern Pygmy-possum	V	
Petauridae	*Petaurus australis*	Yellow-bellied Glider	V	
Phalangeridae	*Trichosurus caninus*	Short-eared Possum	P	
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	P	
Pteropodidae	*Pteropus scapulatus*	Little Red Flying-fox	P	
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V	
Molossidae	*Mormopterus loriae*	Little Northern Freetail-bat	P	
Molossidae	*Mormopterus planiceps*	Little Mastiff-bat	P	
Vespertilionidae	*Miniopterus australis*	Little Bentwing-bat	V	
Vespertilionidae	*Myotis adversus*	Large-footed Myotis	V	
Vespertilionidae	*Vespadelus pumilus*	Eastern Forest Bat	P	
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	P	
Muridae	*Mus musculus* [I]	House Mouse	U	U
Muridae	*Rattus norvegicus* [I]	Brown Rat	U	U
Muridae	*Rattus rattus* [I]	Black Rat	U	U
Leporidae	*Lepus capensis* [I]	Brown Hare	U	U
Leporidae	*Oryctolagus cuniculus* [I]	Rabbit	U	U
Equidae	*Equus caballus* [I]	Horse	U	U
Suidae	*Sus scrofa* [I]	Pig	U	U
Bovidae	*Bos Taurus* [I]	European cattle	U	U
Bovidae	*Capra hircus* [I]	Goat	U	U
Bovidae	*Ovis aries* [I]	Sheep (feral)	U	U
Cervidae	*Cervus* sp. [I]	Unidentified Deer	U	U



Department of
Environment &
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