The Vertebrate Fauna of South Western Blue Mountains National Park

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

Conservation Programs and Planning
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THE VERTEBRATE FAUNA OF SOUTH WESTERN BLUE MOUNTAINS NATIONAL PARK

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Conservation Assessment and Data Unit
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All photographs are held by DEC. To obtain a copy please contact the Bioregional Data Group Coordinator, DEC Hurstville

Cover Photos

Feature Photo (Elizabeth Magarey)
White-striped Freetail-bat (Michael Todd), Rock Plate-Heath Mallee (DEC)
Black Crevice-skink (David O'Connor)
Tall Moist Blue Gum Forest (DEC)
Rainforest (DEC)
Short-beaked Echidna (D. O'Connor)
Grey Gum (Daniel Connolly)
Red-crowned Toadlet (Dave Hunter)

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OVERVIEW

South western Blue Mountains National Park (the study area) encompasses 34610 hectares of land within the catchments of the Abercrombie River and Murruin Creek. The study area is located approximately 35 kilometres south of Oberon and is demarcated by the Blue Mountains National Park boundary except to the east where it is marked by Murruin and Shivering Creeks. The area covers a 30 kilometre stretch along the spine of the Great Dividing Range, surrounded to the west by undulating slopes and to the east by a system of steep slopes and deep gullies. Elevation ranges from 400 metres above sea level (asl) in the lower reaches of Murruin Creek to 1285 metres asl along Banshea Road in the far north west corner, with the majority of the area above 800 metres. Vegetation is a diverse mix of communities that reflect geological and altitudinal patterns, including tall sub-alpine forests, undulating grassy tableland woodlands, riverine flats, dry shrub forests, dry rainforest, mallee-heath, and Tea Tree and sedge bogs and swamps. Distinctive landscape features of the area include the basalt capped Mt. Werong and the limestone outcrops and karsts that form part of the band between Jenolan and Wombeyan Caves.

The diverse range of habitats in the study area support a rich assemblage of fauna that includes species typical of montane and sub-alpine environments as well as species more characteristic of coastal hinterlands. This report describes the terrestrial vertebrate fauna of south western Blue Mountains National Park, derived from fauna surveys that have been undertaken by the Department of Environment and Conservation (DEC, formerly NPWS). It documents for the first time the species and habitats of the area and combines data sourced from all systematic surveys undertaken between 1998 and 2004. It concludes that:

- There are 186 vertebrate fauna species known to occur within the reserve. This includes 99 native diurnal birds, six nocturnal birds, fourteen bats, seven arboreal mammals, eleven native ground mammals, 28 reptiles, ten frogs, three introduced birds and eight introduced ground mammals.
- The study area supports habitat for at least nine fauna species that are as listed as threatened on the NSW Threatened Species Conservation Act (1995). Six of these species have been regularly recorded, indicating that good numbers are present within the park. This includes the Stuttering Frog, Powerful Owl, Yellow-bellied Glider, Greater Broad-nosed Bat, Eastern False Pipistrelle and Eastern Bent-wing Bat. Additional threatened fauna species include Masked Owl, Spotted-tailed Quoll and Koala, which have each been recorded once.
- The population of Stuttering Frog within the study area has very high conservation significance. The population is an outlier of the extant known range of the species, constituting the only known location of the species in the greater Sydney Basin above 280 metres asl, and the western-most location in New South Wales. The Stuttering Frog occurs within at least two creek systems, Ruby Creek and Mt. Werong Creek, which flow east and west of the Divide respectively. Numerous tadpoles were found in each location, but no adults were seen or heard calling. Three dead metamorphlings were collected and identified as infected by chytrid fungus. This marks the first time chytrid fungus has been recorded in this species. Management actions for the species in the study area should be considered immediately, in consultation the Central Threatened Species Unit and the species recovery team.
- A further two threatened species have been recently observed within two kilometres of the study area and, given that suitable habitat occurs within the study area, have the potential to occur within its boundaries. These are the Brush-tailed Rock-wallaby and Large-eared Pied Bat.
- Feral animals including the Rabbit, Fox and Pig are present in the reserve. Pig sightings and evidence of their activity are particularly common around Mt. Werong and along drainage lines east of the Dividing Range.
- The composition and distribution of fauna species within the area reflects landscape patterns in elevation, geology and topography, and the influence of both central tableland and coastal hinterland environments on the study area. There are distinctive assemblages of fauna that correspond to the montane and sub-alpine environments in the north, and to the lower altitude valley systems in the far east.

The recent fauna surveys in south western Blue Mountains NP have contributed important information to our understanding of the distribution, range, habitat preference and conservation status of many animals, including threatened and newly described species. Such information will improve our understanding of species conservation status across the region and assist in the updating of effective management strategies.

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1 INTRODUCTION

1.1 PROJECT AIMS

The Central Directorate Parks and Wildlife Division (PWD) of the NSW Department of Environment and Conservation (DEC, formerly NSW National Parks and Wildlife Service (NPWS)) has for the first time established a biodiversity survey priorities program for all DEC managed estate within the Directorate. This program recognised that south western Blue Mountains National Park (NP), which includes the Murruin and Abercrombie catchments, was characterised by very low levels of information on both its flora and fauna values (NPWS 2003b). The decision to sample this area was enhanced by the opportunity of integrating new survey work into a broader study examining the biodiversity values of the Warragamba and Metropolitan Special Areas (DEC in prep.).

The fauna survey program seeks to address the shortfall in information on vertebrate fauna within south western Blue Mountains NP. Improved information will enable park managers to better integrate local information into planning decisions and to become more active in promoting the values of this section of the reserve. It will provide the opportunity to develop more focused strategies on threatened species management, monitoring programs and community education. Importantly it will expand the ability of park managers to understand the role the reserve plays in conserving fauna within the greater Sydney Region.

Specific objectives of this report are to:

1. Document, review and collate existing fauna data
2. Identify and profile threatened fauna species and other regionally significant fauna that are known or likely to occur
3. Identify broad-scale patterns in fauna occurrence and habitat use across the study area and identify habitats of particular conservation significance.

This report is intended to be read in conjunction with the report on the larger fauna survey program (DEC in prep.).

1.2 BACKGROUND

South western Blue Mountains NP (the study area) encompasses 34 612 hectares of land in the south western most portion of Blue Mountains National Park. The area is demarcated to the north east, north, west and south by the Blue Mountains NP boundary and to the east by Murruin and Shivering Creeks (Map 1). It is located approximately 35 kilometres south of Oberon and 150 kilometres west of outskirts of the Sydney metropolitan area. The study area is bordered to the north and north east by Gurnang State Forest (pine plantations), to the south and south west by partly cleared private land and to the east by the Bindook Highlands and the remainder of Blue Mountains NP.

Sections of the study area were gazetted as part of the Blue Mountains NP in 1978 and the Mt. Werong area was added in 1988. Various small additions to the park have been made since. The study area forms part of the Greater Blue Mountains Area, which was inscribed on the World Heritage List in November 2000. Just under twenty per cent (6300 hectares) of the study area lies within the Warragamba Special Area (drainage flowing east of the Great Dividing Range). A significant portion of the study area falls within the Murruin Creek catchment, which has been nominated for protection under the NSW Wilderness Act 1987 (the Murruin Wilderness). This nomination is currently being assessed (DEC 2004a).

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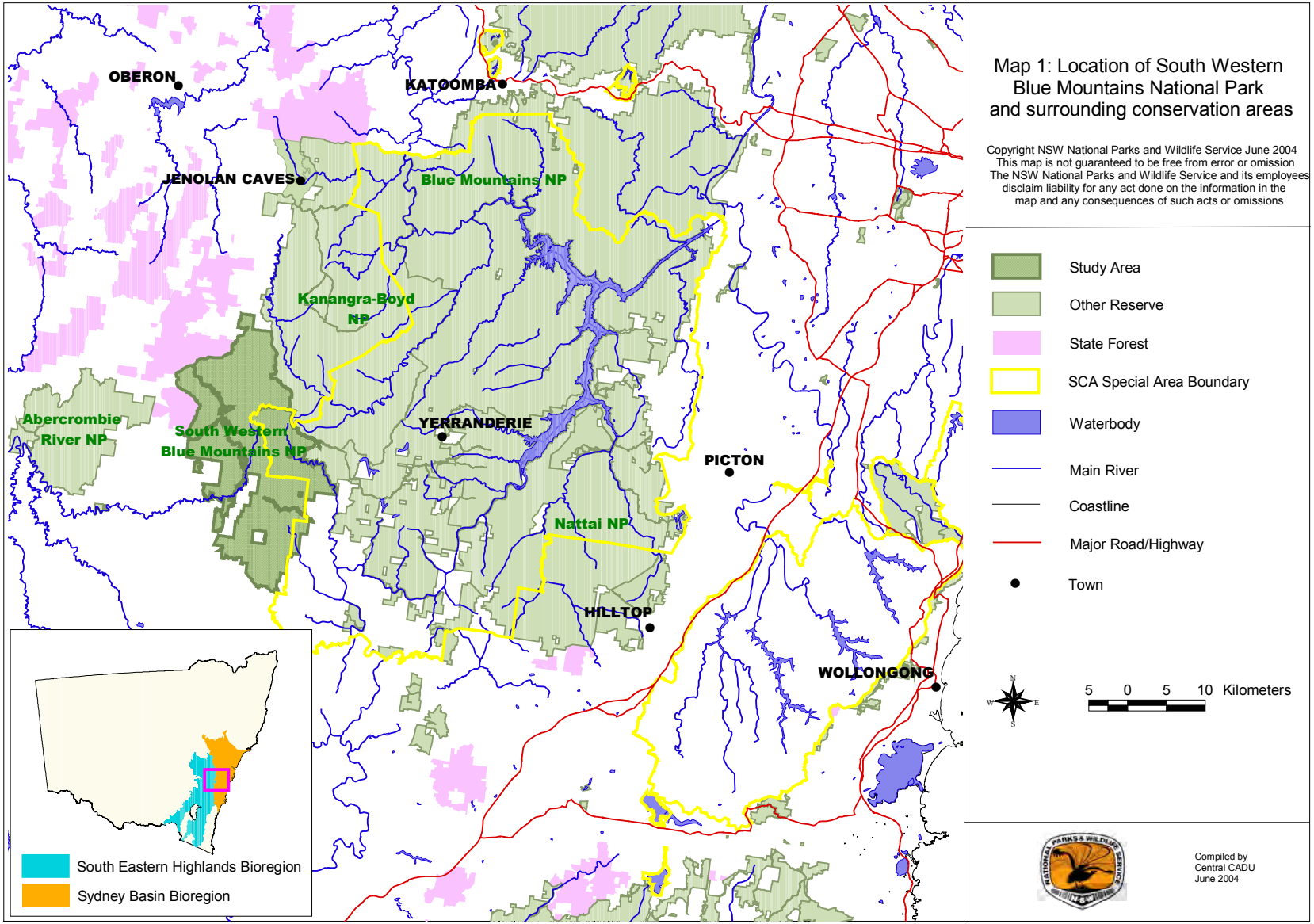
OBERON
KATOOMBA
JENOLAN CAVES
Blue Mountains NP
Kanangra-Boyd NP
Abercrombie River NP
South Western Blue Mountains NP
YERRANDERIE
PICTON
Nattai NP
HILLTOP
WOLLONGONG
South Eastern Highlands Bioregion
Sydney Basin Bioregion
Map 1: Location of South Western Blue Mountains National Park and surrounding conservation areas
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This map is not guaranteed to be free from error or omission
The NSW National Parks and Wildlife Service and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions
Study Area
Other Reserve
State Forest
SCA Special Area Boundary
Waterbody
Main River
Coastline
Major Road/Highway
Town
5 0 5 10 Kilometers
Compiled by
Central CADU
June 2004

1.3 HISTORY OF LAND USE

There is evidence that Aboriginal occupation of the study area dates back to over 12000 years ago (DEC 2004a). Early European occupation of the area is not well documented, with the first recorded activities based around grazing, stock droving and small-scale mining operations during the mid to late 1800s (DEC 2004a). Cattle and Goats were run in the area from the late 1800s to the 1980s. Logging and mining operations took place from the 1800s up until the gazettal of the Mt. Werong area in 1988 (DEC 2004a). This included at various times: a small mine at Ruby Creek producing lead, silver and zinc; removal of gold and gemstones from the area of Wyndham and Werong; alluvial gold mining from the Abercrombie River; a slate mine in the headwaters of Murruin Creek; and a silver, gold and copper mine on Mt. Werong Creek (DEC 2004a). A small settlement was established at Mt. Werong in the 1930s, but was deserted by the 1940s (Burramoko Archaeological Services in DEC 2004a).

A large portion of the study area was once State Forest, including what were known as Mt. Werong, Banshea and parts of Gurnang State Forests. Evidence of the extensive selective logging that occurred through much of the taller moist forests in the northern half of the study area remains in the form of a high density of stumps, particularly of Brown Barrel (*Eucalyptus fastigata*) and an evenly aged stand of regrowth trees. The western parts of the study area have also been subject to logging and misuse in the past (DEC 2004a). Previous selective logging has affected the age structure of the vegetation, by removal of mature trees, in parts of the north of the study area.

1.4 ENVIRONMENT

Biogeography

The study area lies within the South Eastern Highlands Bioregion (Thackway and Creswell 1995). This Bioregion covers an extensive area of the central tablelands and slopes of New South Wales and Victoria. The Bioregion is dominated by a temperate climate characterised by mild to warm summers and no dry season (NPWS 2003c). Approximately fifteen percent of the Bioregion is reserved for conservation (in National Parks, Nature Reserves, karst conservation reserves and State Conservation Areas) (NPWS 2003c).

The Sydney Basin Bioregion lies eight kilometres to the east of the study area. Landscapes in the far east of the park share some climate, geology and landscape features with the western extremity of this Bioregion.

Geomorphology

The south west of the southern Blue Mountains NP straddles the Great Dividing Range, with this range separating catchments of east (Hawkesbury-Nepean) and west (Murray-Darling) flowing streams. The geology of the study area is perhaps the most complex of the entire Blue Mountains reserve network. Other than the alluvial deposits and the basalt caps at Mts. Shivering and Jerrong, the rocks are the oldest found within this series of reserves.

The north of the study area contains subalpine environments that lie on the hard weather-resistant granite knolls around the former Mt. Werong and Banshea State Forests. These lie above 1000 metres in elevation and are a similar landscape feature to the larger Boyd Plateau found to the north within Kanangra-Boyd NP. The rocks in these areas erode to produce a soil of moderate fertility.

To the west the granite knolls are surrounded by an undulating landscape that gradually falls in elevation with distance from the Great Dividing Range. These landscapes form the eastern arm of the south and central tablelands, a region that extends from the Brindabella Ranges near Canberra in the south to Mudgee in the north. The underlying rocks are the oldest in the study area, having been formed during the Ordovician period (Hird 1991). These include silty sandstones, micaceous siltstone, phyllite shale, and slate quartzite (Brunker and Offenberg 1968). Such rocks are found at the headwaters of Burnt Hole Creek, and on Mts. Jerrong and Armstrong. The ridge and gully systems in this area are shallower than the landscapes to the east.

The eastern fall of the Great Dividing Range covers several north-south running bands of different geological age. This combination of rocks is derived from sandstones, slates and quartzite from the Upper Devonian and Ordovician periods (Henderson 2003), leading to soils that are shallow, rocky and infertile. The Chalkers Ridge fire trail traces the line of these geological changes. The landscape

forms a network of narrow ridges and deep gullies that range between 700 and 1000 metres in elevation. These landscapes retain cool temperate influences typical of higher elevations of the Blue Mountains reserves.

Murruin, Jocks and Little Wombeyan Creeks descend into the massive Porphyritic intrusion that spans the Wollondilly Valley. These rocks, formed during the upper Devonian period (Henderson 2003), are easily eroded, meaning that the rivers cut and incise massive gorges into the bedrock. The soils derived from these rocks are moderately fertile and similar in structure to other coarse grained igneous rocks such as granite. These landscapes occupy elevations between 400 and 650 metres in the south eastern part of the study area. A number of limestone outcrops, formed during the Silurian period, are present in the Little Wombeyan and Murruin Creek valleys. These outcrops are part of the distinctive karst systems that extend between Wombeyan and Jenolan Caves.

Small patches of alluvium have developed on bends of some of the larger streams such as Abercrombie River, Mount Werong. Little Wombeyan and Murruin Creeks. These form small flats that have been sought for grazing pursuits, and many are cleared or disturbed.

Elevation

The entire study area lies higher than 600 metres above sea level (asl), with the exception of the lower reaches of Ruby Creek in the north east, which falls to 460 metres asl, and Murruin Creek in the south east, at 400 metres asl. The eastern section of the study area, including the catchments of Little Wombeyan and Jocks Creeks, ranges between 600 and 800 metres asl. The majority of the centre of the area, bounded roughly to the east by Limeburners Flat and the west by Parliament Hill, lies between 800 and 1000 metres asl, with sections along the Range Firetrail and Trailers Mountain above the latter height. The north western corner of the study area, from Parliament Hill north west to Gurnang State Forest, lies above 1000 metres in height, rising from 1088 metres asl at Parliament Hill to 1215 metres at Mt. Werong and 1285 metres asl along Banshea Road in the far north west corner.

Climate

The study area has a cool to mild sub-alpine climate, in which snow can be expected on some days in winter (DEC 2004a). Long term climate patterns across the study area are directly related to topography. The lands higher than 1000 metres asl in the north of the park, have a mean annual temperature of nine degrees, with a maximum of 20 to 25 degrees and a minimum of minus two degrees Celsius. The southern two thirds of the study area experience a mean annual temperate of between ten and twelve degrees, with a minimum of around zero degrees and maximum of 23 to 26 degrees Celsius. The large creeks that drain eastwards, including Ruby, Murruin, Jocks and Middle Creeks, maintain a more moderate average annual temperature of between twelve and fifteen degrees Celsius, with a summer maximum of 28 degrees and a winter minimum of one degree Celsius.

The annual rainfall data for the study area follows a similar pattern. Areas at high elevation, along the Great Dividing Range, at Mt. Werong and along the Banshea Ridge, experience an average of approximately 1000 millimetres of rain per year, while the remainder of the study area receives an average of between 700 and 900 millimetres per year.

1.5 VEGETATION

Vegetation across south western Blue Mountains NP was mapped on a broad scale in 2000 as part of the CRA program (NPWS 2000a). In 2001 DEC was commissioned by the SCA to undertake a comprehensive flora survey of the entire Warragamba Special Area. Fine scale vegetation mapping was undertaken in the far eastern section of the study area as part of this program (NPWS 2003a). The following description of vegetation is based on information contained in NPWS (2000a) and NPWS (2003a).

Such a landscape as described above greatly influences the trend in vegetation patterns across the study area. Overall the vegetation patterns correspond to sub-alpine, montane and eastern tablelands environments that have low to moderate fertility and moderate rainfall. Small areas in the Murruin Creek are characterised by the drier climate of the Wollondilly Valley. The following synopsis of vegetation in the area is drawn from NPWS (2003a) and NPWS (2000a).

In the north of the study area, around the former Banshea and Mt. Werong State Forests, the country is dominated by moderately fertile soil that, in combination with good rainfall and high elevation, supports a sub-alpine tall forest of Narrow-leaved Peppermint (*Eucalyptus radiata*), Mountain Gum (*E. dalrympleana* subsp. *dalrympleana*) and Brown Barrel on ridges and gentle slopes (Plate 1). These forests are shrubby with a herbaceous and grassy ground cover. This community is extensive and has been repeatedly logged for Brown Barrel. Drainage lines and depressions on these granites form a cold air sink and mark a transition into a shorter open forest and woodland dominated by Snow Gum (*Eucalyptus pauciflora*), Mountain Gum and Candle-bark (*E. rubida*). Silver Wattle (*Acacia dealbata*) is a common shrub and the ground cover includes dense clumping of Tussock and Snow Grass (*Poa* spp.).

Plate 1: Montane Sheltered Forest in the former Banshea State Forest © DEC

West of the divide, the landscape and climate slips from a sub-alpine to a cool tableland environment. Rainfall decreases and a low open woodland becomes the distinctive feature of the ridgelines and slopes (Plate 2). This forest is floristically simple, dominated by tree species typical of poor soils in tableland environments. These include Red Stringybark (*Eucalyptus macrorhyncha*), Brittle Gum (*E. mannifera* subsp. *mannifera*), Tablelands Scribbly Gum (*E. rossii*) and Broad-leaved Peppermint (*E. dives*). Again, a sparse understorey and ground cover is present with *Daviesia leptophylla* growing above Snow Grass and Silvertop Wallaby Grass (*Joycea pallida*). The tall montane gully forests that feature Brown Barrel have less mesic understoreys and are restricted to only the most protected sites. Within this area there are also a number of broad valleys and riverine flats, particularly along the Abercrombie River, which are primarily private land holdings. These form frost hollows in which Black Sally (*Eucalyptus stellulata*) and Snow Gum dominate. Much of this riverine flat community has been heavily cleared, although small patches remain at Limeburners Flat, which is the only example of this community east of the Divide.

South of Mt. Werong the deeply dissected Silurian and Ordovician metasediments support a dry shrub forest on ridgelines and exposed slopes. These forests are dominated by dense stands of Silvertop Ash (*Eucalyptus sieberi*) in combination with species such as Narrow-leaved Peppermint and Brown Stringybark (*E. blaxlandii*). The sclerophyllous shrub layer is generally very open with low Narrow-leaved Geebung (*Persoonia linearis*) and Native Holly (*Podolobium ilicifolium*) scattered amongst Snow Grasses (*Poa* spp.) and Bracken (*Pteridium esculentum*). The forest floor tends to support very little vegetation over the bare rocks and soil. Slopes are similar in floristic composition, however as shelter increases Brown Stringybark and Narrow-leaved Peppermint gain dominance in the canopy with taller shrubs and small trees of Broad-leaved Hickory (*Acacia falciformis*) and *Leucopogon lanceolatus* becoming more prominent. Slopes descend into gullies that feature tall Brown Barrel, Narrow-leafed Peppermint, Ribbon Gum (*Eucalyptus viminalis*) and Mountain Gum in the most protected aspects. The understorey is characterised by a dense carpet of ferns and twiners, below a taller though sparse mid strata of Blackwood (*Acacia melanoxylon*) and River Lomatia (*Lomatia myricoides*).

The creeks that flow east into the Wollondilly via the Murruin system gradually cut downwards to expose more erosion-prone rocks. Very steep gorges develop and dry forests of Grey Gum (*Eucalyptus punctata*) and Blue-leaved Stringybark (*E. agglomerata*) are common. The understorey is

Plate 2: Tablelands Exposed Silvertop Ash-Brittle Gum Woodland on Range Fire Trail © DEC

particularly sparse with Daisy Bush (*Olearia viscidula)* and Nodding Blue Lily (*Stypandra glauca)* forming clumps over exposed soil. In the gullies, a tall sheltered forest forms that differs from the Brown Barrel Forests that dominate many of the sheltered aspects at higher elevations. At these scattered locations on Little Wombeyan and Jocks Creeks, River Peppermint (*Eucalyptus elata*) forms a dense forest, sometimes with Ribbon Gum on narrow alluvial flats and lower slopes. The Murruin Creek gorge below the Bindook Highlands exposes large areas of the granite-like porphyry bedrock that is common throughout the Wollondilly Valley. Elevation drops rapidly in the gorge dry slopes, which are covered in Forest Red Gum (*Eucalyptus tereticornis*), Yellow Box (*E. melliodora*) and Stringybarks (*E. eugenioides/globoidea*). This open shrubby woodland generally occurs below 700 metres elevation. The precipitous nature of the Murruin Creek Gorge means slopes and rock falls are common. These scree slopes provide ideal habitat for a low growing dry rainforest to develop wherever there is sufficient protection from the sun and dry westerly winds. Large Port Jackson Fig (*Ficus rubiginosa*), Grey Myrtle (*Backhousia myrtifolia*) and occasionally Giant Stinging Tree (*Dendrocnide excelsa*) may dominate.

There are a number of interesting vegetation communities in the study area that are restricted in distribution. The first of these is a mallee-heath community that occurs on the Loombah Plateau. A thick shrub layer of Silver Banksia (*Banksia marginata*) has taller Mallee Ash (*Eucalyptus stricta*), Snow Gum and Mountain Gum sparsely scattered above. Vegetation growing on Mts. Shivering and Werong are influenced the basalt soils. These soils are fertile and undulating ridges support a forest of Brown Barrel and Ribbon Gum. While Mt. Werong has been heavily logged in the past and is primarily regrowth, Mt. Shivering is largely untouched and provides a example of what these majestic tall forests once were. The floristic assemblages of these forests are very closely aligned with those that are found throughout the gully systems of the area.

A small and contrasting community is the bogs and swamps that form in depressions, drainage lines and soaks of the montane and tableland environments. These form a dense shrub and sedge layer often featuring Tea Trees (*Leptospermum continentale*, *L myrtifolium*) and sedges from the Restionaceae family that include *Empodisma minus* and *Lepyrodia anarthria*.

1.6 FIRE

Little is known about traditional Aboriginal burning practices in the area. Since European settlement, fire events have predominantly been caused by lightning strikes during dry thunderstorms between December and March, with occasional wildfires being caused by burn-offs (DEC 2004a). The most recent wildfire within the study area occurred in the summer of 2001-2002 and effected the area bounded by Mt. Werong to the north, Abercrombie River and Maneveland fire trail to the south and Bindook Ridge to the east. The intensity of the fire was highly variable, reaching extreme (total vegetation consumption) at a number of locations along the ridgelines between Millamein Creek and Mt. Werong. Small areas near the Range Firetrail burnt between 1989 and 1991 and near the Little River fire trail in 1987 and 1997 (DEC 2004a). The remaining areas of the study area have not burnt since the 1980s, when small patchy fires burnt around the upper reaches of Mount Werong Creek, and the upper reaches of Tuglow Hole Creek.

2 METHODS

2.1 EXISTING FAUNA DATA

Prior to the current study, knowledge of the terrestrial vertebrate fauna of the south western Blue Mountains NP was markedly depauperate. The study area was subject to limited investigation during the NSW Comprehensive Regional Assessment (CRA) program, which sought to provide a broad overview of the conservation value of public lands in eastern NSW. Limited bird and mammal surveys were undertaken in the north of the study area in 1998 and the vegetation across the area was mapped on a broad scale in 2000 (NPWS 2000a). In 2001 a small biodiversity survey was undertaken at Mt. Werong, employing various techniques, including pitfall and elliott trapping, spotlighting and bird surveys. This data was originally entered into the Atlas of NSW Wildlife as incidental records at a single location, and this is reflected in the maps within this report. Efforts are being made with GIS Group to alter this data to more accurate locations although unless the original datasheets are used, it will be impossible to transfer this data into systematic data that can be used for further analysis. Also in 2001, DEC was commissioned by the SCA to undertake a comprehensive flora and fauna survey of the entire Warragamba Special Area, which overlaps the east of the study area. Ten systematic fauna survey sites were established and surveyed in 2003 as part of this program (NPWS 2003a, DEC in prep.).

The Atlas of NSW Wildlife was the primary resource used to access existing data on the fauna of the study area. The majority of records within the Atlas prior to the summer of 2003-04 derive from the previous DEC systematic surveys of the park described above. The bulk of the remaining records derive from the licensed data sets of Birds Australia (Blakers *et al*. 1984 and Barret *et al*. 2003) and the specimen register of the Australian Museum. The method used by Birds Australia to record sightings involves designating a ten-minute spatial grid, based on easting and northing lines. All birds recorded from within this grid are then assigned to AMG coordinates at the centre of the grid, such that the data is not spatially accurate on a fine scale. The Australian Museum data derives from specimens submitted to the museum by members of the public, as well as from field trips undertaken by Museum staff specifically to collect fauna specimens. Records collected soon after European settlement have been entered into the Museum database with a low level of spatial and temporal reliability. For this reason, records from the Australian Museum prior to 1950 have been excluded from discussion in this report.

Remaining records within the Atlas derive from observations made by: park rangers and field officers; catchment officers; bushwalkers and naturalists; scientific researchers working in the area; and other visitors to the park. These records have various levels of reliability depending on the type of observation, as well as the certainty and identification experience of the observer.

2.2 SURVEY STRATIFICATION AND SITE SELECTION

Prior to the commencement of the program of fauna surveys in 2004, 27 systematic fauna survey sites had been established within the study area, seventeen as part of the CRA program in 1998 and ten as part of the SCA fauna survey program in 2003. Gap analyses undertaken as part of the survey stratification and site selection for the 2004 survey season incorporated these systematic surveys, to ensure that the data collected would complement, rather than replicate, work that has previously been undertaken within the study area.

The primary stratum used for site selection was vegetation type. The study area is covered by a number of vegetation maps, of which two were used in the selection of fauna survey sites. For the area of park within the SCA Special Area boundary (eastern side of the study area) the vegetation map and descriptions produced by the Central Conservation Assessment and Data Unit (NPWS 2003a) were used; for the remainder of the study area, the vegetation map and descriptions produced by Southern Directorate CRA (NPWS 2000a). Each specific vegetation community within the study area was placed into a broader flora group; vegetation communities which shared significant similarities in floristic composition, structure, topographic position and substrata were grouped together. Fauna survey site stratification was based on these broad flora groups, while aiming to sample the full variation of vegetation communities within each group as much as possible.

A gap analysis identified the previous systematic fauna survey effort undertaken within each vegetation community and broad flora group across the whole of the Kanangra and Highlands area of Blue Mountains NP. Vegetation communities that had not previously been sampled or had been under-sampled (where the amount of previous survey effort was less than that predicted by the proportional size of the community), and were present within the study area, were prioritised for sampling. This ensured that the sites surveyed as part of the current study completed the broader program of systematic fauna survey being undertaken across the greater Blue Mountains region. Due to time and budgetary constraints, vegetation communities that occupied less than 100 hectares of land within the study area were not targeted for systematic replicated sampling, though some techniques were undertaken in some of these communities where possible.

Sites were initially selected using Arcview, with information gained from topographic maps, vegetation maps, access trails, and location of previous survey effort. Sites were positioned primarily on or close to access trails to facilitate conduct of spotlighting and harp trapping surveys and to maximise the number of sites that could be accessed during the limited survey period. In the field, the proposed site locations were ground-truthed to ensure that they were representative of the mapped vegetation community, had not been significantly effected by recent burning or other habitat modification, and comprised a single vegetation community. If these criteria were not met, an alternative location was selected for the site. Systematic survey sites were 100 by 200 metres in area, and spaced a minimum of one kilometre from each other (two kilometres for nocturnal call playback surveys).

Selection of survey sites was limited, at both stages of the process by the location of access trails and the large amount of travelling time between areas. Consequently, considerable difficulties were met in locating survey sites that sampled the range of vegetation communities, maintained sufficient distance between sites to ensure they were independent from one another and could be accessed with a reasonable degree of efficiency. For these reasons, and because fauna survey is very labour intensive, not all communities within the study area could be sampled to the desired extent. Vegetation communities that were restricted in extent and/or difficult to access received comparatively fewer sites in proportion to their area. In particular, problems were encountered in surveying Montane Sandstone Dry Shrub Forests. Table 1 presents the area of mapped vegetation communities (greater than 100 hectares in area) categorised into broad flora groups and the corresponding survey effort for each fauna survey technique. Map 2 shows the location of fauna survey sites and the distribution of broad flora groups within the study area. Appendix A provides the specific AMG, vegetation type and survey techniques undertaken at each survey site. The tables and figures include all systematic surveys undertaken within the study area by DEC between 1998 and 2004.

2.3 SURVEY METHODS

The systematic fauna survey methods used were based on those developed by the NPWS Biodiversity Survey Coordination Unit (NPWS 1997). The systematic techniques described below 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 future comparisons with consistent surveys of environments elsewhere.

Field survey teams were supplied with field proformas to facilitate comprehensive, consistent recording of field data and to increase accuracy and efficiency of data entry into the DEC Biodiversity Subsystem (BSS) of the NSW Wildlife Atlas 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

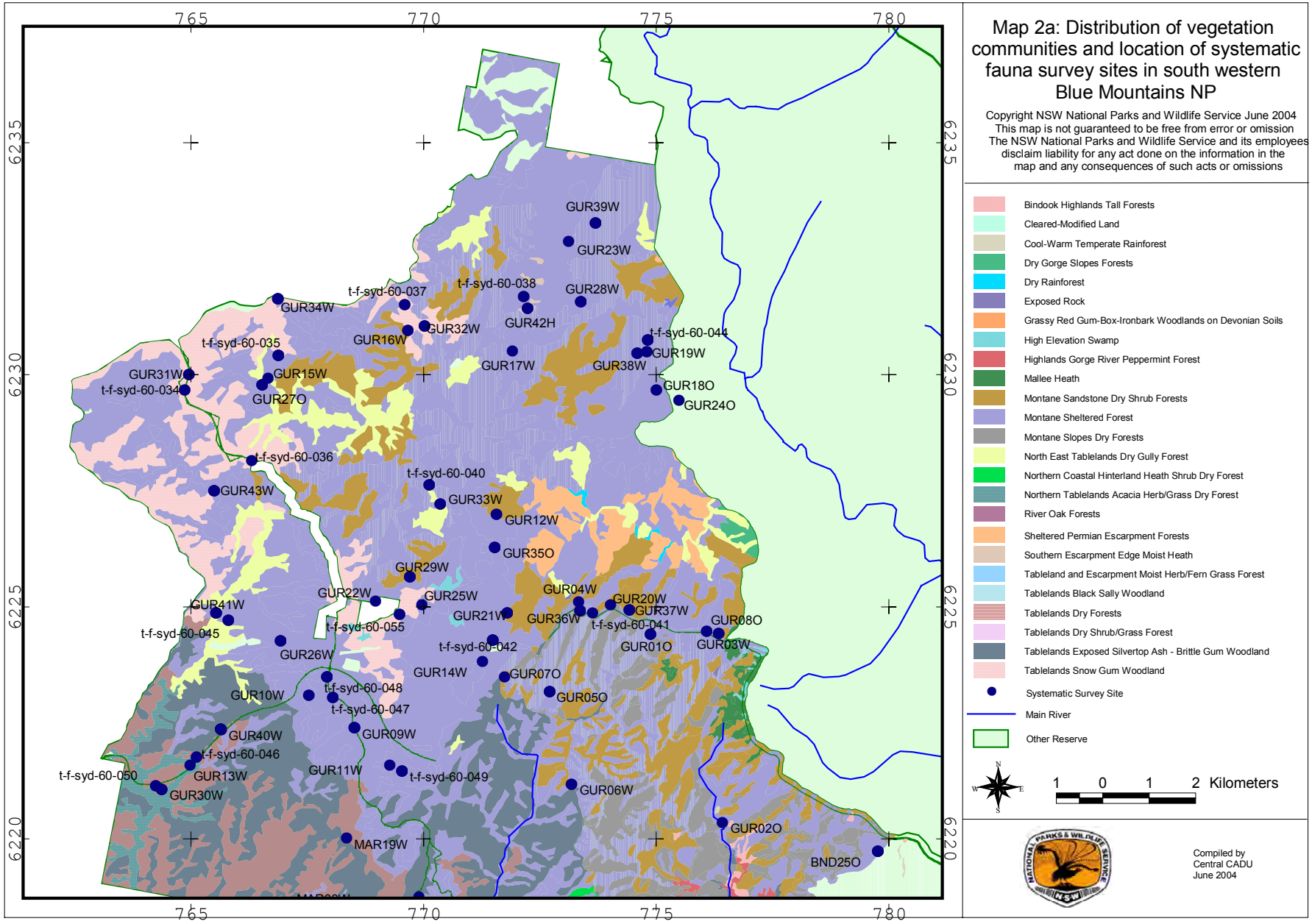
Diurnal bird survey

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

Table 1: Areas of mapped vegetation communities (broad flora groups) within south western Blue Mountains NP and allocation of systematic survey methods (includes systematic survey sites from CRA, SCA and Data Priorities projects). Vegetation communities derived from NPWS (2003a) and NPWS (2000a).

Broad Flora Group	Mapped area of vegetation community in study area[1]	Proportion of study area occupied by vegetation community (%)	No. of diurnal bird surveys	No. of diurnal reptile surveys	No. of site spotlight surveys	No. of harp trapping bat sites	No. of ultrasonic bat detector sites	No. of nocturnal streamside searches for frogs	No. of owl call broadcast sites	No. of Elliott trap sites
Montane Sheltered Forest	12375	35.8	18	14	22	10	4	3	13	3
Montane Sandstone Dry Shrub Forests	7195	20.8	5	6	5	5	3	0	0	1
Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	5119	14.8	5	4	5	3	1	0	2	1
Tablelands Dry Forests	2787	8.1	3	3	5	4	1	0	3	0
Montane Slopes Dry Forests	1665	4.8	1	1	1	0	0	0	1	0
Tablelands Snow Gum Woodland	1214	3.5	5	2	5	1	1	0	4	0
Tableland and Escarpment Moist Herb/Fern Grass Forest	872	2.5	2	2	1	0	0	0	0	0
North East Tablelands Dry Gully Forest	797	2.3	3	2	2	1	0	1	0	0
Dry Gorge Slopes Forests	456	1.3	0	0	0	0	0	0	0	0
Sheltered Permian Escarpment Forests	349	1.0	0	0	0	0	0	0	0	0
Highlands Gorge River Peppermint Forest	230	0.7	1	2	2	0	1	1	1	0
Northern Tablelands Acacia Herb/Grass Dry Forest	227	0.7	0	0	0	0	0	0	0	0
Bindook Highlands Tall Forests	208	0.6	0	0	0	0	0	0	0	0
Grassy Red Gum-Box-Ironbark Woodlands on Devonian Soils	132	0.4	0	0	0	0	0	0	0	0
Mallee Heath	115	0.3	0	0	0	0	0	0	0	1
Southern Escarpment Edge Moist Heath	13	0.0	1	1	0	0	0	0	0	0
Other vegetation communities with < 100 hectares in study area	857	2.5	0	0	0	0	0	0	0	0
Total	**34612**	**100**	**44**	**37**	**48**	**24**	**11**	**5**	**24**	**6**

[1] area based on GIS data layers does not equal gazetted area of reserve

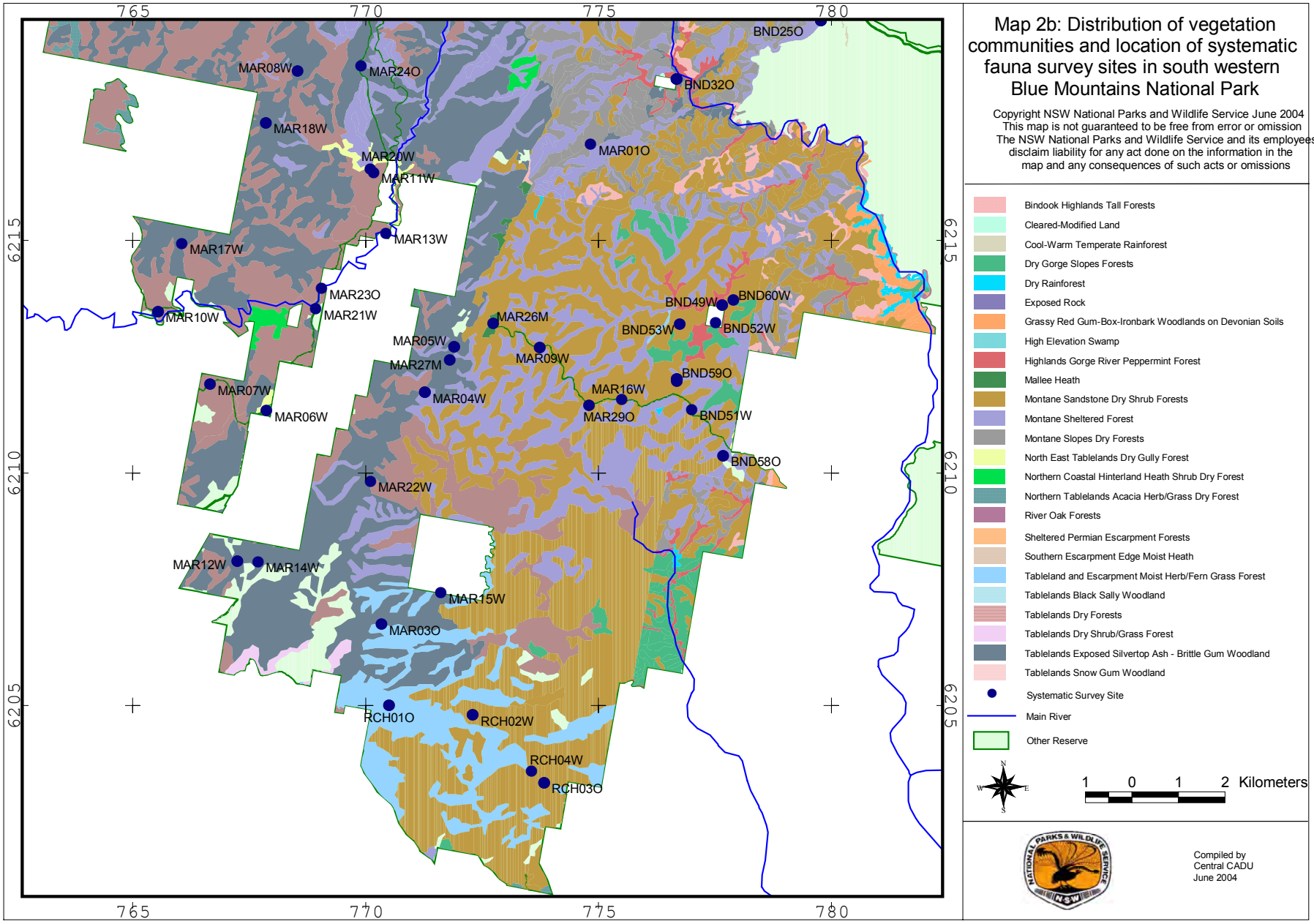


Map 2a: Distribution of vegetation communities and location of systematic fauna survey sites in south western Blue Mountains NP

- Bindook Highlands Tall Forests
- Cleared-Modified Land
- Cool-Warm Temperate Rainforest
- Dry Gorge Slopes Forests
- Dry Rainforest
- Exposed Rock
- Grassy Red Gum-Box-Ironbark Woodlands on Devonian Soils
- High Elevation Swamp
- Highlands Gorge River Peppermint Forest
- Mallee Heath
- Montane Sandstone Dry Shrub Forests
- Montane Sheltered Forest
- Montane Slopes Dry Forests
- North East Tablelands Dry Gully Forest
- Northern Coastal Hinterland Heath Shrub Dry Forest
- Northern Tablelands Acacia Herb/Grass Dry Forest
- River Oak Forests
- Sheltered Permian Escarpment Forests
- Southern Escarpment Edge Moist Heath
- Tableland and Escarpment Moist Herb/Fern Grass Forest
- Tablelands Black Sally Woodland
- Tablelands Dry Forests
- Tablelands Dry Shrub/Grass Forest
- Tablelands Exposed Silvertop Ash - Brittle Gum Woodland
- Tablelands Snow Gum Woodland
- Systematic Survey Site
- Main River
- Other Reserve

1 0 1 2 Kilometers

Compiled by
Central CADU
June 2004


765
770
775
780
6215
6210
6205
MAR08W
MAR24O
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MAR20W
MAR11W
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MAR23O
MAR21W
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MAR22W
MAR12W
MAR14W
MAR15W
MAR03O
RCH01O
RCH02W
RCH04W
RCH03O
MAR01O
MAR26M
MAR09W
MAR16W
MAR29O
BND25O
BND32O
BND49W
BND60W
BND53W
BND52W
BND59O
BND51W
BND58O
Map 2b: Distribution of vegetation communities and location of systematic fauna survey sites in south western Blue Mountains National Park
Copyright NSW National Parks and Wildlife Service June 2004
This map is not guaranteed to be free from error or omission
The NSW National Parks and Wildlife Service and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions
Bindook Highlands Tall Forests
Cleared-Modified Land
Cool-Warm Temperate Rainforest
Dry Gorge Slopes Forests
Dry Rainforest
Exposed Rock
Grassy Red Gum-Box-Ironbark Woodlands on Devonian Soils
High Elevation Swamp
Highlands Gorge River Peppermint Forest
Mallee Heath
Montane Sandstone Dry Shrub Forests
Montane Sheltered Forest
Montane Slopes Dry Forests
North East Tablelands Dry Gully Forest
Northern Coastal Hinterland Heath Shrub Dry Forest
Northern Tablelands Acacia Herb/Grass Dry Forest
River Oak Forests
Sheltered Permian Escarpment Forests
Southern Escarpment Edge Moist Heath
Tableland and Escarpment Moist Herb/Fern Grass Forest
Tablelands Black Sally Woodland
Tablelands Dry Forests
Tablelands Dry Shrub/Grass Forest
Tablelands Exposed Silvertop Ash - Brittle Gum Woodland
Tablelands Snow Gum Woodland
Systematic Survey Site
Main River
Other Reserve
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Compiled by
Central CADU
June 2004

Diurnal herpetofauna search

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

This census technique entailed active searching of potential reptile and frog microhabitats within the 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 listen intently for fauna calls during the survey period. All fauna observed 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. Sites were selected for their perceived potential to interrupt bats along their flight paths, and were usually along tracks or in gaps between trees where adjacent vegetation might force bats to fly.

Traps were checked each morning. Captured bats were identified by external morphology, forearm measurement and body weight, and keyed out where necessary using 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). 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.

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

Anabat recordings were transferred onto computer and analysed by Narawan Williams, a recognised expert in this field. Identification was designated as either definite, probable or possible, following the methodology of Parnaby (1992b) and Pennay *et al.* (2004).

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 within two days of rain. All frogs, and other animals, identified visually or by call within the time period were recorded, together with the weather conditions at the time of the survey.

Nocturnal call playback

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

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

Elliott trapping

This technique involved setting ten Elliott B traps at 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 Targeted survey for Stuttering Frog

In February 2004 targeted surveys were undertaken for the Stuttering Frog (*Mixophyes balbus*) around Mt. Werong. The aim of the surveys was twofold: to re-visit the site where the frog had previously been recorded in order to ascertain the extent, distribution and status of the population; to search for new locations and potential habitats of the species in the area. Surveys were undertaken along sections of: Ruby Creek (from above mine site to two kilometres north east of Ruby Creek Falls); Mount Werong Creek (one kilometre upstream and downstream of Middle Werong Creek Trail and five hundred metres upstream and downstream of Upper Werong Creek Trail); Tuglow Hole Creek (500 metres up and down stream of Bouchers fire trail crossing and near Dingo Dell); Burnt Hole Creek (one kilometre downstream and 500 metres upstream of Burnt Hole Creek fire trail). Diurnal searches were undertaken at all locations, involving dip netting for tadpoles and habitat assessment. Ruby Creek and Mount Werong creek were also surveyed at night, when spotlighting and call playback were used to ascertain the presence of adult frogs. All species of tadpoles and adult frogs seen or heard calling were recorded and entered onto a data sheet.

2.3.3 Opportunistic methods

Predator and herbivore scat and pellet collection

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

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.

Incidental records

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

2.4 SURVEY TIMING

As indicated above, systematic field surveys have been undertaken within south western Blue Mountains NP over a number of years. Table 2 summarises the timing of these surveys and the techniques that were undertaken in each season.

Table 2: Timing of DEC systematic fauna surveys within south western Blue Mountains NP

Survey program	Timing	Techniques employed
Comprehensive Regional Assessment (CRA)	August – September 1998	Diurnal bird census, site spotlighting, nocturnal call playback, opportunistic methods
Warragamba Special Area Surveys – Year 1	March 2003	Diurnal bird census, reptile search, harp trapping, opportunistic methods
	April – May 2003	Nocturnal call playback, site spotlighting
Biodiversity Survey Priorities Program	January – February 2004	Diurnal bird census, reptile search, site spotlighting, harp trapping, bat call detection, nocturnal streamside search, elliott trapping, opportunistic methods
	May 2004	Nocturnal call playback, elliott trapping, site spotlighting, opportunistic methods

3 RESULTS AND DISCUSSION

3.1 OVERVIEW

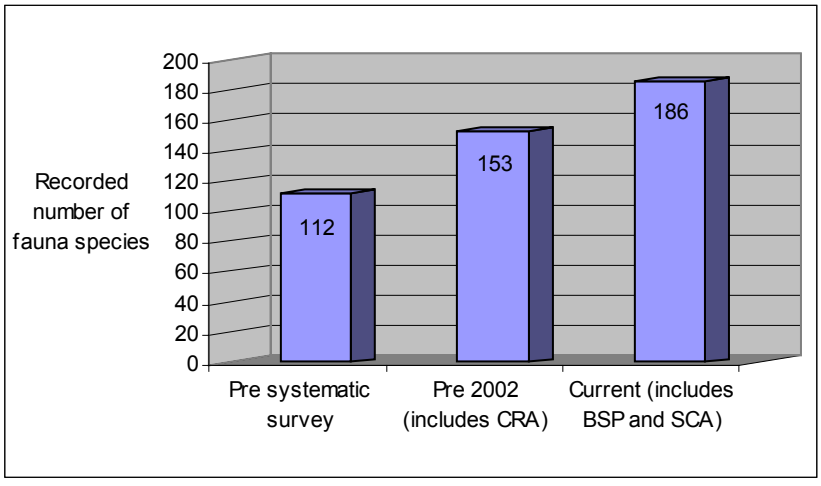
DEC has established and surveyed a total of 100 systematic fauna survey sites within south western Blue Mountains NP, 73 of which were surveyed in 2004 as part of the Biodiversity Survey Priorities fauna survey program. These sites cover the range of dominant habitats and landscapes present within the study area, and have been surveyed during spring, summer and autumn. In addition to these surveys, members of Birds Australia have contributed significantly to the number of fauna records for the study area, as have numerous DEC staff, scientific researchers, and dedicated members of the public.

One hundred and eighty six species of vertebrate fauna have been recorded on the Atlas of NSW Wildlife within the south western Blue Mountains NP. This includes ten species listed as threatened on the NSW Threatened Species Conservation Act (1995) (TSC Act), of which two are also listed on the commonwealth Environmental Protection and Biodiversity Conservation Act (1999) (EPBC Act). Eleven introduced fauna species have been recorded within the study area to date, including eight ground mammals and three birds. A complete species list for all fauna groups is provided in Appendix A.

In addition to the above fauna, 33 species have been recorded within a five kilometre radius of the study area boundary (see Appendix A). This includes six additional threatened species, which will be discussed further below.

The value of systematic fauna survey is apparent in the contribution it has made to the knowledge of fauna within the study area and the building of a species inventory. The CRA surveys, undertaken in 1998, added 41 species to the list of known fauna within south western Blue Mountains NP, and the Biodiversity Survey Priorities (BSP) program, undertaken in 2004, has added a further 33 species to the study area database. Figure 1 indicates the increase in the known number of fauna species within the study area over time, primarily as a result of dedicated systematic fauna survey.

Figure 1: Number of species recorded within south western Blue Mountains National Park following systematic fauna survey.



3.2 NATIVE DIURNAL BIRDS

A total of 108 bird species have been recorded within the study area. Of these 99 are native diurnal species, six are nocturnal species (Section 3.3) and three are introduced (Section 3.9). These records have been accumulated in three stages. Table 3 shows the accumulated species counts and number of records for each of these periods of time. This table includes nocturnal species within the counts of species and records.

The first period was prior to 1998, where a large number of records were gathered as part of the Bird Atlas published by the Royal Australasian Ornithologists Union (RAOU) (Blakers *et al.* 1984). A few incidental records are also included within the Atlas of NSW Wildlife for these period, but the vast majority of records are located at the centre of two ten-minute grid squares that happen to fall within Blue Mountains NP. There

is no guarantee that all or even any of these sightings are actually at that site, and indeed 30 species have not been recorded since this time. The most significant record, in terms of threatened species, was the Regent Honeyeater (*Xanthomyza phrygia*), which listed as endangered on the TSC Act and the EPBC Act. Based on the scarcity of potential habitat for the Regent Honeyeater, it is considered highly unlikely that the bird occurs within the study area. This species is usually found in Grassy Box Ironbark Woodlands or River Oak Forests, such as occur along the Coxs River and to the east of the Study Area. Other species that were recorded on more than five occasions during this period and have not been recorded since include Welcome Swallow (*Hirundo neoxena*), Magpie-lark (*Grallina cyanoleuca*), White-faced Heron (*Egretta novaehollandiae*), Red-browed Finch (*Neochmia temporalis*) and Noisy Miner (*Manorina melanocephala*). Many of the species are waterbirds or woodland species, which are considered unlikely to occur within this part of Blue Mountains NP.

Table 3: Accumulated species and record counts for birds within the study area.

Survey Period	No. of Species	Accumulated No. of Species	No. of Records	Accumulated No. of Records
Pre 1998	99	99	613	613
1998-2002	59	102	384	997
2003-2004	67	108	742	1739

The next period of survey activity started in the late 1990s with the Comprehensive Regional Assessment (CRA) which was part of the Regional Forestry Agreement (RFA) Process. Surveys were conducted over many areas of eastern New South Wales and during 1998 two weeks of systematic surveys were undertaken within the Study Area. Also starting at this time was the second Birds Australia Atlas (Barrett *et al.* 2003) which also obtained incidental records within the Study Area. Only a few species were added to the list at this point, but the number of records obtained between 1998 and 2002 was over one fifth of all bird records for the area.

The final stage of data collection was the current Biodiversity Survey Priorities program in 2004. As most of these records are collected systematically, the number of records obtained in this eighteen month period was more than the either of the two previous stages. The number of species added to the reserve was small (six), but for many other species more than half the records for the Study Area are from this period. These included many common species such as Noisy Friarbird (*Philemon corniculatus*), Superb Lyrebird (*Menura novaehollandiae*), Spotted Quail-thrush (*Cinclosoma punctatum*), Red-browed Treecreeper (*Climacteris erythrops*) and Grey Currawong (*Strepera versicolor*).

Plate 3: Yellow-faced Honeyeater ©P. Green/DEC

Of conservation significance is the presence of a number of bird species that are believed to be in decline in NSW, though they are not yet listed on the TSC Act or Environmental Protection and Biodiversity Conservation Act (1999) (EPBC Act). The Eastern Yellow Robin (*Eopsaltria australis*), Rufous Whistler (*Pachycephala rufiventris*) and Eastern Shrike-tit (*Falcunculus frontatus*) are all part of a group of birds that have been identified as declining in the NSW Wheat-Sheep Belt (Reid 1999) that have been identified within the Study Area. These species, however, are probably the species least reliant on woodland habitats that are included within this list. Barrett *et al.* (2003) identified a number of species that appear to have declined in numbers in recent years. Of these species, the following where recorded within the Study Area in the current survey period: Flame Robin (*Petroica phoenicea*); Gang-gang Cockatoo (*Callocephalon fimbriatum*); Spotted Quail-thrush; White-winged Chough (*Corcorax melanorhamphos*) and Red-browed Treecreeper. The presence of these species within the study area suggests that the area, together with Kanangra-Boyd NP and the Warragamba Special Area, plays an important role in the regional conservation of these species and their habitat.

Honeyeaters are indicative of the diversity of bird species within the study area, with eight species recorded. These include (in descending order of the number of locations they have been recorded) Yellow-faced Honeyeater (*Lichenostomus chrysops*) (Plate 3), Red Wattlebird (*Anthochaera carunculata*), White-eared

Honeyeater (*L. leucotis*), Eastern Spinebill (*Acanthorhynchus tenuirostris*), White-naped Honeyeater (*Melithreptus lunatus*), Brown-headed Honeyeater (*M. brevirostris*), New Holland Honeyeater (*Phylidonyris novaehollandiae*) and Little Friarbird (*Philemon citreogularis*). Four additional species Regent Honeyeater, Noisy Miner, Crescent Honeyeater (*Phylidonyris pyrrhoptera*) and White-cheeked Honeyeater (*P. nigra*) have been recorded, but probably don't occur within the reserve.

Cockatoos (family Cacatuidae) and parrots (family Psittacidae) are both represented in the reserve, with four and three species respectively. This includes the widespread and abundant Crimson Rosella (*Platycercus elegans*), and the charismatic Yellow-tailed Black-cockatoo (*Calyptorhynchus funereus*) and Gang-gang Cockatoo. Glossy Black-cockatoos (*Calyptorhynchus lathami*) have been recorded within a five kilometre radius of the study area, at Back Swamps Creek near Batsch Camp and in the vicinity of Wombeyan Caves (Map 5). However, it is highly unlikely that this species also occurs within the study area, as potential habitat for the species is absent. These Black-cockatoos feed exclusively on *Allocasuarina* trees, which are largely absent from the montane environments of the study area.

Six species of birds of prey have been recorded within the study area to date, though they appear to occur at quite low densities. The Wedge-tailed Eagle (*Aquila audax*) has been seen from atop the Murruin Range, soaring over the valley systems in the east of the study area. Brown Goshawk (*Accipiter fasciatus*) has been recorded once within the study area, at Little Wombeyan Creek in March 2003. Brown Falcon (*Falco berigora*) and Nankeen Kestrel (*F. cenchroides*) have each been recorded within the study area by Birds Australia in the 1970s and 80s, however the low spatial accuracy of these records makes it difficult to assess the species status in the area. The Peregrine Falcon (*Falco peregrinus*) has been recorded at three locations in the study area, most recently at the Mount Werong stone hut in February 2004. At this time, a fauna surveyor had just noticed a Gang-Gang Cockatoo, when a Peregrine Falcon swooped down and attacked it, swiftly killing the Cockatoo by decapitation. Before flying away the Peregrine Falcon coughed up a bundle of prey remains, which was collected for analysis. Unfortunately, however, the cough pellet contained only feathers, which could not be identified. A number of birds of prey, including Brown and Peregrine Falcons are thought to be in decline in various parts of the nation (Barrett *et al* 2003), thus protection of their habitat within the Blue Mountains NP and the surrounding region is important.

South western Blue Mountains NP differs from the adjoining parks within the Warragamba Special Area in that is has only a very small area of grassy woodlands on Devonian soils (NPWS 2003a). This means that many of the woodland birds found in locations like the Burragorang Valley have not been recorded within the park. Similarly, the small areas of rainforest present mean that many species that are common further east, such as Lewin's Honeyeater (*Meliphaga lewinii*) and Brown Gerygone (*Gerygone mouki*) have not been recorded. The species recorded are far more typical of the woodlands and forests of the central tablelands, with many species that appear to favour higher altitudes recorded. These species are discussed further in Section 3.11.

3.3 NOCTURNAL BIRDS

Six nocturnal bird species have been recorded within the study area to date. This includes three owls, the Southern Boobook (*Ninox boobook*) and Powerful and Masked Owls, the latter two of which are listed as Vulnerable on the NSW TSC Act (1995). The Powerful Owl is widespread in the study area, its distinctive low-pitched hoot being heard in response to 11 of 31 nocturnal call playback surveys that were undertaken between April and August, when owls are most likely to respond to the playback (DEC, unpublished data).

Plate 4: Tawny Frogmouth ©Narawan Williams

The abundance of Greater Glider (*Petauroides volans*) in the area, a preferred prey species for this owl, is likely to be a contributing factor to the high numbers of this predator. In contrast, the Masked Owl has only been observed once in the study area, in response to a call playback survey on Limeburners fire trail in May 2003. Both threatened owls will be discussed further in Section 5 below.

Though not known to occur within the study area before systematic surveys were undertaken, Australian Owlet-nightjars (*Aegotheles cristatus*) are relatively common, having been recorded eighteen times during systematic surveys and two times opportunistically. In contrast, the White-throated Nightjar (*Eurostopodus*

mystacalis) is relatively uncommon, having been recorded only once, in the vicinity of Little Wombeyan Creek in January 2004. This Nightjar is generally found at lower elevations (DEC 2004c) and thus would only be expected to occur in lower altitude gorges in the east of the study area. Both the Southern Boobook and Tawny Frogmouth (*Podargus strigoides*, Plate 4) are widespread and abundant within the study area, each having been observed within a variety of vegetation types, but particularly common in the Montane Sheltered Forests and Tablelands Snow Gum Woodlands in the north of the study area.

Other large forest owls are not expected to occur, as their preferred habitats are rare within the study area. The Sooty Owl (*Tyto tenebricosa*) is dependent on tall wet forests with a complex understorey, including wet sclerophyll and rainforest. The Barking Owl (*Ninox connivens*) prefers open woodland habitats at lower elevations, and are rare within the South East Highlands Bioregion (DEC 2004c).

3.4 ARBOREAL MAMMALS

Six species of arboreal mammal have been recorded within the study area during systematic surveys. Of conservation significance is the occurrence of the Yellow-bellied Glider (*Petaurus australis*) in the area, which is listed as Vulnerable on the TSC Act. It has been directly observed at two locations in the east of the study area; one individual was seen and the other was detected by its loud gurgling call, each during nocturnal call playback surveys in May 2004. Yellow-bellied Gliders have a distinct preference for Grey Gum, from which they extract sap to feed (Mackowski 1988). Location of the Gliders at lower altitudes in the east of the study area, in areas where this tree species makes up a significant component of the canopy, is therefore to be expected. Somewhat surprising, however, is the number of locations at which Yellow-bellied Glider scratches and feed marks have been recorded at higher elevations in the study area, particularly around Mt. Werong and along the Boucher Fire Trail. This result will be discussed further in Section 5 of this report.

Also of conservation significance is the presence of the Koala (*Phascolarctos cinereus*) within the study area. Only one individual of this species has been observed within the area, on Mt. Werong Road in October 1995 (de Govrik pers. comm.). Evidence of these large distinctive marsupials has also been collected just 500 metres east of the study area, on the slope between Bindook Mountain and Murruin Creek. This observation was of Koala scats within the Grassy Red Gum-Box-Ironbark Woodlands that dominate the area south east of the study area. It is possible that Koalas also occupy the far east of the study area where this vegetation type occurs, as well as the Montane Slopes Stringybark Forest and other communities where Grey Gum and/or Forest Red Gum comprises part of the canopy. This species is discussed further in Section 5 of this report.

The most abundant and frequently encountered species of arboreal mammal in the study area is the Greater Glider. This large glider was observed during over 80 per cent (36 of 43) of systematic site spotlight surveys, as well as during nocturnal call playback surveys, in predator scats, and numerous times opportunistically. The density of Greater Glider within the study area is indicated by that fact that nine to ten individuals were regularly observed during 200 metre spotlighting transects. The gliders were recorded within all of the vegetation types where systematic spotlighting was undertaken, and are particularly abundant in the taller Montane Sheltered Forests around Mt. Werong, where tree hollows are in good supply. This trend is typical of the species, as tall montane forests support high densities of the species across their range (NPWS 1998). The Sugar Glider (*Petaurus breviceps*) is also abundant in the study area (recorded at twenty locations), frequently detected by their distinctive yapping call, which carries a long distance. These gliders are regularly encountered in the south eastern half of the study area, but have not been recorded in the north east of the study area or in the Snow Gum Woodlands north west of Mt. Werong, despite extensive spotlighting surveys.

Plate 5: Feathertail Glider ©Narawan Williams

Both Common Ringtail Possum (*Pseudocheirus peregrinus*) and Common Brushtail Possum (*Trichosurus vulpecula*) are widespread in the centre and south of the study area, though at low abundance. The Common Ringtail has being recorded at just nine locations, while the Common Brushtail has been recorded at twelve.

Interestingly, Common Brushtail Possums interfered with almost all of the Elliott traps placed along Little Wombeyan Creek in May 2004 by pulling the waterproof bags off, eating the bait, pushing the traps down slopes and depositing scats on top of them. The small Common Ringtail Possum prefers habitats with a dense sub-canopy and shrub layer, in which to shelter and build their nests (dreys); such habitats are uncommon in the study area, largely restricted to patches in the eastern half. Neither of the possums occur within the undulating high-altitude Tableland Snow Gum Woodlands in the north east of the study area.

The Feathertail Glider (*Acrobates pygmaeus*, Plate 5) is also present, though this small elusive marsupial is very difficult to detect. The only evidence of the species within the study area is by a capture made by a domestic cat at Lanigans Swamp. Further targeted survey should reveal the presence and distribution of this species in the study area.

One additional species of arboreal mammal, the Eastern Pygmy-possum (*Cercartetus nanus*), that is listed as Vulnerable on the TSC Act has been recorded within five kilometres of the study area, by a specimen held at the Australian Museum. Unfortunately, this record does not have a date of collection and has a low degree of spatial accuracy. Eastern Pygmy-possum has not been recorded in the region in recent times, and it is therefore considered unlikely to occur within the study area. The nearest recent sighting of the species was made approximately seventeen kilometres east of the study area at The Peaks in 1997.

3.5 BATS

Fourteen species of microbat are known to occur within the study area, including both tree and cave-roosting species. This includes three species that are listed as Vulnerable on the NSW TSC Act: the Greater Broad-nosed Bat (*Scoteanax rueppellii*); Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*). A fourteenth species of bat, the Large-eared Pied Bat (*Chalinolobus dwyeri*) which also listed as Vulnerable on the NSW TSC Act, has been recorded at two locations approximately three kilometres south of the study area, and south of Wombeyan Caves. There is potential for this species to also occur within the study area, as it is known to exist within similar habitats and altitudes in the adjacent Kanangra-Boyd NP (DEC 2004b) and in the eastern blocks of Blue Mountains NP (DEC 2004c). These species will each be discussed further in Section 5.

Generally, the smaller microbats are the most common, including members of the *Vespadelus* genus, the *Nyctophilus* genus, and the Chocolate Wattled Bat (*Chalinolobus morio*). This observation may be an artefact of the sampling technique, however, as these bats tend to fly below the tree canopy and are therefore more readily captured in harp traps. These species primarily roost in trees, in hollows and under bark, meaning that they have less restricted habitat than cave-dwelling species. Bats of the *Vespedelus* genus are abundant in the study area, and can often be seen at dusk flying rapidly along roads or coming in to drink from creeks and other water bodies. The most frequently encountered species during the surveys were the Large Forest Bat (*V. darlingtoni*, captured 87 times and in 70 per cent of harp traps), and the Chocolate Wattled Bat (captured 85 times in 70 per cent of traps). The Southern Forest Bat (*V. regulus*, captured 55 times and in 58 per cent of harps traps) and Little Forest Bat (*V. vulturnus*, captured 54 times in 46 per cent of harp traps) are also abundant. A review of the distribution of microbat records across the Blue Mountains and Kanangra region reveals that the Southern Forest Bat, Large Forest Bat and Chocolate Wattled Bat have been captured most frequently above 600 metres in altitude, while the Little Forest Bat has been captured most frequently below 600 metres (DEC 2004c). This finding is consistent with the pattern of bat captures within the study area, as the Little Forest Bat appears to be absent from the north western corner of the study area, which has the strongest central tablelands influence, while 30 per cent of records for the species in the study area occur above 1000 metres. In contrast, the Southern Forest Bat is most common in the north western half of the study area, and 45 per cent of records for the species were collected above 1000 metres. The Chocolate Wattled Bat, however, appears to be evenly distributed throughout the study area, as does the Large Forest Bat.

Long-eared Bats (*Nyctophilus* spp.) are distributed widely throughout the study area. Gould's Long-eared Bat (*N. gouldii*) has been trapped at sixteen locations, all but two of which are north of Parliament Creek. Often a number of bats of this species are captured in a single trap, with up to eighteen bats captured on one occasion during the 2004 surveys. The Lesser Long-eared Bat (*N. geoffroyi*) is less widespread, captured in eight locations, spread sparsely between Jocks Creek and Cockerills Firetrail. The Long-eared Bats have only been detected by harp trapping, as the species of this genus cannot be distinguished by their ultrasonic call using standard parameters (Pennay *et al.* 2004). These bats can orientate and forage without using echolocation (Churchill 1998), such that very short, quiet calls are often all that is recorded by ultrasound recording devices.

The presence of larger members of the tree-roosting microchiropteran bat group is indicated by a smaller number of captures in harp traps, as well as by ultrasonic call detection. These species tend to fly higher, either within or above the tree canopy (Churchill 1998) and are therefore infrequently captured in harp traps. Gould's Wattled Bat (*Chalinolobus gouldii*) has only been detected by the recording of its ultrasonic call, at four locations in the north and one location in the south of the study area. Similarly the White-striped Freetail-bat (*Nyctinomus australis*) has not been captured in harp traps, yet is regularly detected by its distinctive call which is audible to humans, as well as by using the Anabat device. The Eastern Broad-nosed Bat (*Scotorepens orion*), Greater Broad-nosed Bat and Eastern False Pipistrelle have each been captured a few times, and recorded by anabat at additional locations. This indicates the importance of using a variety of techniques to effectively sample bats within an area. A single record of *Mormopterus* sp. 1 (undescribed Freetail-bat) exists for the study area, collected during the Mt. Werong Biodiversity survey, though it is unsure whether this was from Anabat or harp-trapping. This little known species is likely to be rare within the study area, however further work is required to understand its taxonomic relationships, distribution and habitat preferences.

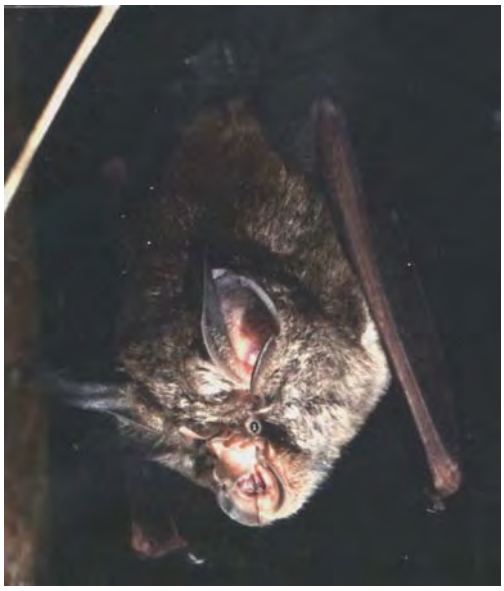


Plate 6: Eastern Horseshoe-bat © Ray Williams

The karst systems within Blue Mountains and Kanangra-Boyd NP, together with Jenolan and Wombeyan Caves, support a number of cave-dwelling bat species. Though abundant within Kanangra-Boyd NP, the cave-dwelling bats are present only in low numbers within the study area. The Eastern Bent-wing Bat has been detected by its ultrasonic call at three locations, and observed at a fourth. It is not known whether a roost site(s) for this species occurs within the study area, however it is considered likely that the individuals recorded roost within Kanangra-Boyd NP or Wombeyan Caves and use the study area as part of their large foraging range. The Eastern Horseshoe-bat (*Rhinolophus megaphyllus*, Plate 6) was first detected in the study area in January 2004, and has been recorded by anabat at three locations in total. This species is known to roost within the study area; it was observed roosting within a limestone karst along Little Wombeyan Creek during an inspection undertaken in January 2004 and has been detected by anabat at the entrance to another cave in the same system. The cave in which the Eastern Horseshoe-bats were seen roosting is known as 'Twin Caverns' and consists of a narrow three metre long drop which opens out into a double chamber approximately two metres wide and thirteen metres long (Landsdowne 1987). This species has a smaller foraging range than the Eastern Bent-wing Bat and is reported to have a slow and fluttery flight within metres of the ground (Churchill 1998). It is therefore likely that this bat gets recorded closer to its roosting site more frequently than the Eastern Bent-wing Bat does.

The Little Bent-wing Bat (*Miniopterus australis*), listed as vulnerable on the TSC Act, has been recorded at one location within a five kilometre radius of the study area, south of Wombeyan Caves in 1962. This record is of questionable reliability, however, as it does not lie within the species current known range. The Little Bent-wing Bat prefers lower altitude coastal habitats north of the Hawkesbury River (R. Williams pers. comm.). The species will therefore not be discussed further in this report.

3.6 NATIVE GROUND MAMMALS

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

The Spotted-tailed Quoll, listed as Vulnerable on the TSC Act, has been recorded once within the study area, by a scat collected near Mt. Werong in 2001. This species has never been directly observed within the study area, but is known to occur to the east in Kanangra-Boyd NP (DEC 2004b). It is likely that the species occurs only in very low abundance within the study area, as will be discussed further in Section 5 of this report. A second species listed on the TSC Act has been recorded within a five kilometre radius of the study

area, but not within the park itself, is the Brush-tailed Rock-wallaby. This endangered species was formerly known from around Wombeyan Caves, though the last known individual from this population was captured and taken to Jenolan Caves in 1995 (R. Humphries pers. comm.). Anecdotal records from the area around Wombeyan Caves persist, with possible sightings in the Guineacor Creek and Top of the World Area (D. Ashton pers. comm.), though these have not been confirmed. The only recent sighting of the species within a five kilometre radius of the study area is of two individuals in the Murruin Creek catchment, 400 metres south of the National Park boundary, in November 2001. This species is considered to have the potential to occur within the study area, and will be discussed further in Section 5 of this report.

Four species of macropod are definitely known to occur within the study area. The most frequently encountered of these within the study area is the Red-necked Wallaby (*Macropus rufogriseus*, 34 locations), which is commonly observed along roads throughout the study area. The Swamp Wallaby (*Wallabia bicolor*, 29 locations) is also widespread and abundant in the area, with the majority of records coming from opportunistic sightings along roads, as well as observations made during spotlighting surveys. This species has also been identified in Fox scats, as presented in Section 3.10 below. The Eastern Grey Kangaroo (*Macropus giganteus*, 17 locations) is less common in the study area, with records concentrated around Mt. Werong and along the edges of cleared land between Back Creek and Range Fire Trail. These kangaroos prefer open grassy habitats for foraging and are therefore a common sight in more open vegetation types that feature a dense ground layer of grasses. The Common Wallaroo (*Macropus robustus*) has been recorded at seven locations in the south of the study area, including on steep slopes on the east side of Mount Jim Dingo, as well as at Limeburners Flat and south of the Little Wombeyan Firetrail.

A record of Tasmanian Bettong (*Bettongia gaimardi*) exists for Wombeyan Caves, two and a half kilometres south of the study area, probably of subfossil remains, collected in 1987. This species is listed on the TSC Act as being presumed to be extinct in NSW, and is highly unlikely to occur within the study area. It will therefore not be discussed further in this report.

Common Wombats (*Vombatus ursinus*) have been recorded over fifty times within the study area, evidenced by direct observation, burrow entrances, and their characteristic prominently placed scats. These large marsupials have been observed in all areas where systematic surveys have been undertaken, and in a variety of vegetation types, however they are most commonly recorded in the Montane Sheltered Forests in the north of the study area.

One species of monotreme occurs within the study area, the Short-beaked Echidna (*Tachyglossus aculeatus*). This distinctive animal has been observed opportunistically during the systematic fauna survey field trips five times, three individuals around Mount Werong, one on the Maneveland fire trail and one along Little Wombeyan Creek. In addition, diggings and tracks have been recorded in the far north of the study area, just south of Gurnang State Forest. It is likely that the second species of monotreme, the Platypus (*Ornithorhynchus anatinus*), occurs within the study area, for example along the Abercrombie River or Mount Werong Creek. Landholders have observed the latter species in neighbouring lands, such as at Abercrombie Station (C. Mateer pers. comm.).

The Elliott trapping which has been undertaken has increased our limited understanding of the distribution and abundance of small terrestrial mammals within the study area. Two small dasyurid marsupials occur in the study area, the Brown Antechinus (*Antechinus stuartii*) and the Common Dunnart (*Sminthopsis murina*). The former is widespread in the area, captured at five of seven Elliott trapping sites, and observed at an additional two locations. They have been captured in a variety of vegetation types, from Montane Sheltered Forests to Mallee Heath. A number of the *Antechinus* captured in the study area in May 2004 had an unusual appearance. They were quite small, had prominent eye rings, had a greyish head and brownish body, and some lacked orange colouring on their underside. A sample of hair from one of these unusual individuals was collected, and later analysis identified the animal as a Brown Antechinus, ruling out the possibility that it was Yellow-footed Antechinus (*A. flavipes*). Further refinement of the taxonomy and zoogeography of the *Antechinus* genus, however, may reveal a second species to occur within the study area.

The Common Dunnart is generally rarely captured in Elliott traps, and has only been captured once within the area in a pitfall trap installed at Mt. Werong. It is likely that this species is more widespread in the area than records indicate, however elucidation of its distribution and abundance in the study area would require a very labour intensive pitfall trapping effort. One species of native rodent, the Bush Rat (*Rattus fuscipes*) occurs in the study area. This species has only been observed once, again at Mt. Werong in 2001. As this native rat readily uses Elliott traps, and has not been recorded in any predator scats, it is considered to occur only at very low abundance in the study area. This species prefers habitats with dense shrubs and ground cover (Lunney 1995), which may be a reason for its scarcity within the study area.

The Dingo (*Canis lupus dingo*) has been recorded in the study area in 2004. One animal was found dead just north of Banshea Road in February, while at least eight animals were detected by their distinctive howling between Mt. Armstrong and Mt. Jim Dingo in May. These animals appeared to have a relatively high degree of Dingo breeding, however the degree of the animals' purity is unknown and would only be confirmed by genetic testing. Knowledge of the distribution of these animals within the study area is minimal. It is reported that in the early days of European settlement, Dingoes were so numerous in the area that they prevented the grazing of sheep, such that graziers turned to Cattle as an alternative (DEC 2004a). A research project on the Dingo across the Warragamba Catchment will commence shortly, which aims to tease out the distribution of Dingos in comparison to Dogs across the region (B. Purcell pers. comm.). Currently, most records on the Atlas of NSW Wildlife are entered as Dingo/Dog, and the distribution of these records is discussed below.

3.7 REPTILES

The diversity of landscapes within the study area provides a variety of habitats for reptiles which is shown by the diverse mix of species, including high altitude specialists, litter dwelling species, low altitude species and water-loving species. A total of 28 species of reptile have been recorded to date, including one species of turtle, four dragons, one monitor, eighteen skinks and four snakes. None of these reptiles are listed as threatened under state or federal legislation, however some of the records provide important information on species ranges and habitats.

The Eastern Snake-necked Turtle (*Chelodina longicollis*) was recorded within the study area for the first time in May 2004, when it was seen at two locations on the Abercrombie River, between Round Flat and Johnny Barnes Flat. This species is likely to occur elsewhere along the river, and possibly also within other large drainage systems, such as Werong Creek.

Of the four species of dragon within the study area the Mountain Heath Dragon (*Tympanocryptis diemensis*) is the most common, occurring at low density throughout the area. The species has been observed at seven locations, in a variety of vegetation types from montane sheltered forests to dry woodlands. The Eastern Water Dragon (*Physignathus lesueurii*) has been recorded at five locations, including along the Abercrombie River, Ruby Creek and Mount Werong Creek. As its name suggests, this large dragon occurs along drainage lines and is usually spotted during the day, basking on rocks or vegetation by the water's edge. The Jacky Lashtail (*Amphibolurus muricatus*) has also been recorded at five locations, in the vicinity of Mt. Werong and along the Abercrombie River. This species has only been observed opportunistically, including basking on rocks and sheltering under piles of abandoned corrugated iron. The Eastern Bearded Dragon (*Pogona barbata*) has only been recorded once, in the vicinity of Mt. Werong in December 2000. It is possible that this species also occurs elsewhere within the study area, though the fact that they have not been observed during any of the systematic fauna survey periods indicates that they are at very low abundance.

Lace Monitors (*Varanus varius*) have been observed at four locations in the study area including at Lanigans Swamp, on Little Wombeyan Creek Firetail south of the creek, on Cockerills Firetrail and on the Murruin Range. This large goanna is a habitat generalist with a large home range, and is likely to occur at low density throughout the study area.

The northern half of the study area accommodates a suite of skinks typical of the south eastern NSW high country. This area of the study area lies entirely above 800 metres in altitude, with significant portions above 1000 metres. The reptile fauna is therefore dominated by skinks that prefer the grassy open forests and woodlands of montane sub-alpine environments. This includes the species (in order of recorded abundance) Trunk-climbing Cool-skink (*Pseudemoia spenceri*), Tussock Cool-skink (*P. entrecasteauxii*), Southern Forest Cool-skink *(Niveoscincus coventryi*), Cool-temperate Water-skink (*Eulamprus tympanum*) and Blotched Bluetongue (*Tiliqua nigrolutea*). Bold-striped Cool-skink (*Bassiana duperreyi*) is also considered to be a high-altitude species, yet within the study area it has been recorded only three times, including once below 800 metres above sea level.

The most abundant and widespread reptile species in the study area is the Warm-temperate Water-skink (*Eulamprus heatwolei*), which has been recorded at 46 locations and at over 50 per cent (20 of 37) of systematic diurnal herpetofauna surveys. This species is typical of mid to high altitude landscapes within the greater Blue Mountains area, occurring in a diversity of habitats ranging from Montane Sheltered Forests to Tablelands Exposed Silvertop Ash-Brittle Gum Woodland and Tablelands Snow Gum Woodland. The Pale-flecked Sunskink (*Lampropholis guichenoti*) is also abundant in the area, having been observed at 35 locations and during 65 per cent (24 of 37) of systematic diurnal herpetofauna surveys. This species occurs at a wide range of altitudes, but in contrast to the related Dark-flecked Garden Sunskink (*Lampropholis delicata*), is generally more common above 800 metres above sea level (DEC 2004c).

A number of species more typical of low altitude habitats also occur within the study area, but at very low abundance. These include the Cream-striped Shinning-skink (*Cryptoblepharus virgatus*), which has been observed once between Parliament Creek Firetrail and the Abercrombie River; Copper-tailed Ctenotus (*Ctenotus taeniolatus*), which has been recorded once around the limestone outcrops at Little Wombeyan Creek; and the Dark-flecked Garden Sunskink, which has been recorded at four locations, including on Murruin Range, near Little Wombeyan Creek and on the southern boundary of the study area, just north of Wombeyan Caves. None of these species have been recorded above 1000 metres within the study area. The Eastern Water-skink (*Eulamprus quoyii*) is also generally considered to be a low elevation species and within the Kanangra region is usually identified below 600 metres in altitude (DEC 2004c). The species has been recorded ten times within the study area, however, including seven times between 800 and 1000 metres, and twice above 1000 metres in altitude. The species is typically an inhabitant of streamlines and other wet areas at lower altitudes, but has previously been recorded, as it has been in this study, extending up streamlines to higher elevations, where it can become sympatric with the Warm-temperate Water-skink (R. Wellington pers. comm.). Interestingly, however, the Eastern Water-skink has not been recorded in the south east of the study area, which is lower in altitude. Further work is required on the Water-skinks in this area, and throughout the state, to elucidate the taxonomic relationships and relative distribution of species in this genus.

The Weasel Shadeskink (*Saproscincus mustelinus*) shows no obvious altitudinal preference across the greater Blue Mountains region (DEC 2004c), reflected in its occurrence at a range of altitudes within the study area (from 690 to 1100 metres). This litter-dwelling species has been recorded at eleven locations, most of which are located within Montane Sheltered Forest along the Murruin Range; the species has not been found in the north east of the study area. The Red-throated Cool-skink (*Bassiana platynota*) similarly exists at a range of altitudes within the region (DEC 2004c), yet is relatively uncommon within the study area, with just four locations on record, including three in the east around Limeburners Flat and Little Wombeyan Creek, and one north of Mt Werong.

Two species of lizard from the *Egernia* genus occur within the study area, though White's Rock-skink (*E. whitii*) has only been observed on one occasion, just south of the junction between Swamp Creek and the Abercrombie River. The Black Crevice-skink (*Egernia saxatalis intermedia*, Plate 7) is more widespread, having been recorded at five locations, each south of Mount Werong. Within the greater Blue Mountains region this species has not been observed below 600 metres in altitude, and is much more common above 800 metres.

Plate 7: Black Crevice-skink near Goker Firetrail © David O'Connor/DEC

The habitat in which the lizards have been located within the study area, however, is somewhat unusual for the species. This medium-sized lizard is typically rock-dwelling, usually found on boulder slopes and in crevices under exfoliating slabs on exposed rock faces (Cogger 1996). Typical habitat for the species does occur within the study area, for example within the system of limestone outcrops around Little Wombeyan Creek, where numerous Black Rock-skinks were located during a systematic survey in January 2004. Of interest, however is the location of the species within Tableland and Escarpment Moist Fern/Herb Grass Forest along the Goker Firetrail and within Tablelands Exposed Brittle Gum-Silvertop Ash Woodland along the Range Firetrail. Neither of these habitats had any outcropping or exposed surface rock, but featured a ground cover of Bracken Fern (*Pteridium esculentum*). The lizards were located on logs exposed above the layer of ground cover.

Two species of short-limbed fossorial skinks occur within the study area: the Yellow-bellied Three-toed Skink (*Saiphos equalis*) and the Three-toed Earless Skink (*Hemiergis decresiensis*). These species have only been recorded above 800 metres in altitude within the study area, and have each been found once above 1000 metres. Both species occur at low abundance, having been recorded at three locations (Mt. Werong, Range fire trail and Little River fire trail) and five locations (around Mt. Werong and at Parliament Hill) respectively.

The importance of comprehensive stratified fauna survey is indicated by the fact that no snake species had been recorded within the study area prior to 2003. Four species of snake are now known to occur, each

detected at low abundance during DEC systematic surveys. The Highlands Copperhead (*Austrelaps ramsayi*) is a specialist of montane/sub-alpine environments, and hence has been recorded at three locations in the north east of the study area (each above 800 metres in altitude). The Mainland Tiger Snake (*Notechis scutatus*) has been recorded at one location on the Loombah Plateau, on the boundary of Blue Mountains and Kanangra-Boyd NPs. The occurrence of these two species within the study area has conservation significance, as they are both thought to be in decline in NSW (R. Wellington pers. comm.). The Red-bellied Black Snake (*Pseudechis porphyriacus*) and Eastern Brown Snake (*Pseudonaja textilis*) are more uncommon inhabitants of the study area, having been observed at only two and one locations respectively. These species occupy a broad range of habitats within the region, and have the potential to occur at further sites in the study area, particularly at lower altitudes.

3.8 FROGS

The success of frog surveys is largely dependent on the immediate weather, season and recent climatic conditions. Unfortunately, in the lead up to and during the 2002-2004 systematic survey period, survey conditions were dry and warm, providing poor conditions for conducting frog surveys. Hence minimal systematic frog surveys were carried out, and frogs were primarily recorded during other systematic survey techniques such as site spotlighting, diurnal herpetofauna searches, nocturnal call playback and opportunistically.

A total of ten frog species have been recorded within south western Blue Mountains NP, including seven ground frogs and three tree frogs. Of high conservation significance is the occurrence of the Stuttering Frog, which is listed as Endangered on the NSW TSC Act and Vulnerable on the Commonwealth EPBC Act. This species has declined rapidly through much of its former range in recent years. The species was first discovered in the study area in December 2000 when a fauna surveyor spotted two adults in amplexus in Ruby Creek during the day (C. Barker pers. comm.). Since then, the species has been recorded at numerous locations along Ruby Creek, both above and below the falls. Targeted surveys for the species were undertaken as part of the DEC survey program in February 2004, during which tadpoles of the species were discovered in two new locations on Mount Werong Creek (Plate 8). The occurrence of the Stuttering Frog within the study area is particularly important, as it is the only known extant population of the species within the greater Sydney Basin (bounded by Bathurst, the Hunter River and Macquarie Pass) occurring above 280 metres above sea level (White in prep.); the locations for the species within the study area are all over 1000 metres. Unfortunately four dead adults and metamorphs of the species were found during the surveys of Ruby Creek. A post mortem was carried out by Dick Montali of Taronga Zoo, revealing the presence of chytridiomycosis (chytrid fungus). This is the first report of chytrid fungus for the species (refer to NSW Scientific Committee 2002a). This fatal disease, listed as a Key Threatening Process on the NSW TSC Act (1995), presents a severe threat to the survival of the Stuttering Frog population as it is known to have had a particularly dramatic impact on populations of stream-dwelling species at high altitudes in recent years (NSW Scientific Committee 2003a). This species is considered to be a very high priority for conservation research and management within the study area, as will be discussed further in Sections 4 and 5 of this report.

Plate 8: Mount Werong Creek where Stuttering Frog tadpoles were located © DEC

By far the most commonly recorded frog within the study area is the Common Eastern Froglet (*Crinia signifera*), which has been observed or heard calling at thirty locations in a variety of water bodies, from

swamps to creeks, and within a range of vegetation types, from Montane Sheltered Forest to Tablelands Snow Gum Woodlands and High Elevation Swamp. It has not been recorded in the south of the study area, although this is likely to be due to the dry conditions experienced during surveys in this area rather than an absence of the species. The remaining ground frogs have been recorded at much lower frequency, and include (followed by the number of locations at which they have been observed) Banjo Frog (*Limnodynastes dumerilii*, 7), Bibron's Toadlet (*Pseudophryne bibronii*, 6), Spotted Marsh Frog (*Limnodynastes tasmaniensis*, 3), Striped Marsh Frog (*Limnodynastes peronii*, 2) and Smooth Toadlet (*Uperoleia laevigata*, 1).

It is widely hypothesised that the Bibron's Toadlet that occurs in highland areas, including south western Blue Mountains NP, is a different form from the frog that occurs at lower elevations in the Sydney Basin (A. White pers. comm.). The highland form of Bibron's Toadlet has yellow on the urostyle, red fringes around the dorsum papillae and a distinct call (A. White pers. comm.). There is widespread concern that the low elevation form of Bibron's Toadlet is in decline, particularly within the Sydney Basin (R. Wellington pers. comm.), possibly due to loss of breeding habitat (A. White pers. comm.). The highland form of the species appears to be stable, however, occurring in large numbers in the Kanangra region, including Kanangra-Boyd NP (DEC 2004b). Within the study area, however, the species has only been recorded along the Murruin Range, just west of the Loombah Plateau. It is likely that the species does occur elsewhere in the study area, but has not been detected due to the dry conditions at the time of survey.

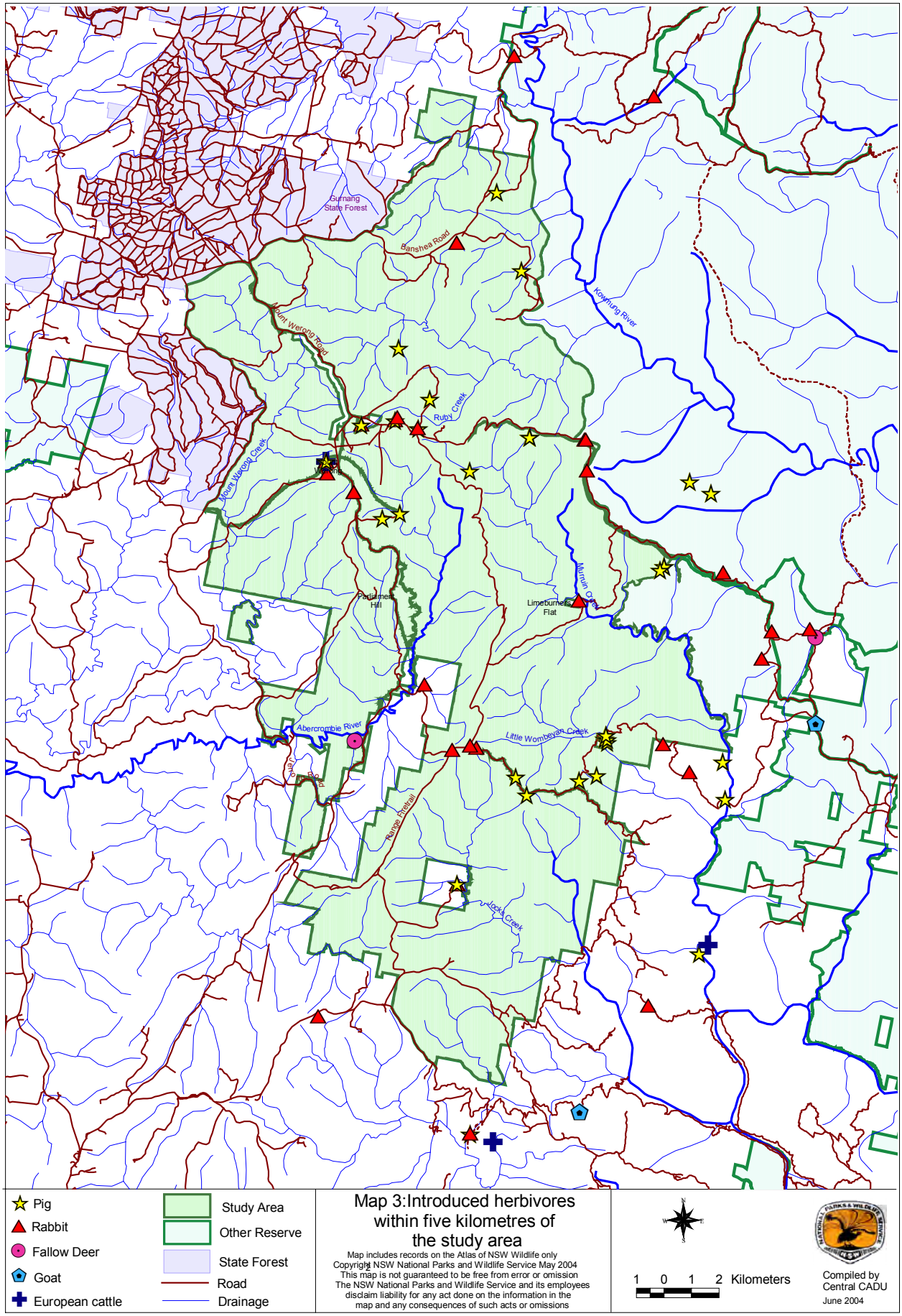
Tree frogs have only been recorded at low abundance in the study area, which again is likely to be an artefact of the dry conditions at the time of systematic survey. Verreaux's Tree Frog (*Litoria verreauxii*) is the most commonly recorded of the tree frogs, with five records in the vicinity of Lanigans Swamp and Mt. Werong, one on Banshea Road, one on Mt. Werong Road, one on Mount Werong Creek and one on the Abercrombie River. Adult Peron's Tree Frog (*Litoria peronii*) have been heard calling, and metamorphs seen, on the Abercrombie River in January 2004, and tadpoles of the species were located along Burnt Hole Creek in February 2004. The identification of *Litoria nudidigita* in south western Blue Mountains NP in January 2004 is an exciting find, as it constitutes a range extension for the species and contributes important information to the known distribution of the frog. This is a newly described species (Donellan et al 1999), which had previously been identified as the southern call race of the Green Stream Frog (*L. phyllochroa*) (Anstis 2002). The frog has also recently been identified in Kanangra-Boyd NP (DEC 2004b). It would be valuable to undertake further frog surveys in appropriate weather conditions to ascertain the distribution of this species within the study area, as well as the distribution and abundance of other frog species that have only been recorded on a small number of occasions.

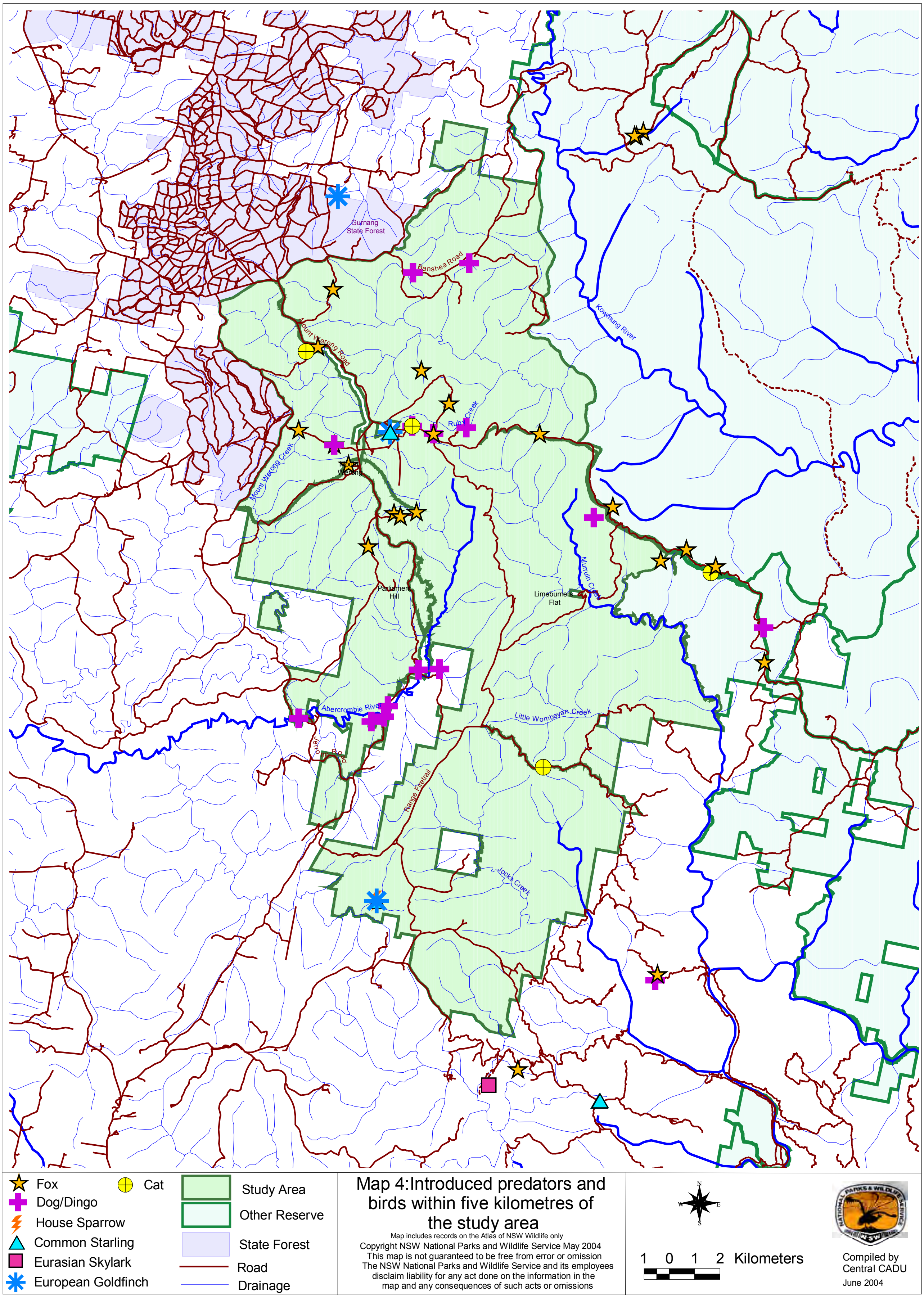
The Booroolong Frog (*Litoria booroolongensis*), classified as Endangered under the NSW TSC Act, has not been recorded within the study area. However, specimens held by Australian Museum have been collected within a five kilometre radius of the area, at Morong Falls on the Kowmung River (1976) and at Wombeyan Caves (unknown collection date) (Map 5). The species is known to occur in good numbers within Abercrombie River Nature Reserve, six kilometres to the west of the study area (DEC 2004c). Broad-scale habitat modelling for the species identified high quality habitat in the south east of the study area (NPWS 2000b) although this prediction was based on very limited information. More recent on-site assessment suggests that potential habitat for the species is virtually absent in the study area (A. White pers. comm.). The Booroolong Frog is generally considered to be more secure in drainage systems west of the Divide, possibly due to reduced abundance of introduced Brown Trout (*Salmo trutta*) and the Rainbow Trout (*Oncorhynchus mykiss*) (A. White pers. comm.). There is therefore a potential for the frogs to persist within the study area, but it is considered unlikely.

3.9 INTRODUCED SPECIES

Eight species of introduced ground mammals have been recorded within the study area. This includes species that are well established and widespread (such as the Fox, Rabbit (*Oryctolagus cuniculus*) and Pig) and species that have only been recorded at one or two locations (such as Fallow Deer (*Dama dama*)). The distribution of introduced species records within the study area is presented in Map 3 and Map 4. As noted above, Dingoes and Dogs have been presented together in the distribution map, as until recently they could not be entered separately into the Atlas of NSW Wildlife, and it is difficult to ascertain the level of Dingo purity in the field.

The most commonly recorded introduced species within the study area is the Feral Pig, the occurrence of which is often evidenced by their characteristic tracks, scats and diggings. Pigs primarily feed and wallow in moist environments or along drainage lines, particularly in Montane Sheltered Forest and to a lesser extent Highlands Gorge River Peppermint Forest. Evidence of the species is concentrated in these environments, yet Pigs also roam widely through a variety of habitats. The species or evidence of the species has been


Gurnang State Forest
Banshea Road
Mount Werong Road
Mount Werong Creek
Ruby Creek
Kowmung River
Parliament Hill
Limeburners Flat
Murrin Creek
Abercrombie River
Little Wombeyan Creek
Range Firetrail
Jocks Creek
Pig
Rabbit
Fallow Deer
Goat
European cattle
Study Area
Other Reserve
State Forest
Road
Drainage
Map 3:Introduced herbivores within five kilometres of the study area
Map includes records on the Atlas of NSW Wildlife only
Copyright NSW National Parks and Wildlife Service May 2004
This map is not guaranteed to be free from error or omission
The NSW National Parks and Wildlife Service and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions
1 0 1 2 Kilometers
Compiled by Central CADU
June 2004



Map 4: Introduced predators and birds within five kilometres of the study area

Map includes records on the Atlas of NSW Wildlife only

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recorded 26 times in the study area, with records concentrated on the highlands around Mt. Werong and the Murruin Range, as well as in the vicinity of Little Wombeyan Creek (Map 3). Pig damage has also been noticed along creek lines near the southern part of the Lower Werong Creek fire trail and near where woodland borders the cleared land south of the Abercrombie River (J. Bros pers. comm.).

Both Fox and Rabbit are well established in the study area, recorded at nineteen and eighteen locations respectively (Map 4 and Map 3). Sightings and evidence of Fox have only been recorded north of Parliament Hill, despite searches for scats being undertaken in the south of the study area. It is likely that the species does occur in the south of the study area, however results imply that they must be at markedly lower abundance in that area, in contrast to their widespread distribution in the north. Rabbit records are spread throughout the central third of the study area, particularly around Mount Werong, the Loombah Plateau and the Range Firetrail. Dog/Dingo has been recorded at ten locations, either by direct observation or by the collection and analysis of scats. Records for this species area concentrated around Mt. Werong, as well as along the Abercrombie River (Map 4).

Feral Cats (*Felis catus*) and Fallow Deer have also been observed within the study area, though in relatively low numbers. The Cat has been recorded at three locations (Map 5), while Fallow Deer was recorded for the first time in the study area on cleared land by the Abercrombie River, south of Johnny Barnes Flat. Recently, Deer have been observed at increasing frequency in the adjacent Kanangra-Boyd NP (M. Jones pers. comm.) and it is possible that this trend will extend to the study area unless appropriate management actions are taken. Fallow Deer have recently been seen moving north into the study area from the Abercrombie River area, and in the vicinity if Abercrombie River Station (J. Bros pers. comm.). Though not yet recorded on the Atlas of NSW Wildlife, low numbers of Goats (*Capra hircus*) are known to occasionally occupy parts of the study area along the Abercrombie River (J. Bros pers. comm).

These introduced species are likely to be having a significant negative impact on the native terrestrial flora and fauna of the study area. Six of the species are listed, or are pending finalisation, as a Key Threatening Process on the TSC Act, as they are known to adversely affect threatened species and have the potential to cause other species to become threatened. The threats posed to native fauna by each animal are summarised below. The first five of these species are also listed as a Key Threatening Process on the EPBC Act.

- Feral Pigs compete for food resources with native fauna, actively predate upon native birds, reptiles, bird and reptile eggs, and frogs, and are capable of significant habitat degradation as a result of their behaviour and feeding habits (NSW Scientific Committee 2004a).
- Feral Rabbits impact negatively on indigenous species via competition for resources, alteration of the structure and composition of vegetation, and land degradation (NSW Scientific Committee 2002b).
- Predation by Foxes is a major threat to the survival of native Australian fauna, with non-flying mammals weighing between 35 and 5500 grams and ground-nesting birds at greatest risk. Fox predation has been implicated in limiting habitat choice and population size of a number of medium-sized marsupials (NSW Scientific Committee 1998). The fact that Foxes prey upon native animals within the study area is evident from scat analysis, as summarised in section 3.10 below.
- Feral Cats threaten native fauna by direct predation. Cats are carnivorous and capable of killing vertebrates up to three kilograms. Preference is shown for mammals weighing less that 220 grams and birds less than 200 grams, but reptiles, and amphibians are also eaten (NSW Scientific Committee 2000).
- Feral Goats were given a preliminary determination as a Key Threatening Process in June 2004. They cause habitat degradation and have the ability to significantly alter the habitat of native fauna. Goats may compete with native fauna for food, water and shelter (NSW Scientific Committee 2004b).
- Deer cause environmental degradation through overgrazing, browsing, trampling, ring-barking, antler rubbing, dispersal of weeds, creation of trails, concentration of nutrients, exposing soils to and accelerating erosion (NSW Scientific Committee 2003b).

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

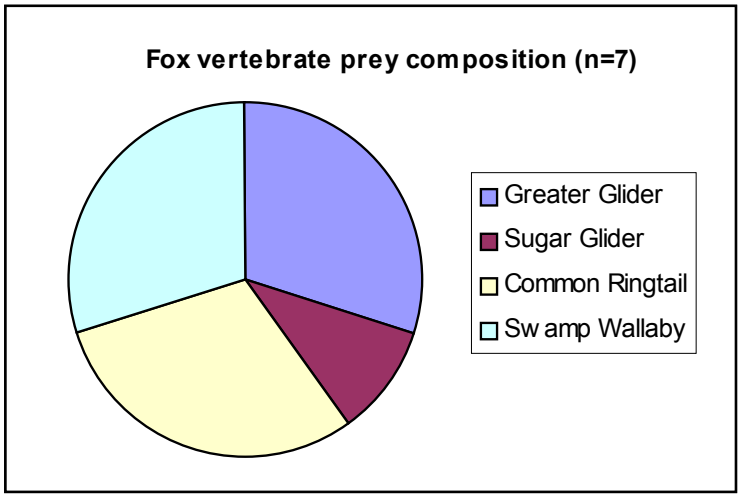
Three species of introduced birds have been recorded within the study area, these being House Sparrow (*Passer domesticus*), European Goldfinch (*Carduelis carduelis*) and Common Starling (*Sturnus vulgaris*). All were recorded as part of the first Bird Atlas (see Section 3.2) and hence have inaccurate spatial referencing. These species are considered unlikely to occur within south western Blue Mountains NP, but may occur

within and at the margins of adjacent private lands that have been cleared or contain weed species on which the birds forage. As these species are restricted in their occurrence and abundance in the study area, it is considered unlikely that they impact significantly on native fauna at this stage.

3.10 Predator Scat Analysis

The analysis of Fox and Dingo/Dog scats has yielded interesting information about the vertebrate prey composition of the predator's diet. Only three Dog/Dingo scats collected within the study area have been analysed, within which the remains of Greater Glider and Rabbit were found. Seven Fox scats have been analysed, revealing that within the study area arboreal mammals make up the largest vertebrate component of the Foxes' diet, with Swamp Wallabies also consumed (Figure 2). Only limited conclusions can be drawn from these analyses due to the low number of scats analysed. An analysis of predator scats across the region is being undertaken as part of the SCA fauna survey program, with the aim of obtaining more comprehensive information about prey composition (DEC in prep).

Figure 2: Vertebrate prey items (hair and skeletal remains) identified from Fox scats



3.11 Landscape Scale Patterns in Fauna Distribution

The vegetation of south western Blue Mountains NP is broadly effected by two parameters - elevation and geology. This has resulted in a number of distinct structural vegetation types, as described in Section 1.2 above. In summary, the study area features: tall montane forests on granite knolls in the north of the study area around Mt. Werong and Banshea; woodlands typical of undulating slopes of the central tablelands in the north west; cool temperate gullies and ridges on the eastern fall of the Divide; deeply incised gorges along Murruin, Little Wombeyan and Jocks Creeks, including limestone outcrops and karsts; alluvial flats along the Abercrombie River and larger creeks; heath on the Loombah plateau; and small isolated bogs and swamps. The distribution of fauna species across the study area reflects this diversity of habitat types, with suites of species responding, either directly or indirectly, to the habitat changes.

The reptiles exhibit the most obvious example of the response of fauna to these changes. The northern half of the study area accommodates a suite of reptiles typical of the south eastern NSW coastal high country, including Trunk-climbing Cool-skink, Tussock Cool-skink, Southern Forest Cool-skink, Cool-temperate Water-skink, Blotched Bluetongue, and Highlands Copperhead. These species are likely to be responding variously to habitat changes (such as the occurrence of tussock grasses (for *Pseudemoia* spp.)) and temperature differences (for example, Highlands Copperhead is one of the few snakes in Australia that can survive above the snowline). At lower altitudes in the study area, a number of species typical of more coastal hinterland habitats occur, including Copper-tailed Ctenotus at Little Wombeyan Creek and the Eastern Snake-necked Turtle on the Abercrombie River. The restricted extent of lower altitude habitats within the study area is reflected in the low abundance of these species. In addition, there are a number of reptiles species for which the majority of the study area comprises suitable habitat, such as the Cool-temperate Water-skink, which is a species typical of mid to high altitude landscapes within the greater Blue Mountains region, and the Pale-flecked Sunskink which is known to occur at a wide range of altitudes (DEC 2004c).

Some bird species appear to effectively replace each other in the various broad habitat areas. For example, the Satin Flycatcher (*Myiagra cyanoleuca*) appears to replace the more widespread Leaden Flycatcher (*M. rubecula*) on the Boyd Plateau within Kanangra-Boyd NP, and though there are less records in the study area, the same appears to happening there. This reflects the situation in the ACT where the former species replaces the latter in closed habitats and is rare below 800 metres, while the Leaden is uncommon above 900 metres (Taylor and COG 1992). Other birds that seem to be more prevalent at higher altitudes are Flame Robin, Red-browed Treecreeper, Grey Currawong and Red Wattlebird. Some species that appear to be recorded more regularly at lower altitudes have not been recorded within the study area including Brown Gerygone, Lewin's Honeyeater and Bell Miner (*Manorina melanophrys*). It must be remembered, however, that because most of records were collected during systematic surveys undertaken in spring, these patterns reflect habitat preferences only at this time of year. Some species, such as the Flame Robin, may move to lower altitudes in winter, for example.

The pattern of distribution of mammals is less distinct, but trends are still apparent. The Greater Glider has been recorded throughout the study area, but at greatest density in the tall moist sheltered forests in the montane and tableland influenced landscapes to the north of the study area. In contrast, Yellow-bellied Gliders have only been directly observed only in the south east of the study area, within the steep gorges and slopes of the Murruin Creek Catchment. This area lies at lower altitude and is influenced by the landscapes of the neighbouring Wollondilly valley, with species such as Grey Gum occurring, which is a preferred feed tree for the Yellow-bellied Glider. This pattern is also seen in the Koala, which also relies on trees that grow at lower altitudes, such as Grey Gum and Forest Red Gum.

4 FUTURE WORK

Every effort was made during the recent systematic fauna surveys to sample the full variety of habitat types and fauna groups within south western Blue Mountains NP, and hence obtain a comprehensive picture of terrestrial vertebrate fauna within the area. The surveys were, however, subject to a number of constraints, in particular drought and access, leading to limitations and a recommendation that further work by undertaken within the area in coming years. Areas of endeavour that should be targeted in the future include:

- Systematic frog surveys using the nocturnal streamside search method described above. The surveys should be undertaken under appropriate weather conditions when the current drought breaks, that is on warm, humid nights in spring or early summer after an extended period of rain. Some surveys should also be undertaken in winter to target winter-breeding species. This program should specifically endeavour to ascertain whether Booroolong Frogs persist within the study area, focussing on rocky west-flowing creeks. Gathering information on the distribution of *Litoria nudidigita* would also be interesting, as it would contribute important information to the understanding of this newly described species.
- Further systematic surveys for medium sized ground mammals, particularly Quolls.
- Surveys for Yellow-bellied Gliders, particularly in the north west of the study area where numerous traces have been recorded, but no animals observed. Confirmation of the existence of the glider within this montane environment would contribute important information about the range and habitat tolerance of the species.
- Targeted surveys for Koalas in the east and south east of the study area, particularly in vegetation communities where Grey Gum and Forest Red Gum occur. These should be undertaken to ascertain whether the species occurs within the study area, and if so to estimate the species abundance and distribution.
- A questionnaire survey of adjoining landholders could provide valuable information on occurrence and abundance of both Koalas and Spotted-tailed Quolls in the area.
- Targeted surveys for Brush-tailed Rock-wallabies, particularly along the limestone cliffs and outcrops in the more inaccessible parts of Murruin Creek and Little Wombeyan Creek. These surveys would require some overnight walks or helicopter drop-offs.
- Undertake systematic survey techniques within vegetation types that remain under-sampled, particularly the Montane Slopes Dry Forests. These habitats may contain fauna species that have not yet been recorded for the study area.
- Any systematic work undertaken in the future should be undertaken utilising the methods described in Section 2.3 and in NPWS (1997). Data entry into the BSS is the responsibility of the survey coordinator and time and resources for data entry should be included within the original survey proposal. This will ensure that the data is available to all staff and clients of DEC with accurate details and also the data to be included in any analysis of systematic data undertaken.

4.1 RESEARCH INTO STUTTERING FROG

Due to the high significance of the Stuttering Frog population within the study area, a scientific research project on the species is highly recommended, in consultation with the species recovery team. A well designed project would contribute immensely to the understanding of the species in the area and across the region, and provide vital information for conservation management across the state. Any further work within the area, however, must be undertaken in strict accordance with the *Hygiene Protocol for the Control of Disease in Frogs* (NPWS 2001).

The project could include the following:

- A detailed study of population demographics. Most importantly, this would include determining the rate of recruitment and attrition, and whether any metamorphs are surviving through to adulthood and sexual maturity. The 2004 surveys suggest that though breeding is occurring, a number of metamorphs are dying from chytrid fungus. Research should determine the proportion of metamorphs that are dying, and whether low recruitment levels are threatening the viability of the population.

- Investigation into factors that have allowed the species to persist in the area, when all other known populations above 280 metres above sea level and west of the Divide have disappeared.
- Determination of the affect (if any) of mining tailings and pollutants present in Mountt Werong and Ruby Creeks on the species, and its interaction with chytrid fungus infection.
- Determination of specific risks to the survival of the species in the study area and consequent formation of appropriate management actions to address these risks in the short and long term.
- Detailed habitat assessment of the sites within the study area (including terrestrial and aquatic factors). From this attempts could be made to predict and investigate other suitable habitats in highland Blue Mountains and elsewhere.
- Publish outcomes of the research in a format that is useful for conservation management of the species across the region and the state.

5 THREATENED SPECIES PROFILES

This section provides a profile of each of the threatened fauna species that are known to occur within south western Blue Mountains NP, together with two additional threatened species that are considered likely to occur. The aim of these profiles is to provide: a background on the species biology; a summary of threats to the species; an assessment of how well the species is protected in the region; a map of known records of the species in the study area and the surrounding five kilometres; and an appraisal of the distribution and status of the species in Kanangra-Boyd and the surrounding area.

The list of threatened vertebrate fauna for the study area contains records of various levels of reliability. For this reason, a species profile has not been generated for all of the threatened species listed on the DEC Atlas of NSW Wildlife as occurring within the area. Only species that have been directly and reliably observed within the study area since 1950, or have been recorded on the Atlas of NSW Wildlife within two kilometres and considered likely to occur within the area, have been afforded a species profile. Table 4 presents all of the threatened species recorded on the Atlas of NSW Wildlife within five kilometres of the study area, together with annotation for each species regarding the latest record, reliability of identification and a rationale for the generation of a species profile.

Table 4: Threatened fauna species within and around south western Blue Mountains National Park

Scientific name	Common name	Status in NSW (TSC Act)	Status in Australia (EPBC Act)	No. of locations within study area[1]		No. of locations within a five kilometre radius of study area[1]	Notes on reliability and date of last record	Species profile generated?
				DEC[2]	Other[3]			
Litoria booroolongensis	Booroolong Frog	E	-	0	0	2	Not recorded in study area. Australian Museum specimens, one from 1976 on Kowmung River, one undated record from Wombeyan Caves.	N
Mixophyes balbus	Stuttering Frog	E	V	3	1	1	Observed in February 2004 at Ruby Creek and Mount Werong Creek.	Y
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-	0	0	5	Not recorded in study area. Recently recorded by DEC out of study area.	N
Xanthomyza phrygia	Regent Honeyeater	E	E	0	1	1	Recorded by Royal Australasian Ornithologists Union in 1980 in 10 minute grid. Unlikely to occur in study area.	N
Ninox strenua	Powerful Owl	V	-	13	1	5	Regularly observed within study area.	Y
Tyto novaehollandiae	Masked Owl	V	-	1	0	1	Heard by DEC on Limeburners Trail in May 2003.	Y
Dasyurus maculatus	Spotted-tailed Quoll	V	E	0	1	1	Scat collected at Mount Werong in 2001.	Y
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	0	0	2	Not recorded in study area. Possible sighting 400 metres south east of study area in 2001; historical population at Wombeyan Caves.	Y
Bettongia gaimardi	Tasmanian Bettong	Presumed Extinct	-	0	0	1	Not recorded in study area. CSIRO subfossil record from 1987 in Wombeyan Caves.	N
Phascolarctos cinereus	Koala	V	-	0	1	2	Observed once in study area in 1995. Scat collected 500 metres south east of study area in 2001 and call heard 4.5 kilometres south east of study area in 2001.	Y
Petaurus australis	Yellow-bellied Glider	E	-	14	0	4	Observed in east of study area; scratches and feed marks recorded in north west of study area.	Y
Cercartetus nanus	Eastern Pygmy-possum	V	-	0	0	1	Undated Australian Museum specimen from the vicinity of Wombeyan Caves.	N
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	0	0	2	Not recorded in study area. Recorded by DEC three kilometres south of study area in 1999 and by CSIRO and Charles Sturt University between 1957 and 2000 at Wombeyan Caves.	Y
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	4	1	8	Captured in harp traps and recorded by anabat within study area.	Y
Miniopterus australis	Little Bent-wing Bat	V	-	0	0	1	CSIRO record from 1962 in vicinity of Wombeyan Caves.	N
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	4	1	5	Recorded by anabat within study area.	Y
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	8	1	2	Captured in harp traps and recorded by anabat within study area.	Y

E Endangered

V Vulnerable

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

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

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

STUTTERING FROG

Species Profile

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The Stuttering Frog (*Mixophyes balbus*) is a large (up to eight centimetres) 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, from which the species gets its common name. 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, NPWS 2000c). It is usually associated with 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 extremely long-lived tadpoles. It was formerly found along the coast and ranges between northern New South Wales and far-north eastern Victoria. It appears to have disappeared from the latter state, and is now only found patchily throughout the rest of its former distribution (Anstis 2002).

Threats

The threats to this species are poorly understood, however the main ones are thought to be habitat fragmentation and degradation, leading to the isolation of sub-populations and increased vulnerability to other threats and to local extinction via stochastic events such as epidemic disease (NSW Scientific Commitee 2002a). The Stuttering Frog is also threatened by chytrid fungus (chytridiomycosis, *Batrachochytrium dendrobatidis*) which is listed as a Key Threatening Process on the NSW TSC Act (1995). This fatal disease particularly affects higher altitude frog populations (greater than 400 metres) and stream-breeding frog species (NSW Scientific Committee 2003a). The disease is known to have seriously affected populations of the closely related Fleay's Barred Frog (*M. fleayi*) (Berger *et al.* 1998), but is recorded for the first time in the Stuttering Frog as part of this study. The Frog is also potentially threatened by predation of eggs and tadpoles by the exotic Plague Minnow (*Gambusia holbrooki*), also listed as a Key Threatening Process on the TSC Act. This small fish has not yet been reported within the study area (J. Bros pers. comm.), although targeted surveys for the species have not been undertaken.

Local and Regional Conservation Status

The Stuttering Frog is listed as Endangered on the NSW TSC Act (1995) and Vulnerable on the Commonwealth EPBC Act (1999). Within the southern portion of its range the frog appears to have declined dramatically in recent times. Surveys of forty historical locations of the species between Watagans National Park and Wombeyan Caves between 1999 and 2000 found frogs to be extant at only fourteen locations, of which thirteen were clustered between Gosford and the Watagan Mountains (A. White in prep.). Targeted surveys undertaken in 2000 from south of Sydney to Victoria found only two locations where frogs still occur (Daly *et al* 2002). Within the greater Sydney Basin the species is known to occur within Watagan and Macquarie Pass National Parks, as well as within Olney, Strickland and Awaba State Forests (DEC 2004c).

The Stuttering Frog was first discovered at Ruby Creek in 2000, when two adults were located in a pool near the falls (C. Barker pers. comm.). This is an eastern flowing creek within the catchment of the Kowmung River. Targeted surveys for the species undertaken as part of the current study located tadpoles in every large pool along Ruby Creek from 150 metres above the abandoned mine site to two kilometres north east of the falls. Also along this stretch, three dead metamorphs of the species were found. These were collected, and a post mortem undertaken by the Veterinary and Quarantine Centre at Taronga Zoo revealed the presence of chytrid fungus. No adult Stuttering Frogs were seen or heard calling at Ruby Creek during the surveys. Searches of potential habitat within the study area resulted in the discovery of two new sites for the species on Mount Werong Creek. Tadpoles of the species were located in the vicinity of the Middle Werong and Upper Werong fire trail crossings, but no adults were seen or heard calling. This is a significant find as Mount Werong creek is western flowing, within the catchment of the Abercrombie River.

The occurrence of the Stuttering Frog at Ruby and Mount Werong Creeks has very high conservation significance. These are the only known extant high elevation populations of the species; all other populations occur below 280 metres (A. White in prep.), while the records for the species obtained in this study range between 690 and 1080 metres above sea level. These sites are the western-most known location of the species in New South Wales (DEC 2004c), while Mount Werong Creek is the only known occurrence of the species on the western watershed of the Divide, south of the Hunter Valley. Between 1999 and 2004 tadpoles of the species have been recorded at only two other locations in the greater Sydney Basin (A. White pers. comm.). Clearly, conservation of the species within the study area is of very high priority, and crucial to the survival of the species across its range in NSW.

The identification of chytrid fungus-infected frogs at Ruby Creek should be treated with extreme concern. As mentioned above, this fatal disease has been implicated in the rapid decline and local extinction of sub-populations of a number of high-altitude stream-breeding frog species. Chytrid is virulent only to adult and metamorphosing amphibians, though it may be carried on the keratinised mouthparts of tadpoles (Berger *et al.* 1998). It is important to note that the dead chytrid-infected individuals located in this study were metamorphs, a stage in development when frogs are generally most susceptible to disease. It is probable that tadpoles in the population carry the disease, which then becomes virulent on metamorphosis. This may reduce the rate of recruitment to the adult population below a critical level, leading to long term population declines or crashes. Understanding this issue and the demographics of the population should be a focus of scientific research into the population.

Causes of the local extinctions of this species from all other historic sites above 280 metres in altitude are not known, but could be due to chytrid infections or to some related factor associated with elevated UV-B levels at higher elevations (A. White in prep.). Prior to the identification of chytrid, it had been postulated that the Mount Werong sub-population had been afforded a degree of immunity to the fungus because of pollutants in the catchment resulting from mining activities (R. Wellington pers. comm.). This has not been tested, and would be an important factor to examine in future research. Further scientific research within the study area is recommended, with the aim of determining factors influencing the species survival, its distribution, habitat preference and approximate population size (see Section 4.1 of this report). Such information would guide management actions for the species within the study area and across the region. Any further work or visitation within the area, however, must be undertaken in strict accordance with the *Hygiene Protocol for the Control of Disease in Frogs* (NPWS 2001). In the meantime, access to breeding sites should be limited as much as possible.

This species is of very high conservation concern. Management actions for the species in the study area should be considered immediately, in consultation the Central Threatened Species Unit and the species recovery team.

POWERFUL OWL

Species Profile

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

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 roost sites. The owl can, however, survive in areas with some levels of disturbance, such as in selectively logged forests (Kavanagh 1997) and suburban areas of Brisbane, Sydney and Melbourne (Garnett and Crowley 2000, DEC 2004d). Two of the determining factors for the species persistence in disturbed areas is the presence and suitable abundance of prey species (Chafer 1992) and nesting/roosting sites (Debus and Chafer 1994).

Local and Regional Conservation Status

The Powerful Owl is listed as Vulnerable on the NSW TSC Act (1995). Broad-scale modelling has predicted that a relatively large area of suitable habitat for this species occurs within the Sydney Basin Bioregion (NPWS 2000b), within which a high number of records occur (DEC 2004c). The species is less widespread in the South Eastern Highlands Bioregion, with concentrations of records in the Central Tablelands, around Tallaganda and in western Kosciuszko National Park. A large amount of modelled habitat is in reserves such as Blue Mountains, Royal and Brisbane Waters National Parks, as well as in the Sydney Catchment Authority Special Areas (Woronora and Warragamba). Recent DEC surveys within the Warragamba Special Area, and the neighbouring Blue Mountains, Kanangra-Boyd and Nattai National Parks have found Powerful Owls to be relatively abundant and widespread in the region (DEC in prep.).

Powerful Owls have been recorded throughout the study area, with the exception of the centre between Parliament Hill and Mt. Werong (Map 5). The absence of owls from around Mt. Werong may be due to a reduction in the number of suitable roosting sites as a result of extensive logging activities in the area in the past. The owl was directly observed at three locations in May 2004: two owls responded to nocturnal call playback surveys along Langs Road by coming in and perching five metres above the broadcaster; the third owl was spotted opportunistically flying across Little Wombeyan Creek fire trail. All other records of the owl within the study area have been detected by the bird's distinctive low-pitched hooting call, which can be heard over some distance. The species has been recorded in a wide variety of vegetation types, ranging from Montane Sandstone Dry Shrub Forests in the south of the study area, Tablelands Dry Forest in the east and Tablelands Snow Gum Woodland and Montane Sheltered Forest in the north. Powerful Owls inhabit a large home range that is likely to include areas of tall forests with some mesic influence for roosting, and areas with a high density of prey items, particularly the Greater Glider, for foraging. Suitable habitat for this species is widespread in the study area and prey density (particularly Greater Glider) is markedly high. As few threats currently impose on the species within the study area, the owl is likely to be widespread in this area, mirroring trends across the region.

MASKED OWL

Species Profile

The Masked Owl (*Tyto novaehollandiae*) is a large 'barn' owl, which has three colour morphs (with intermediates), but is distinguished from the similar Barn Owl (*T. alba*) by its larger size, more thickset and hunchbacked appearance, fully feathered legs and larger feet (Higgins 1999). It inhabits a wide range of woodland habitats with large hollows for roosting and open areas for hunting. It feeds mostly on ground-dwelling mammals, such as rats (*Rattus*) and Antechinus (*Antechinus*), and occasionally on diurnal birds, Sugar Gliders (*Petaurus breviceps*) and insects. The owl has a home range of 800 to 1200 hectares (Kavanagh 2002). It nests in hollow trees, usually eucalypts, where two to three eggs are the normal clutch (Higgins 1999). The nominate subspecies *novaehollandiae* was formerly found around the southern coast of Australia between Fraser Island (Queensland) and Carnarvon (Western Australia), though its range has contracted, particularly in Western Australia (Garnett and Crowley 2000). Other subspecies occur in Tasmania, northern Australia and in New Guinea and adjoining islands, some of which are sometimes considered separate species (Higgins 1999).

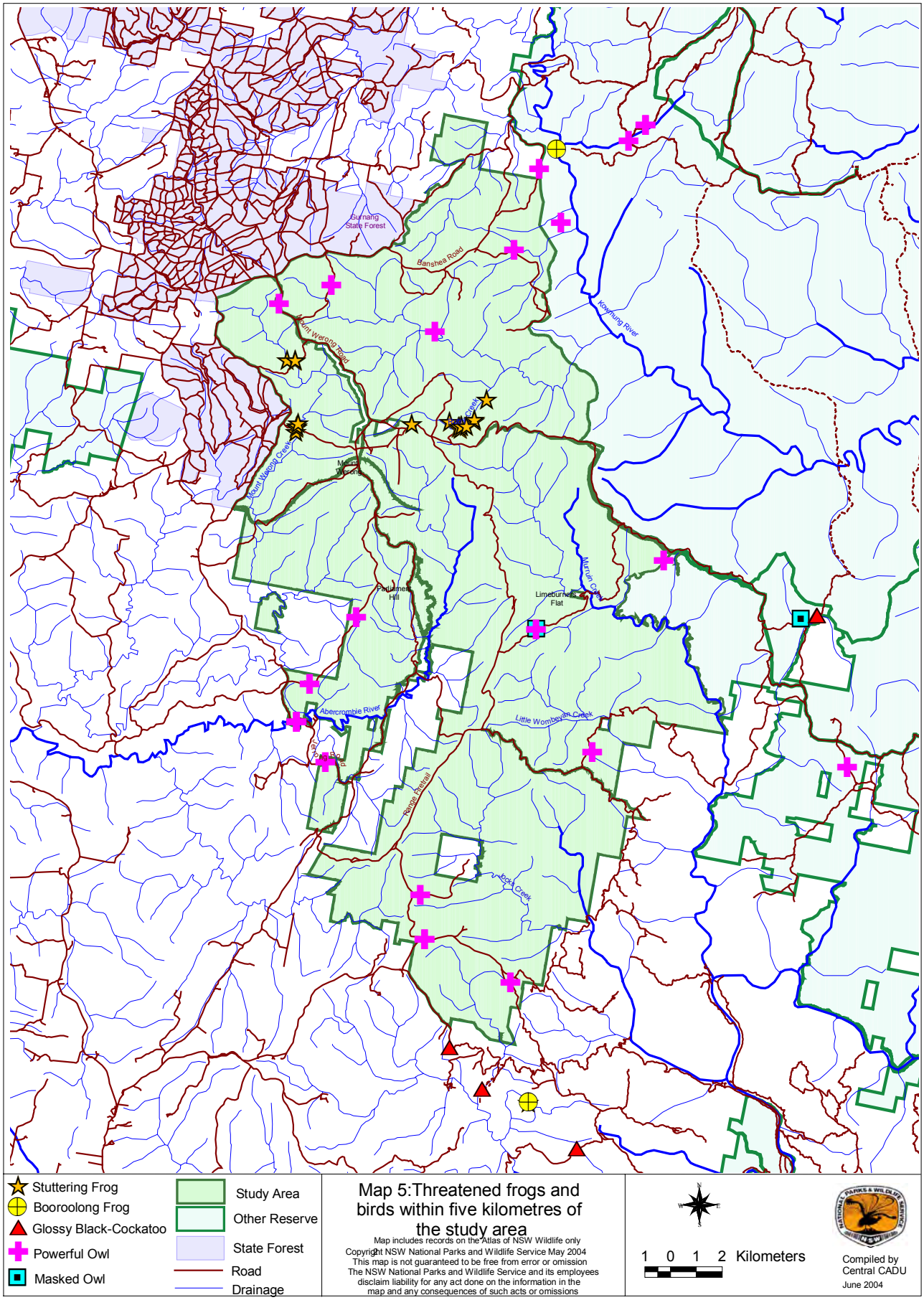
Threats

Clearance of native forest for agriculture and urban development, and the resulting fragmentation of habitat, has negatively affected the abundance of Masked Owls (Kavanagh 2002, Garnett and Crowley 2000). The species does not persist within fragments of forest less than 200 hectares (Kavanagh 2002). The species may be affected by logging, through removal of hollows or reduction in foraging habitat due to vigorous regrowth (Garnett and Crowley 2000), though it has been suggested that modern mosaic logging operations do not cause major changes to the abundance of the species (Kavanagh 2002).

Local and Regional Conservation Status

The Masked Owl is listed as Vulnerable on the NSW TSC Act (1995). Most records for the species in NSW are located in the NSW North Coast, Sydney Basin and South East Corner Bioregions, with a few scattered records west of the Divide (DEC 2004c). Records of the species in South Eastern Highlands are restricted to the eastern extremity of the Bioregion with records within NPWS reserves including Blue Mountains and Morton National Parks and Bungonia State Conservation Area (DEC 2004c). Significant numbers of the species have recently been recorded by DEC within the Warragamba Special Area and Greater Blue Mountains Area, including within Blue Mountains and Nattai National Parks (DEC in prep.). Observations have been made in areas not previously considered to contain substantial amounts of high quality habitat. Records of Masked Owl in the western sections of the Kanangra Area have high conservation significance, as they near the western extremity of the species known distribution.

The Masked Owl has been recorded once within the study area, heard calling in response to a nocturnal call playback survey in Limeburners fire trail in May 2003. The Masked Owl has also been recorded at one other location within a five kilometre radius of the study area, heard calling at Back Swamps Creek, during DEC fauna surveys in January 2004 (Map 5). Potential habitat for the species occurs in more open vegetation types in the east of the park. It is unlikely, however, that the species occurs in the far west or north west of the study area, as this is probably beyond the western and altitudinal extremity of the species distribution. Due to the large home range of this species it is hard to predict specifically where individuals would occur, however their home ranges are likely to incorporate areas of forest or woodland near minor drainage lines for roosting, and areas of woodland with a more open understorey and sparse ground cover for foraging.


Burnang State Forest
Banshea Road
Mount Werong Road
Koyhung River
Mount Maggy Creek
Mount Werong
Parliament Hill
Limeburners Flat
Marrin Creek
Abercrombie River
Little Wombeyan Creek
Range Firetrail
Rock Creek
Stuttering Frog
Booroolong Frog
Glossy Black-Cockatoo
Powerful Owl
Masked Owl
Study Area
Other Reserve
State Forest
Road
Drainage
Map 5:Threatened frogs and birds within five kilometres of the study area
Map includes records on the Atlas of NSW Wildlife only
Copyright NSW National Parks and Wildlife Service May 2004
This map is not guaranteed to be free from error or omission
The NSW National Parks and Wildlife Service and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions
1 0 1 2 Kilometers
Compiled by Central CADU
June 2004

SPOTTED-TAILED QUOLL

Species Profile

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 it uses several 'latrines' within its territory for defecation (NPWS 1999a). There are three populations of this species. The first is in far north Queensland, the second extends from Southern Queensland to Victoria, and a final genetically distinct population occurs in Tasmania (Firestone *et al.* 1999).

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Threats

The main problems confronting the Spotted-tailed Quoll are believed to be habitat loss, habitat degradation, predation and competition by the introduced predators such as Cat (*Felis catus*) and Fox (*Vulpes vulpes*), and direct mortality at the hands of humans (Mansergh 1984). Quolls were heavily persecuted as killers of domestic fowl, and have been hunted and trapped to extinction in many parts of the country. In more recent years, baiting for foxes, dogs and dingoes may have taken a toll on this species (D. Andrew pers. comm.).

Local and Regional Conservation Status

The Spotted-tailed Quoll is listed as Vulnerable on the NSW TSC Act (1995) and as Endangered on the Commonwealth EPBC Act (1999). The southern populations are believed to have declined in range by up to 50 percent in recent years (Maxwell *et al.* 1996). Within NSW the species has been recorded most in the NSW North Coast, Sydney Basin and South East Corner Bioregions (DEC 2004c). Within the South Eastern Highlands Bioregion the species is most common in the south eastern corner with records from Blue Mountains, Tallaganda and Kosciuszko National Parks amongst others. The species is occasionally observed around the townships of the central Blue Mountains and Picton (DEC in prep.), either in the vicinity of chicken coops or as road kill. The low abundance of the species across the region is evidenced, however, by the fact that not a single Quoll has been observed within the Warragamba Special Area during two years of DEC surveys, despite a huge number of hours being spent in the field during both the day and night (DEC in prep.).

The Spotted-tailed Quoll is not known to have ever been directly observed within the study area. However, a single scat of the species was collected during the biodiversity surveys at Mount Werong in January 2001, though this is yet to be confirmed (Map 6). The species was known from Wombeyan Caves in the 1870s but has not been recorded there since. The closest recent records of the species lie within Kanangra-Boyd National Park, where the animal has been recorded five times since 1988 (DEC 2004b). Potential habitat for Quolls is widespread within the study area and prey items are dense. Further survey work, including extensive cage trapping over an extended time period, is required to determine whether the species persists within the study area, its distribution and abundance. Quolls may be effected by competition from introduced species, such as the Feral Pig (*Sus scrofa*), which are abundant in the study area (D. Andrew pers. comm.). High priority should be given to increasing public awareness of this species and its identification, and to encouraging neighbours and park visitors to report any sightings, together with accurate location information.

KOALA

Species Profile

The Koala (*Phascolarctos cinereus*) is a distinctive arboreal mammal of eucalypt forest and woodland. It feeds on a wide range of eucalypt and other tree species, though in a local area a few species will be preferred almost exclusively. Individuals spend most of the day resting in the forks of trees, and are most active following sunset (NPWS 1999b). They generally move about a home range, the size of which varies on the density of food trees and population size, though individuals, particularly dispersing juveniles, are known to travel up to 50 kilometres (Martin and Handasyde 1995; NPWS 1999b). Three subspecies occur between north Queensland and the Eyre Peninsula in South Australia. However, the distribution is now fragmented and introductions, such as to Phillip Island, have possibly altered the genetic diversity of many of the populations (Martin and Handasyde 1995).

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Threats

NPWS (1999b) summarises the threats to the Koala as follows: destruction of habitat by clearing for urban development, agriculture and mining; degradation of habitat through fragmentation and disturbance such as fire or weed invasion; direct mortality from dogs and motor vehicles; and infection by *Chlamydia* which causes keratoconjunctivitis (an infection of the eyes) and infertility. The latter appears to occur naturally in Koalas in NSW, and symptoms are displayed when animals are stressed (NPWS 2003d). In Victoria, populations that have been transferred from Phillip Island appear to have lost their immunity and rates can be high, but it does not appear to be a major threat (Menkhorst 1995). Throughout its entire range, loss, fragmentation and degradation of habitat is its greatest threat (NPWS 2003d). Reed *et al*. (1990) reported on a survey in 1986-87 that 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.

Local and Regional Conservation Status

The Koala is listed as Vulnerable on the NSW TSC Act (1995). The species is widespread across the eastern third of the state, with records scattered throughout the South Eastern Highlands Bioregion (DEC 2004c). Records within reserves this Bioregion are regular in Morton National Park and Bungonia State Conservation Area, and less frequent in South East Forest National Park and a number of small Nature Reserves. Within the region, Koalas have recently been discovered in Nattai National Park and Wollondilly River Nature Reserve (DEC 2004e, DEC 2004f).

A single Koala was seen on Mt. Werong Road in October 1995, which is the only time the species has been recorded within the study area. In addition, two records for the species exist within a five kilometre radius: an individual was detected by its loud distinctive grunting approximately five kilometres to the south east in January 2001; and scats were collected 500 metres east of the study area, in the Murruin Creek valley, also in January 2001. The vegetation found in the greater Wollondilly Valley contains a number of tree species that are preferred foraging by the Koala. It is considered likely that this iconic mammal also occurs within the east of the study area, probably in relatively low numbers. The majority of potential habitat for the species occurs in the east and south east of the study area, in locations where Grey Gum (*Eucalyptus punctata*) and/or Forest Red Gum (*E. tereticornis*) make up a significant component of the canopy. Vegetation types potentially used by Koalas within the area include the Grassy Red Gum-Box-Ironbark Woodlands and Highlands Slopes Grey Gum Stringybark Forest. Much of this habitat occurs within regions that are difficult to access, which is perhaps the reason Koalas have only been observed once to date. Additional targeted surveys will need to be undertaken on foot, perhaps with helicopter drop offs, to determine the abundance and distribution of the species.

BRUSH-TAILED ROCK-WALLABY

Species Profile

The Brush-tailed Rock-wallaby (*Petrogale penicillata*) is a medium sized macropod, characterised by its distinctive facial markings, black paws and high levels of agility (NSW Scientific Committee 2003c). The tail is often used to aid identification, being long and thickly furred with a distinctive brush-like appearance near its tip (NPWS 2002). 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 2002). Vegetation forms a vital component of the habitat, especially as refugia near major rock outcrops. The species typically exhibits low migration rates between colonies, impeding persistence and recovery of populations affected by threatening processes. Its range formerly extended between south east Queensland to the Victoria, but is was thought to be extinct in the latter state until small populations were rediscovered in the Grampians and near the Snowy River (Eldridge and Close 1995)

©E. Holland/DEC

Threats

Historical decline of the Brush-tailed Rock-wallaby is attributed to three factors: hunting for bounty and fur; predation by introduced predators; and competition with introduced herbivores (feral Goat (*Capra hircus*), Rabbit (*Oryctolagus cuniculus*) and stock) (NSW Scientific Committee 2003c). The major threats continuing to impact on the species include ongoing predation and competition with feral species such as Fox (*Vulpes vulpes*) and wild Dogs (*Canis lupus familiaris*), habitat modification by fire, vegetation clearing, disease transmission (toxoplasmosis and hydatosis) by feral carnivores (NSW Scientific Committee 2003c) and inbreeding (Environment ACT 1999).

Local and Regional Conservation Status

Brush-tailed Rock-wallabies are listed as Endangered on the NSW TSC Act (1995) and as Vulnerable on the commonwealth EPBC Act (1999). The Rock-wallabies were probably once widespread in the South Eastern Highlands, but are now restricted to the north eastern boundary. Known locations within the South Eastern Highlands and Sydney Basin Bioregions include Kangaroo Valley, Broke in the Hunter Valley and Morton National Park with an introduced population at Jenolan Caves (DEC 2004c). Recently, during DEC fauna surveys, a colony of Brush-tailed Rock-wallabies was discovered within Nattai National Park, contributing significantly to the conservation and management of the species (DEC 2004e). These locations fall within the most fragile metapopulation of Brush-tailed Rock-wallabies in NSW, and consequently are all of very high conservation significance (NSW Scientific Committee 2003c).

The Brush-tailed Rock-wallaby has not been recorded within the study area. This endangered species was formerly known from around Wombeyan Caves, though the last known individual from this population was captured and taken to Jenolan Caves in 1995 (R. Humphries pers. comm.). Anecdotal records from this area persist, though these have not been confirmed (D. Ashton pers. comm.). In November 2001, during systematic flora surveys, two individuals are thought to have been were observed in the Murruin Creek catchment, 400 metres south of the National Park boundary. The identification of these animals is uncertain, however, as the observer did not get a good enough look at the wallabies to be sure of their identity.

Broad-scale modelling has indicated that a small amount of medium to high quality habitat for Brush-tailed Rock-wallabies is contained within the study area, in the lower reaches of Ruby Creek before it joins the Kowmung River (NPWS 2000b). Potential habitat for the species also occurs within the south eastern corner of the study area, primarily along escarpments and steep rocky slopes that occur within the Murruin, Little Wombeyan and Limestone Creek valley systems. Numerous limestone outcrops are present in these environments, within which the agile Rock-wallabies may shelter. In particular, the limestone outcrops and cliffs downstream of Limeburners Flat, on Murruin Creek and a side gully, hold potential as habitat (J. Bros pers. comm.). Sites with a northerly aspect would be preferred (Environment ACT 1999), where habitat features provide opportunities for the wallabies to sun themselves during the morning and evening periods.

Targeted surveys are required to determine whether Brush-tailed Rock-wallabies occur within the study area. As much of the potential habitat is inaccessible, the surveys will require overnight walks, possibly in combination with helicopter drop offs. Recent anecdotal sightings of the species in the region, and the discovery of the population within Nattai National Park, lend hope for the survival of the species in the study area, such that determination of their presence or absence should be considered a high conservation and management priority.

YELLOW-BELLIED GLIDER

Species Profile

©Joel Winter/DEC

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

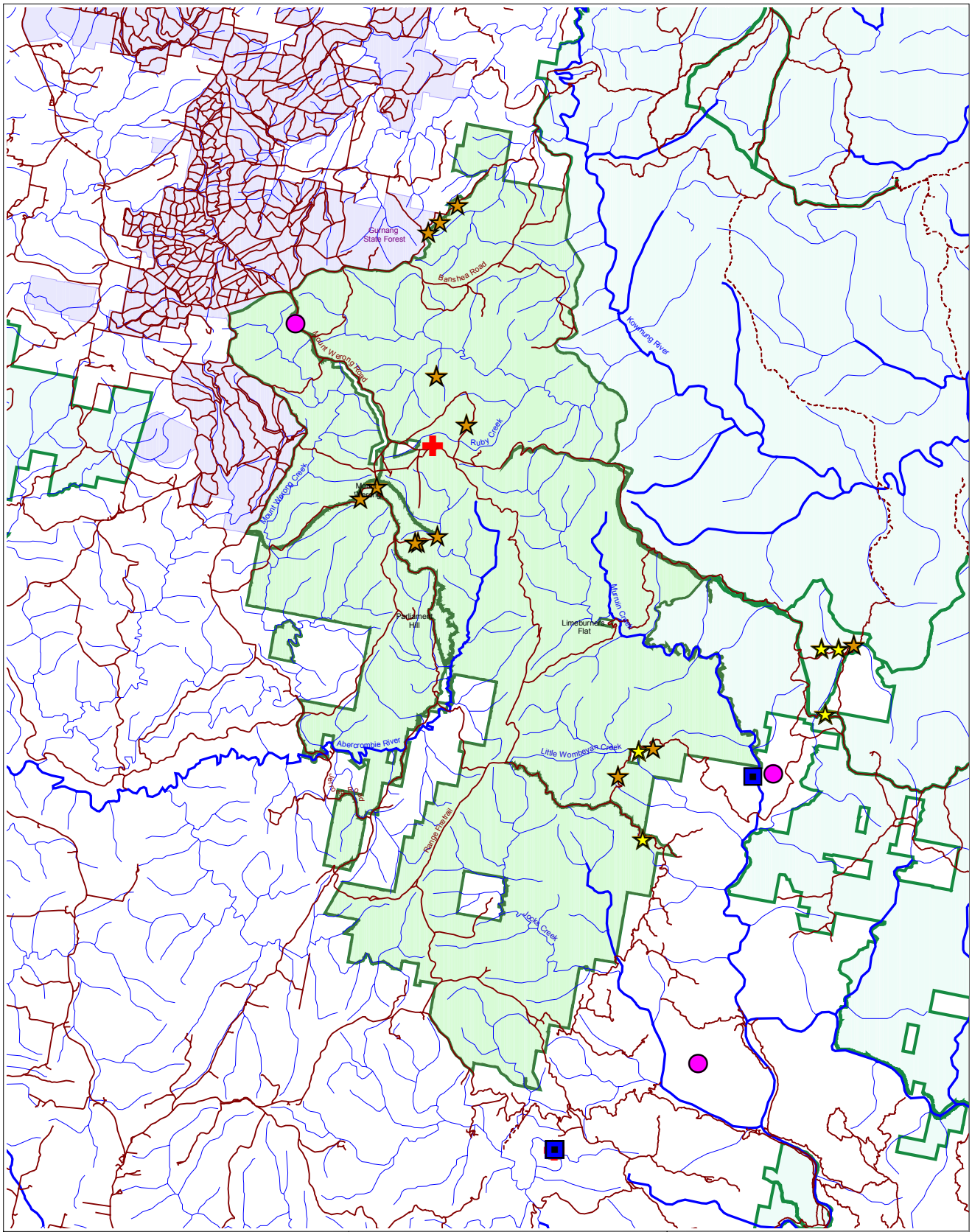
Threats

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

Local and Regional Conservation Status

The Yellow-bellied Glider is listed as Vulnerable on the NSW TSC Act (1995). In the South Eastern Highlands Bioregion, records are mainly located at the eastern extremity of the region, with isolated populations to the north and west of Kosciuszko National Park (DEC 2004c). Recent DEC surveys have discovered the species to be more abundant than previously thought in the escarpments and gullies in the Blue Mountains and Nattai National Parks. During the recent DEC fauna surveys the species have been found to be abundant and widespread in the Warragamba Special Area, particularly where Grey Gum (*Eucalyptus punctata*), a known feed tree (Mackowski 1988), makes up a component of the canopy. The species habitat preferences will be modelled in order to obtain better understanding of the species occurrence and status across this region (DEC in prep).

The Glider has been directly observed at only two locations, each at lower elevations (below 800 metres) in the east of the study area, in the vicinity of Little Wombeyan Creek and the Maneveland fire trail. Though neither of the Gliders were located within communities containing Grey Gum (Highlands Gorge River Peppermint Forest and Northern Plateau Moist Fern/Herb/ Grass Forest), both observations were made in areas where Grey Gum occurs within 200 metres. Evidence of Yellow-bellied Glider activity, in the form of incision marks, has been noted twice within Highlands Slopes Grey Gum Stringy bark Forest in this area of the study area. In addition to these observations, evidence of Yellow-bellied Glider activity has been recorded at a number of locations in the centre and north west of the study area. Here, feeding incisions and scratches have been recorded at eleven locations, yet Yellow-bellied Gliders have not been seen or heard despite the extensive spotlighting and nocturnal call playback surveys. Habitat within the centre and north west of the study area is not typical of Yellow-bellied Gliders, as their preferred feed trees are absent, and the landscape is at higher altitude than is characteristic of the species (DEC 2004c). All of these records were taken by a single observer during a single field trip in 1998, and unfortunately the age of the scars was not recorded. These records warrant further investigation in order to validate their reliability and accuracy. Targeted surveys for the Yellow-bellied Glider should be undertaken in the north west of the study area to determine whether the Gliders do occur here. Such a finding would yield very important information on the habitat and altitude range and tolerance of the species, which is vital for effective conservation management.


Gunnang State Forest
Banshea Road
Mount Werong Road
Ruby Creek
Mount Marong Creek
Kowmung River
Murrin Creek
Limeburners Flat
Parliament Hill
Abercrombie River
Little Womboyan Creek
Range Fire Trail
Jacks Creek
Yellow-bellied Glider
seen or heard
feed trace or scratching
Brush-tailed Rock-wallaby
Eastern Pygmy-possum
Koala
Spotted-tailed Quoll
Study Area
Other Reserve
State Forest
Road
Drainage
Map 6: Threatened terrestrial and arboreal mammals within five kilometres of the study area
Map includes records on the Atlas of NSW Wildlife only
Copyright NSW National Parks and Wildlife Service May 2004
This map is not guaranteed to be free from error or omission
The NSW National Parks and Wildlife Service and its employees disclaim liability for any act done on the information in the map and any consequences of such acts or omissions
1 0 1 2 Kilometers
Compiled by Central CADU
June 2004

LARGE-EARED PIED BAT

Species Profile

©Narawan Williams

The Large-eared Pied Bat (*Chalinolobus dwyeri*) is readily recognisable from other members of its genus by the combination of large ears and overall black colour, with bands of white fur along the sides of the body, that join to form a V-shape (Parnaby 1992a; Churchill 1998). The call (undetectable by the human ear) is an alternate pattern made at a low frequency, which is readily distinguishable from all other species (Reinhold *et al.* 2001). Originally described from Copeton in 1966, it has been recorded from a number of scattered locations on either side of the Great Dividing Range between Rockhampton (Queensland) and Bungonia (New South Wales) (Hoye and Dwyer 1995). It has been found in a wide range of habitats, including wet and dry eucalypt forest, Cypress (*Callitris*) forest and sub-alpine woodland (Duncan *et al.* 1999). It is a cave-roosting species, though it has also been detected roosting in disused mine shafts, overhangs and once in an abandoned Fairy Martin (*Petrochelidon ariel*) nest (Churchill 1998). It seems to prefer the 'twilight' areas of caves, and may be dependent on sandstone outcrops (Duncan *et al.* 1999, Hoye and Dwyer 1995).

Threats

The only confirmed threat to this species is the destruction or interference of roost sites. Other potential threats include mining induced subsidence (particularly coal-mining in sandstone areas) which may destroy roost sites, habitat destruction for agriculture and urban development, and predation by feral animals (Duncan *et al.* 1999).

Local and Regional Conservation Status

The Large-eared Pied Bat is listed as Vulnerable on the NSW TSC Act (1995) and also as Vulnerable on the Commonwealth EPBC Act (1999). The Sydney Basin appears to support a significant proportion of the Large-eared Pied Bat population, with scattered records occurring to the north and west of the Bioregion (DEC 2004a). Recent survey conducted by DEC across the Greater Blue Mountains has found the species to be more widespread in the region than previously thought, yielding important information on the species habitat preferences and conservation status (DEC in prep.). Within the South Eastern Highlands Bioregion, the species is restricted to the north and east, with Jenolan Karst Conservation Reserve and Wombeyan Caves Reserve forming the western boundary of the species known distribution (DEC 2004a). The species is protected within Blue Mountains and Wollemi National Parks, and to a lesser extent Royal, Gardens of Stone and Morton National Parks.

The Large-eared Pied Bat has not been detected within the study area, but has recently been recorded at Wombeyan Caves, one and a half kilometres south of the National Park boundary, during southern zone CRA surveys in 1999 and by Charles Sturt University in 2000 (Herr 2000). There is high potential for the species to also occur within the study area, as (in addition to Wombeyan Caves) the species is known to occur within similar habitats and altitudes as exist in the study area in the adjacent Kanangra-Boyd National Park (DEC 2004b) and in the eastern blocks of Blue Mountains National Park (DEC 2004c). The study area borders the far western extremity of the species known range, however, and the species is therefore likely to occur only in the east of the study area, east of the Dividing Range. Potential roost sites for the species occur within south western Blue Mountains National Park, however the species may roost outside the park and utilise the study area as only foraging habitat.

Records of the species within the region have high conservation value (as they are at the western extent of the species known distribution) and it therefore recommended that further systematic bat survey be undertaken in the study area, particularly in the south east, to positively determine whether the species occurs.

EASTERN FALSE PIPISTRELLE

Species Profile

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) is a relatively large (up to 70 millimetres) bat that is similar to the Greater Broad-nosed Bat (*Scoteanax rueppellii*), though it has 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 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 found in small numbers throughout its range in south eastern Australia, between south east Queensland and western Victoria, and Tasmania. It seems to prefer wet habitats, particularly riparian or high rainfall areas, with large trees (greater than 20 metres) (Menkhorst and Lumsden 1995). It may be more common at high elevations (Phillips 1995), though it has been recorded between sea level and 1500 metres in Victoria (Menkhorst and Lumsden 1995). It usually roosts in hollows in *Eucalyptus*, though it has been recorded in caves (Churchill 1998). It may hibernate over winter and has been known to travel at least twelve kilometres from its roost site (Churchill 1998).

Threats

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

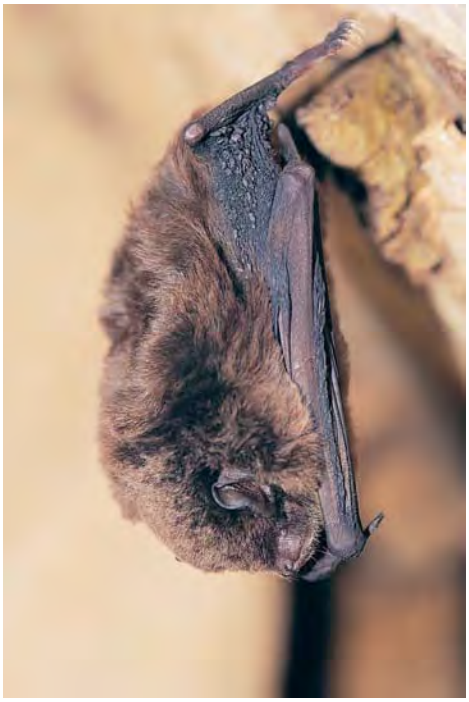
Local and Regional Conservation Status

The Eastern False Pipistrelle is listed as Vulnerable on the NSW TSC Act (1995). Records for the species are scattered across both the Sydney Basin and South Eastern Highlands Bioregion. Broad-scale modelling has predicted areas of high quality habitat in the Blue Mountains National Park, the Woronora Plateau, and the Watagan Ranges, as well as on the Boyd Plateau of Kanangra-Boyd National Park (NPWS 2000b). A large number of sightings have been made in Wollemi National Park and the species has also been recorded in Gardens of Stone, Blue Mountains, Abercrombie River, Wadbilliga, Tallaganda and Woomargama National Parks. Recent DEC surveys have recorded the species to be widespread at low density in Blue Mountains National Park and to a lesser extent Nattai National Park (DEC in prep, DEC 2004e). The species has recently been reported at Wombeyan Caves, one and a half kilometres south of the study area (Herr 2000).

During the 2004 surveys, the Eastern False Pipistrelle was captured at two locations in the study area (at the top of Mt. Werong and just south of Banshea Road). It was also detected by its ultrasonic call at a third location, flying over pool of water at the start of Wattle Creek fire trail, just north of Lanigans Swamp. In addition, the species was captured a number of times during CRA surveys immediately south of the study area, on private land between Broughtons Lookout and Wombeyan Caves (Map 7). It appears from these results that the species prefers higher elevations within the study area, having not been recorded below 800 metres in altitude, and twice recorded above 1000 metres. This species of bat has recently been found to be widespread in the neighbouring Kanangra-Boyd National Park, where it also has not been recorded below 1000 metres above sea level (DEC 2004c). The species was also found to exhibit this higher altitude preference during DEC surveys of Coolah Tops National Park (NPWS 1998). As with all bats a better understanding of habitat requirements and further survey is needed to establish its conservation status in the study area and the surrounding region. It is expected, however, that the species occurs in low numbers across the higher elevation landscapes in the study area, particularly in taller forests such as the Montane Sheltered Forests.

COMMON BENT-WING BAT

Species Profile



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

Threats

Damage and disturbance to roosting sites are the greatest threats to this species. Because only relatively few nursery caves are used, significant population changes can occur if these sites are damaged (Dwyer 1995). Disturbance of hibernating colonies can lead to starvation due to loss of energy reserves (Gilmore and Parnaby 1994). Disturbance of smaller roosts by recreational 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 (*Felis catus*) and, less often, foxes (*Vulpes vulpes*) (Dwyer 1995).

Local and Regional Conservation Status

The Common Bent-wing Bat is listed as Vulnerable on the NSW TSC Act (1995) as the Eastern Bent-wing Bat. The species is widely recorded in the eastern third of NSW, with the number of records decreasing with distance from the coast (DEC 2004c). Sightings for the species are scattered throughout the South Eastern Highlands Bioregion, and good numbers have been recorded in the Sydney Basin Bioregion in recent years (DEC 2004c). Broad-scale habitat modelling for the species has identified a very large area of suitable habitat within these bioregions (NPWS 2000b), reflecting the large distances that this species travels whilst foraging. Individuals have been recorded in a diverse range of National Parks. Within the region the species has recently been recorded during recent DEC fauna surveys in Nattai, Kanangra-Boyd, Blue Mountains, and Abercrombie River National Parks and Bargo and Nattai State Conservation Areas. The species has also recently been recorded at Wombeyan Caves (Herr 2000).

This species has been detected by its ultrasonic call at three locations in the north of the study area during the 2004 surveys, including the Murruin Range, Ruby Creek and flying along Banshea Road. In addition, the species was recorded during the biodiversity survey around Mt. Werong in January 2001, and was detected by Anabat at a number of locations to the south and east of the study area during the CRA surveys. The Common Bent-wing Bat is a high flying species which can travel at 50 kilometres per hour at many times the height of the canopy (Churchill 1998) and so is not commonly caught in harp traps. Large numbers of the species are known to occur in Kanangra-Boyd National Park, which houses a large roosting site at Colong Caves (DEC 2004b). It remains unknown whether this species roost within the study area, however the Anabat detectors did not record the species at the entrance to any of the limestone cave systems. The study area is well within the possible foraging distance for bats that roost at Colong Caves. Alternatively, other roost sites for the bat may exist within the study area, in caves that are less accessible to humans. Due to the high mobility of the species, it is difficult to predict which habitats and areas of the study area the species would use preferentially, however the bats are expected to be widespread.

GREATER BROAD-NOSED BAT

Species Profile

©Michael Murphy

The Greater Broad-nosed Bat (*Scoteanax rueppellii*) is a large microchiropteran bat that can only be confused with the Eastern False Pipistrelle but can be separated by having only one pair of upper incisors and smaller ears (Parnaby 1992a). Its ultrasonic calls can also be confused with this species, and with species of the genus *Scotorepens* (Reinhold *et al*. 2001). It is usually found in gullies draining east from the Great Dividing Range between south east New South Wales and north Queensland (Atherton Tablelands), where it utilises creeks and clearings for hunting (Churchill 1998; Hoye and Richards 1995). It is often said to be a lowland species, though Ayers *et al.* (1996) mention several examples of this species being recorded at higher altitudes. It usually roosts in tree hollows, though it may also utilise old buildings (Churchill 1998).

Threats

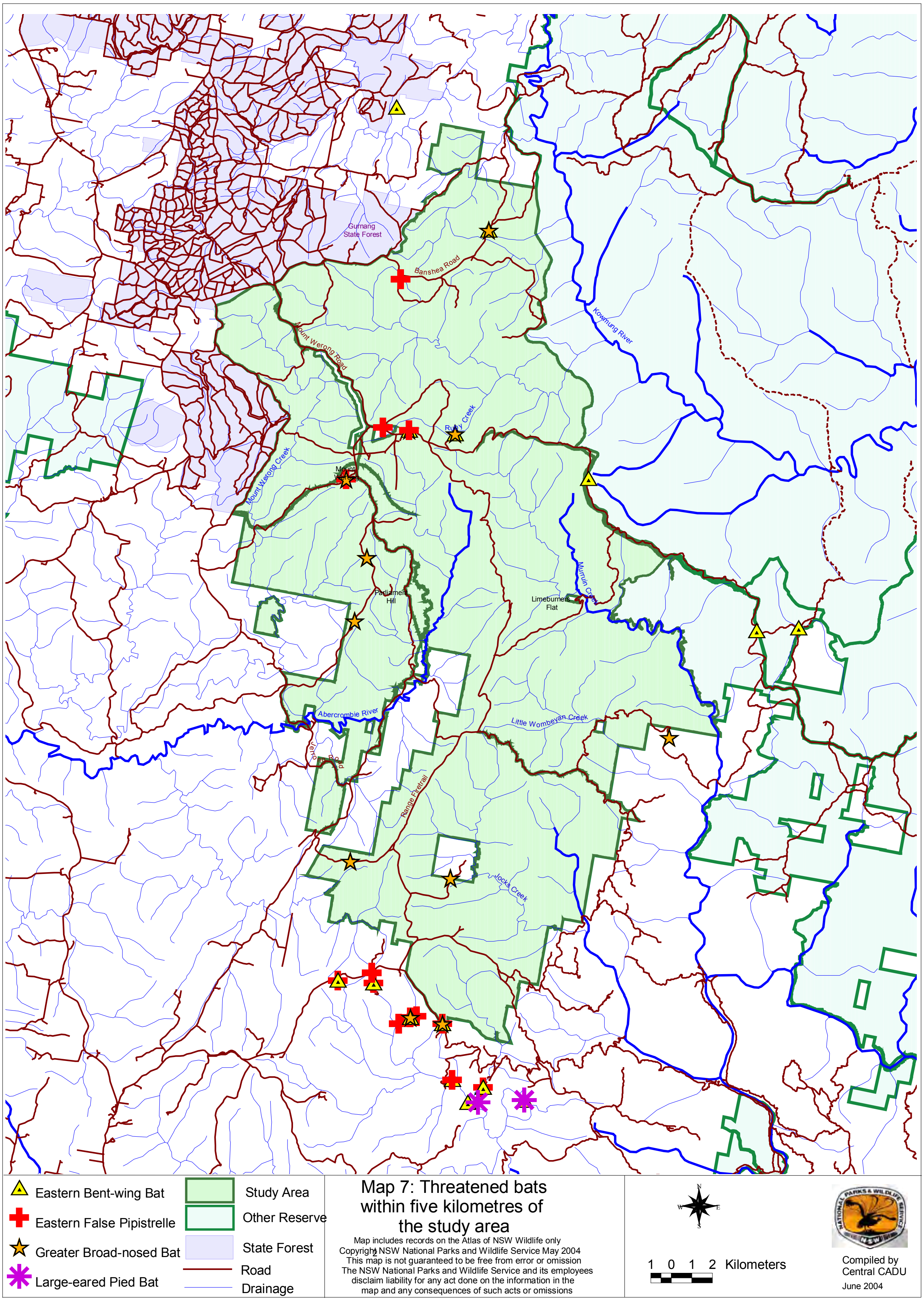
The threats to this species are poorly known, though they probably include habitat clearance for agriculture and urban development, and logging, which may remove suitable hollows (Duncan *et al.* 1999).

Local and Regional Conservation Status

The Greater Broad-nosed Bat is listed as Vulnerable on the NSW TSC Act (1995). The majority of records for the species in NSW occur in the NSW North Coast, South East Corner and Sydney Basin, with some records in the New England Tableland Bioregion (DEC 2004c). Within the South Eastern Highlands the species is mainly restricted to the eastern extremities of the Bioregion. The species is reasonably well reported from NPWS reserves, including Wollemi, Wyrrabalong, Abercrombie River and Wadbilliga National Parks (DEC 2004a). Recent DEC surveys in Blue Mountains and Nattai National Parks have found the species to be widespread across the southern Blue Mountains (DEC in prep.).

The species is widespread within the study area, being the most frequently encountered of the threatened microbats. During the 2004 survey the Greater Broad-nosed Bat nine individuals were captured at five harp trap locations and the species was detected by its ultrasonic call at a further two locations (Map 7). In addition, the species was recorded during the biodiversity survey at Mt. Werong in 2001, and has been recorded at locations to the south and east of the study area during CRA and SCA fauna surveys (Map 7). The species has most frequently been recorded within Tablelands Silvertop Ash-Brittle Gum Woodlands, but also within Montane Sheltered Forests and Montane Sandstone Dry Shrub Forests. This species is highly likely to occur at further locations within the study area in a variety of vegetation types.

The DEC Kanangra Area (including south Western Blue Mountains and Kanangra-Boyd National Parks) is near the western limit of the known distribution of the species. Furthermore, some of the captures made within the study area are at an altitude previously not considered typical for the species, as has recently been found to be the case in Kanangra-Boyd National Park (DEC 2004b). During the 2004 surveys, the species was recorded at up to 1200 metres above sea level. The records collected this are therefore contribute important information to our knowledge of the species, its distribution and its habitat. The occurrence of the species within the Kanangra Area has high conservation significance as it may be at the extreme of the species ecological tolerance.



Map 7: Threatened bats within five kilometres of the study area

Map includes records on the Atlas of NSW Wildlife only
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APPENDIX A

Location of, vegetation type and techniques undertaken at systematic fauna survey sites in south western Blue Mountains National Park.

Site number	Easting	Northing	Vegetation community	Broad flora group	Diurnal bird census	Diurnal reptile census	Sitespotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott trap
BND25O	226410	6219900	Montane Gully Brown Barrel Forest	Montane Sheltered Forest	1	1	1			1		
BND32O	223384	6218462	Highlands Gorge River Peppermint Forest	Highlands Gorge River Peppermint Forest		1	1			1	1	
BND48O	223770	6212028	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest	1	1	1					
BND49W	224654	6213670	Highlands Gorge River Peppermint Forest	Highlands Gorge River Peppermint Forest	1	1	1					
BND51W	224127	6211389	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests				1				
BND52W	224528	6213285	Highlands Gorge River Peppermint Forest	Highlands Gorge River Peppermint Forest					1			
BND53W	223763	6213197	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests		1			1			
BND58O	224858	6210442	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest			1			1		
BND59O	223780	6211982	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest								1
BND60W	224887	6213795	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests								1
GUR01O	774880	6224400	Montane Gully Brown Barrel Forest	Montane Sheltered Forest	1	1						
GUR02O	776424	6220350	Montane Gully Brown Barrel Forest	Montane Sheltered Forest		1						
GUR03W	776086	6224472	Montane Sheltered Narrow-leaved Peppermint Forest	Montane Sheltered Forest				1				
GUR04W	773336	6225110	Montane Gully Brown Barrel Forest	Montane Sheltered Forest				1				
GUR05O	772717	6223168	Montane Gully Brown Barrel Forest	Montane Sheltered Forest		1	1			1		
GUR06W	773181	6221170	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland			1			1		
GUR07O	771743	6223478	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests				1				
GUR08O	776348	6224420	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest	1	1	1					
GUR09W	768512	6222390	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest	1	1	1					

Site number	Easting	Northing	Vegetation community	Broad flora group	Diurnal bird census	Diurnal reptile census	Sitespotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott trap
GUR10W	767536	6223083	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest				1				
GUR11W	769281	6221579	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest				1				
GUR12W	771571	6226985	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests				1				
GUR13W	764980	6221580	Tablelands Dry Shrub/Tussock Grass Forest	Tablelands Dry Forests				1				
GUR14W	771270	6223813	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest				1				
GUR15W	766657	6229923	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest				1				
GUR16W	769671	6230938	Tablelands Snow Gum Woodland	Tablelands Snow Gum Woodland				1				
GUR17W	771915	6230510	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest				1				
GUR18O	775009	6229659	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest				1				
GUR19W	774799	6230488	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest				1				
GUR20W	774023	6225033	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests					1			
GUR21W	771804	6224868	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest					1		1	
GUR22W	768970	6225122	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest					1			
GUR23W	773126	6232869	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest					1			
GUR24O	775491	6229431	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest					1			
GUR25W	769964	6225035	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest								1
GUR26W	766934	6224258	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest	1	1	1					
GUR27O	766533	6229783	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest	1	1	1				1	
GUR28W	773388	6231571	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest	1	1	1					
GUR29W	769710	6225644	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests	1	1	1					
GUR30W	764371	6221058	Tablelands Dry Shrub/Tussock Grass Forest	Tablelands Dry Forests	1	1	1					
GUR31W	764955	6229999	Tablelands Snow Gum Woodland	Tablelands Snow Gum Woodland	1		1					
GUR32W	770025	6231051	Tablelands Snow Gum Woodland	Tablelands Snow Gum Woodland	1	1	1					
GUR33W	770365	6227209	North East Tablelands Shrub/Herb/Grass Dry Forest	North East Tablelands Dry Gully Forest	1	1						

Site number	Easting	Northing	Vegetation community	Broad flora group	Diurnal bird census	Diurnal reptile census	Sitespotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott trap
GUR34W	766875	6231628	Tablelands Snow Gum Woodland	Tablelands Snow Gum Woodland	1	1			1			
GUR35O	771532	6226270	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest	1	1	1					
GUR36W	773368	6224905	Montane Slopes Stringybark Forest	Montane Slopes Dry Forests	1	1	1					
GUR37W	774429	6224918	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests	1	1	1					
GUR38W	774597	6230448	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest	1	1	1					
GUR39W	773700	6233270	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest	1	1	1					
GUR40W	765641	6222350	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	1	1	1					
GUR41W	765545	6224869	North East Tablelands Shrub/Herb/Grass Dry Forest	North East Tablelands Dry Gully Forest	1	1	1	1			1	
GUR42H	772245	6231426	Southern Escarpment Edge Moist Heath-*Oxylobium ellipticum*	Southern Escarpment Edge Moist Heath	1	1						
GUR43W	765496	6227493	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest	1		1	1			1	
MAR01O	774827	6217054	Montane Slopes Stringybark Forest	Montane Slopes Dry Forests						1		
MAR03O	770336	6206742	Tableland and Escarpment Moist Herb/Fern Grass Forest	Tableland and Escarpment Moist Herb/Fern Grass Forest	1	1						
MAR04W	771270	6211719	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest	1	1	1					
MAR05W	771900	6212705	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	1	1	1					
MAR06W	767870	6211329	North East Tablelands Shrub/Herb/Grass Dry Forest	North East Tablelands Dry Gully Forest	1		1					
MAR07W	766656	6211901	Tablelands Dry Shrub/Tussock Grass Forest	Tablelands Dry Forests	1		1					
MAR08W	768533	6218628	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland		1	1					
MAR09W	773734	6212684	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests	1	1	1					
MAR10W	765538	6213466	Tablelands Dry Shrub/Tussock Grass Forest	Tablelands Dry Forests	1	1	1					
MAR11W	770170	6216441	Tablelands Dry Shrub/Tussock Grass Forest	Tablelands Dry Forests		1						

Site number	Easting	Northing	Vegetation community	Broad flora group	Diurnal bird census	Diurnal reptile census	Sitespotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott trap
MAR12W	767243	6208089	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	1	1	1					
MAR13W	770433	6215140	Tablelands Shrub/Tussock Grass Forest-*Eucalyptus dives/Chionochloa pallida*	Tablelands Dry Forests				1				
MAR14W	767688	6208084	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland				1				
MAR15W	771610	6207410	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests				1				
MAR16W	775495	6211569	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests				1				
MAR17W	766047	6214921	Tablelands Dry Shrub/Tussock Grass Forest	Tablelands Dry Forests				1				
MAR18W	767856	6217517	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	1			1				
MAR19W	768342	6220005	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland				1				
MAR20W	770095	6216527	Tablelands Dry Shrub/Tussock Grass Forest	Tablelands Dry Forests				1				
MAR21W	768928	6213514	Tablelands Shrub/Tussock Grass Forest-*Eucalyptus dives/Chionochloa pallida*	Tablelands Dry Forests					1			
MAR22W	770100	6209819	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland					1			
MAR23O	769050	6213960	Tablelands Shrub/Tussock Grass Forest-*Eucalyptus dives/Chionochloa pallida*	Tablelands Dry Forests						1		
MAR24O	769900	6218750	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland						1		
MAR26M	772733	6213214	Montane Heath-Mallee	Mallee Heath								1
MAR27M	771806	6212413	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland								1
MAR29O	774794	6211450	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest								1
RCH01O	770503	6204996	Tableland and Escarpment Moist Herb/Fern Grass Forest	Tableland and Escarpment Moist Herb/Fern Grass Forest	1	1	1					

Site number	Easting	Northing	Vegetation community	Broad flora group	Diurnal bird census	Diurnal reptile census	Sitespotlight census	Harp trap	Bat ultrasound detection	Nocturnal call playback	Nocturnal streamside search	Elliott trap
RCH02W	772297	6204789	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests	1	1	1					
RCH03O	773827	6203330	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests	1	1	1					
RCH04W	773555	6203588	Montane Exposed Silvertop Ash Forest	Montane Sandstone Dry Shrub Forests					1			
t-f-syd-60-034	764865	6229675	Tablelands Snow Gum Woodland	Tablelands Snow Gum Woodland			1			1		
t-f-syd-60-035	766884	6230415	Tablelands Snow Gum Woodland	Tablelands Snow Gum Woodland	1		1			1		
t-f-syd-60-036	766304	6228148	Tablelands Snow Gum Woodland	Tablelands Snow Gum Woodland						1		
t-f-syd-60-037	769600	6231510	Tablelands Snow Gum Woodland	Tablelands Snow Gum Woodland			1			1		
t-f-syd-60-038	772157	6231669	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest			1			1		
t-f-syd-60-040	770126	6227614	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest	1					1		
t-f-syd-60-041	773638	6224869	Montane Gully Brown Barrel Forest	Montane Sheltered Forest						1		
t-f-syd-60-042	771492	6224287	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest	1		2			2		
t-f-syd-60-044	774829	6230736	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest	1		1			1		
t-f-syd-60-045	765808	6224712	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest			1			1		
t-f-syd-60-046	765115	6221762	Tablelands Dry Shrub/Tussock Grass Forest	Tablelands Dry Forests			1			1		
t-f-syd-60-047	768045	6223042	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest			2			1		
t-f-syd-60-048	767920	6223479	Tablelands Shrub/Grass Moist Forest	Montane Sheltered Forest	1		1			1		
t-f-syd-60-049	769536	6221453	Northern Plateaux Moist Fern/Herb/Grass Forest	Montane Sheltered Forest	1					1		
t-f-syd-60-050	764246	6221140	Tablelands Dry Shrub/Tussock Grass Forest	Tablelands Dry Forests			1			1		
t-f-syd-60-054	765653	6222349	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	Tablelands Exposed Silvertop Ash-Brittle Gum Woodland	1							
t-f-syd-60-055	769492	6224823	Tablelands Snow Gum Woodland	Tablelands Snow Gum Woodland	1							
Total					44	37	48	24	11	24	5	6

APPENDIX B

List of the fauna species within south western Blue Mountains NP, including the Abercrombie and Murruin Catchments, from the DEC Atlas of NSW Wildlife. Records have been included from DEC systematic surveys, licensed data sets (Birds Australia and the Australian Museum) and incidental observations submitted by individuals, including park rangers and field officers; catchment officers; bushwalkers and naturalists; scientific researchers working in the area; and other visitors to the park. The final column shows fauna species that have not been recorded within the park, but have been observed within a five kilometre radius of the park. The list contains records of various levels of reliability and spatial accuracy. Species where there is doubt about the occurrence within the study area have been marked with an asterisk *. Introduced species are indicated with the addition of an [I].

Family	Scientific Name	Common Name	Conservation Status	Species occurring within study area			Species not recorded within the study area, but recorded within a 5km radius.
				DEC Systematic Survey	Licensed Datasets	Other Sources	
Frogs							
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P	✓		✓	
Myobatrachidae	*Limnodynastes dumerilii*	Banjo Frog	P	✓		✓	
Myobatrachidae	*Limnodynastes peronii*	Striped Marsh Frog	P	✓			
Myobatrachidae	*Limnodynastes tasmaniensis*	Spotted Marsh Frog	P	✓			
Myobatrachidae	*Mixophyes balbus*	Stuttering Frog	E	✓		✓	
Myobatrachidae	*Pseudophryne bibronii*	Bibron's Toadlet	P	✓			
Myobatrachidae	*Uperoleia laevigata*	Smooth Toadlet	P			✓	
Hylidae	*Litoria booroolongensis*	Booroolong Frog	E				✓
Hylidae	*Litoria dentata*	Keferstein's Tree Frog	P				✓
Hylidae	*Litoria ewingii*	Brown Tree Frog	P				✓
Hylidae	*Litoria littlejohni*	Littlejohn's Tree Frog	V				✓
Hylidae	*Litoria lesueuri*	Lesueur's Frog	P				✓
Hylidae	*Litoria nudidigita*		P	✓			
Hylidae	*Litoria peronii*	Peron's Tree Frog	P	✓		✓	
Hylidae	*Litoria verreauxii*	Verreaux's Tree Frog	P	✓		✓	
Reptiles							
Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle	P	✓			
Agamidae	*Amphibolurus muricatus*	Jacky Lashtail	P	✓		✓	
Agamidae	*Physignathus leseurii*	Eastern Water Dragon	P	✓		✓	
Agamidae	*Pogona barbata*	Eastern Bearded Dragon	P			✓	
Agamidae	*Tympanocryptis diemensis*	Mountain Heath Dragon	P	✓			
Varanidae	*Varanus varius*	Lace Monitor	P	✓			
Scincidae	*Bassiana duperreyi*	Bold-striped Cool-skink	P	✓		✓	
Scincidae	*Bassiana platynota*	Red-throated Cool-skink	P	✓			
Scincidae	*Cryptoblepharus virgatus*	Cream-striped Shinning-skink	P	✓			
Scincidae	*Ctenotus robustus*	Robust Ctenotus	P				✓

Family	Scientific Name	Common Name	Conservation Status	Species occurring within study area			Species not recorded within the study area, but recorded within a 5km radius.
				DEC Systematic Survey	Licensed Datasets	Other Sources	
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Ctenotus	P	✓			
Scincidae	*Egernia cunninghami*	Cunningham's Spiny-tailed Skink	P				✓
Scincidae	*Egernia saxatilis intermedia*	Black Crevice-skink	P	✓			
Scincidae	*Egernia whitii*	White's Rock-skink	P	✓			
Scincidae	*Eulamprus heatwolei*	Warm-temperate Water-skink	P	✓		✓	
Scincidae	*Eulamprus quoyii*	Eastern Water-skink	P	✓			
Scincidae	*Eulamprus tympanum*	Cool-temperate Water-skink	P	✓			
Scincidae	*Hemiergis decresiensis*	Three-toed Earless Skink	P	✓	✓	✓	
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P	✓			
Scincidae	*Lampropholis guichenoti*	Pale-flecked Sunskink	P	✓		✓	
Scincidae	*Lygisaurus foliorum*	Tree-base Litter-skink	P				✓
Scincidae	*Niveoscincus coventryi*	Southern Forest Cool-skink	P	✓			
Scincidae	*Pseudemoia entrecasteauxii*	Tussock Cool-skink	P	✓			
Scincidae	*Pseudemoia pagenstecheri*		P				✓
Scincidae	*Pseudemoia spenceri*	Trunk-climbing Cool-skink	P	✓		✓	
Scincidae	*Saiphos equalis*	Yellow-bellied Three-toed Skink	P	✓		✓	
Scincidae	*Saproscincus mustelinus*	Weasel Shadeskink	P	✓		✓	
Scincidae	*Tiliqua nigrolutea*	Blotched Bluetongue	P	✓		✓	
Elapidae	*Austrelaps ramsayi*	Highlands Copperhead	P	✓			
Elapidae	*Demansia psammophis*	Yellow-faced Whipsnake	P				✓
Elapidae	*Drysdalia rhodogaster*	Mustard-bellied Snake	P				✓
Elapidae	*Notechis scutatus*	Mainland Tiger Snake	P	✓			
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	P	✓			
Elapidae	*Pseudonaja textilis*	Eastern Brown Snake	P	✓			
Birds							
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis	P		✓		
Anatidae	*Anas gracilis*	Grey Teal	P				✓
Anatidae	*Anas superciliosa*	Pacific Black Duck	P		✓		
Anatidae	*Chenonetta jubata*	Australian Wood Duck	P		✓		
Anatidae	*Cygnus atratus*	Black Swan	P	✓			
Podicepedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe	P		✓		
Podicepedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	P		✓		
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	P		✓		
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P		✓		
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	P	✓			
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	P	✓	✓		
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	P	✓			

Family	Scientific Name	Common Name	Conservation Status	Species occurring within study area			Species not recorded within the study area, but recorded within a 5km radius.
				DEC Systematic Survey	Licensed Datasets	Other Sources	
Falconidae	*Falco berigora*	Brown Falcon	P		✓		
Falconidae	*Falco cenchroides*	Nankeen Kestrel	P		✓		
Falconidae	*Falco peregrinus*	Peregrine Falcon	P	✓	✓		
Charadriidae	*Vanellus miles*	Masked Lapwing	P		✓		
Columbidae	*Leucosarcia melanoleuca*	Wonga Pigeon	P		✓		
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	P	✓	✓	✓	
Cacatuidae	*Callocephalon fimbriatum*	Gang-gang Cockatoo	P	✓	✓	✓	
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	P	✓	✓	✓	
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-cockatoo	V				✓
Cacatuidae	*Eolophus roseicapillus*	Galah	P		✓	✓	
Psittacidae	*Alisterus scapularis*	Australian King-Parrot	P	✓	✓	✓	
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	P				✓
Psittacidae	*Platycercus adscitus eximius*	Eastern Rosella	P		✓	✓	
Psittacidae	*Platycercus elegans*	Crimson Rosella	P	✓	✓	✓	
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P	✓	✓	✓	
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	P		✓		
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo	P		✓	✓	
Cuculidae	*Cuculus pallidus*	Pallid Cuckoo	P		✓		
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo	P	✓	✓		
Strigidae	*Ninox boobook*	Southern Boobook	P	✓	✓	✓	
Strigidae	*Ninox strenua*	Powerful Owl	V	✓		✓	
Tytonidae	*Tyto novaehollandiae*	Masked Owl	V	✓			
Podargidae	*Podargus strigoides*	Tawny Frogmouth	P	✓	✓	✓	
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	P	✓			
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	P	✓			
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	P	✓	✓		
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	P	✓	✓	✓	
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	P	✓	✓		
Meropidae	*Merops ornatus*	Rainbow Bee-eater	P				✓
Coraciidae	*Eurystomus orientalis*	Dollarbird	P		✓		
Menuridae	*Menura novaehollandiae*	Superb Lyrebird	P	✓	✓	✓	
Climacteridae	*Climacteris erythrops*	Red-browed Treecreeper	P	✓	✓		
Climacteridae	*Cormobates leucophaeus*	White-throated Treecreeper	P	✓	✓	✓	
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P	✓	✓		
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P				✓
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P	✓	✓	✓	
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	P	✓	✓	✓	
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill	P		✓		

Family	Scientific Name	Common Name	Conservation Status	Species occurring within study area			Species not recorded within the study area, but recorded within a 5km radius.
				DEC Systematic Survey	Licensed Datasets	Other Sources	
Acanthizidae	*Acanthiza lineata*	Striated Thornbill	P	✓	✓	✓	
Acanthizidae	*Acanthiza nana*	Yellow Thornbill	P		✓		
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P	✓	✓	✓	
Acanthizidae	*Acanthiza reguloides*	Buff-rumped Thornbill	P	✓	✓		
Acanthizidae	*Calamanthus pyrrhopygius*	Chestnut-rumped Heathwren	P		✓		
Acanthizidae	*Gerygone mouki*	Brown Gerygone	P				✓
Acanthizidae	*Gerygone olivacea*	White-throated Gerygone	P		✓		
Acanthizidae	*Origma solitaria*	Rockwarbler	P		✓		
Acanthizidae	*Sericornis citreogularis*	Yellow-throated Scrubwren	P				✓
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P	✓	✓	✓	
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P	✓	✓	✓	
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P	✓	✓	✓	
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	P				✓
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P	✓	✓	✓	
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater	P	✓	✓	✓	
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P		✓		
Meliphagidae	*Manorina melanophrys*	Bell Miner	P				✓
Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater	P				✓
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	P	✓	✓		
Meliphagidae	*Melithreptus lunatus*	White-naped Honeyeater	P	✓	✓	✓	
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	P	✓	✓		
Meliphagidae	*Philemon citreogularis*	Little Friarbird	P	✓			
Meliphagidae	*Phylidonyris nigra*	White-cheeked Honeyeater*	P			✓	
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P	✓	✓		
Meliphagidae	*Phylidonyris pyrrhoptera*	Crescent Honeyeater	P		✓	✓	
Meliphagidae	*Xanthomyza phrygia*	Regent Honeyeater*	E		✓		
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P	✓	✓	✓	
Petroicidae	*Microeca fascinans*	Jacky Winter	P		✓		
Petroicidae	*Petroica boodang*	Scarlet Robin	P	✓	✓	✓	
Petroicidae	*Petroica goodenovii*	Red-capped Robin*	P		✓		
Petroicidae	*Petroica phoenicea*	Flame Robin	P	✓	✓	✓	
Petroicidae	*Petroica rosea*	Rose Robin	P	✓		✓	
Eupetidae	*Cinclosoma punctatum*	Spotted Quail-thrush	P	✓	✓		
Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	P	✓	✓		
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	P	✓	✓		
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P	✓	✓	✓	
Pachycephalidae	*Falcunculus frontatus*	Eastern Shrike-tit	P	✓	✓	✓	
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P	✓	✓	✓	

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Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P	✓	✓	✓	
Dicruridae	*Grallina cyanoleuca*	Magpie-lark	P		✓		
Dicruridae	*Monarcha melanopsis*	Black-faced Monarch	P		✓		
Dicruridae	*Myiagra cyanoleuca*	Satin Flycatcher	P	✓	✓	✓	
Dicruridae	*Myiagra inquieta*	Restless Flycatcher	P		✓		
Dicruridae	*Myiagra rubecula*	Leaden Flycatcher	P	✓	✓		
Dicruridae	*Rhipidura albiscapa*	Grey Fantail	P	✓	✓	✓	
Dicruridae	*Rhipidura leucophrys*	Willie Wagtail	P	✓	✓		
Dicruridae	*Rhipidura rufifrons*	Rufous Fantail	P	✓		✓	
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P	✓	✓	✓	
Campephagidae	*Coracina tenuirostris*	Cicadabird	P	✓	✓	✓	
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	P	✓	✓		
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	P	✓	✓		
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird	P				✓
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P	✓	✓		
Artamidae	*Gymnorhina tibicen*	Australian Magpie	P	✓	✓	✓	
Artamidae	*Strepera graculina*	Pied Currawong	P	✓	✓	✓	✓
Artamidae	*Strepera versicolor*	Grey Currawong	P	✓	✓	✓	✓
Corvidae	*Corvus coronoides*	Australian Raven	P	✓	✓	✓	
Corvidae	*Corvus mellori*	Little Raven	P		✓		
Corcoracidae	*Corcorax melanorhamphos*	White-winged Chough	P	✓	✓		
Ptilonorhynchidae	*Ptilonorhynchus violaceus*	Satin Bowerbird	P	✓	✓	✓	
Alaudidae	*Alauda arvensis*	Eurasian Skylark[I]	U				✓
Motacillidae	*Anthus australis*	Australian Pipit	P		✓		
Passeridae	*Passer domesticus*	House Sparrow[I]	U		✓		
Fringillidae	*Carduelis carduelis*	European Goldfinch[I]	U		✓		
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P		✓		
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	P	✓	✓		
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P		✓		
Hirundinidae	*Petrochelidon ariel*	Fairy Martin	P				✓
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	P		✓		
Zosteropidae	*Zosterops lateralis*	Silvereye	P	✓	✓	✓	
Muscicapidae	*Zoothera lunulata*	Bassian Thrush	P				✓
Sturnidae	*Sturnus vulgaris*	Common Starling[I]	U		✓		
Mammals							
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P	✓			
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus	P				✓

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Dasyuridae	*Antechinus stuartii*	Brown Antechinus	P	✓		✓	
Dasyuridae	*Antechinus swainsonii*	Dusky Antechinus	P				✓
Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	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	✓			
Petauridae	*Petaurus breviceps*	Sugar Glider	P	✓		✓	
Pseudocheiridae	*Petauroides volans*	Greater Glider	P	✓	✓	✓	
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P	✓		✓	
Acrobatidae	*Acrobates pygmaeus*	Feathertail Glider	P	✓			
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	P	✓		✓	
Phalangeridae	*Trichosurus caninus*	Mountain Brushtail Possum	P				✓
Potoroidae	*Bettongia gaimardi*	Tasmanian Bettong*	E4				✓
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	P	✓		✓	
Macropodidae	*Macropus robustus*	Common Wallaroo	P	✓			
Macropodidae	*Macropus rufogriseus*	Red-necked Wallaby	P	✓		✓	
Macropodidae	*Petrogale penicillata*	Brush-tailed rock Wallaby	V				✓
Macropodidae	*Wallabia bicolor*	Swamp Wallaby	P	✓		✓	
Pteropodidae	*Pteropus scapulatus*	Little Red Flying-fox	P				✓
Rhinolophidae	*Rhinolophus megaphyllus*	Eastern Horseshoe-bat	P	✓			
Molossidae	*Mormopterus* sp. 1	Undescribed Freetail-bat	P			✓	
Molossidae	*Nyctinomus australis*	White-striped Freetail-bat	P	✓		✓	
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V				✓
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	P	✓		✓	
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	P	✓		✓	
Vespertilionidae	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	V	✓		✓	
Vespertilionidae	*Miniopterus australis*	Little Bentwing-bat*	V				✓
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V	✓		✓	
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	P	✓			
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat	P	✓			
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V	✓		✓	
Vespertilionidae	*Scotorepens orion*	Eastern Broad-nosed Bat	P	✓		✓	
Vespertilionidae	*Vespadelus darlingtoni*	Large Forest Bat	P	✓		✓	
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat	P	✓			
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	P	✓	✓	✓	
Muridae	*Rattus fuscipes*	Bush Rat	P	✓		✓	

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Muridae	*Rattus lutreolus*	Swamp Rat	P				✓
Leporidae	*Oryctolagus cuniculus*	Rabbit[I]	U	✓		✓	
Canidae	*Canis lupus*	Dingo, domestic dog[I]	U	✓		✓	
Canidae	*Canis lupus dingo*	Dingo	U	✓			
Canidae	*Vulpes vulpes*	Fox[I]	U	✓		✓	
Felidae	*Felis catus*	Cat[I]	U	✓		✓	
Suidae	*Sus scrofa*	Pig[I]	U	✓		✓	
Bovidae	*Bos taurus*	European Cattle[I]	U			✓	
Bovidae	*Capra hircus*	Goat[I]	U			✓	
Cervidae	*Dama dama*	Fallow Deer[I]	U	✓			




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