2 METHODS

2.1 PRE-EXISTING FAUNA DATA

Prior to the current study, knowledge of the terrestrial vertebrate fauna of north-western Wollemi National Park was limited. Some of this knowledge had been stored in the Atlas of NSW Wildlife, the state's major fauna database. This database was the primary resource used to access existing data on the fauna of the study area. Several small-scale fauna studies had been undertaken within the park for which records had not been entered into the Atlas of NSW Wildlife. These include: biodiversity assessment of the Glen Alice fuel management burn (Washington & Mullins Imrie 1998); National Parks Association biodiversity survey of Dunns Swamp (Tame 1997); fauna assessment of the proposed Myrtle Grove fuel management burn (Bell 1997); and a survey of fauna between Wheelbarrow Gap and Wilsons Clearing (Goldney & Cardale 1993). Where possible, results from these surveys have been included in the discussion of species occurrence and distributions.

Approximately half of the records within the Atlas prior to the summer of 2005-06 derive from the licensed data sets of Birds Australia. These records were collected in two stages. The first period was prior to 1984 (primarily 1977-1981) when a large number of records were gathered as part of the Bird Atlas published by the Royal Australasian Ornithologists Union (RAOU) (Blakers *et al.* 1984). The method used by Birds Australia at this time involved designating a ten-minute spatial grid, based on easting and northing lines, and attributing all sightings within that grid to coordinates at the centre of the grid. Six such grid centres lie within the study area. This data is spatially inaccurate and there is no guarantee that all or even any of these sightings actually occurred at the given location. Consequently some of this bird data presents a misleading picture of the species composition of Wollemi National Park. The second period of Birds Australia data collection occurred between 1998 and 2002 for the second Bird Atlas (Barrett *et al.* 2003). Most of the records collected during this period have a higher degree of spatial accuracy and are more useful for the purposes of this project. Observations arising from this data were sourced from major access points, particularly the Widden Valley, Kerrabee Arm, Dunns Swamp and Glen Alice.

The other half of the records within the Atlas of NSW Wildlife prior to 2005 derive from systematic surveys undertaken as part of the NSW Comprehensive Regional Assessment (CRA) process, which sought to provide a broad overview of the conservation value of public lands in eastern NSW. Work was undertaken in 1997 and centred on the Myrtle Creek Trail (from Nullo Mountain to the head of Myrtle Creek), Growee/Spring Log Creek Trail, the Hunter Range (from Mount Coricudgy to Mount Monundilla), Dunns Swamp, and the Army Road (from Box Hole Clearing to Geebung Ground and Gospers Mountain). These surveys were undertaken by NPWS using the systematic techniques described below (NPWS 1997b).

A relatively small number of records were derived from the specimen register of the Australian Museum. Remaining records within the Atlas were derived from observations made by park rangers and field 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 experience of the observer.

2.2 SURVEY STRATIFICATION AND SITE SELECTION

The aim of the survey stratification and site selection process was to proportionately sample the full range of habitat types contained within north-western Wollemi National Park. Choosing an appropriate data layer(s) to develop stratification proved difficult. A two stage approach was therefore adopted.

2.2.1 Gap analysis and selection of priority areas for survey

The first step undertaken was to classify the vegetation communities mapped by Bell (1998) into broader strata that represented the main fauna habitat types within the park. The vegetation formations and classes defined by Keith (2004) were used in this process. The Keith (2004) classification relates vegetation communities to broad statewide distributions and influences, thereby providing a meaningful basis for examining fauna composition patterns. Thirty broad strata were generated (see Table 2).

Prior to the commencement of this project 50 systematic fauna survey sites had been established within the study area as part of the CRA program. The CRA sites were concentrated along the easily accessible major trails leaving immense portions of the study area unsurveyed. In addition, not all survey techniques were undertaken at each site. The site selection process undertaken for the 2005-06 survey season ensured that the data collected would complement, rather than duplicate, work that had previously been undertaken within the study area. A gap analysis was performed to identify the amount of previous systematic fauna survey effort within each broad stratum. Broad strata 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 stratum) were prioritised for sampling.

Secondly, an assessment was undertaken to identify significant gaps in the spatial distribution of systematic fauna survey sites within the study area. Thirdly, for logistical reasons survey points were required to be on or within ten kilometres of a road. The exception to this latter rule was survey sites accessed by helicopter, which sought to fill the vast spatial gap in the south-eastern section of the study area. These three factors were used to select priority regions of the study area to be targeted for survey in the spring/summer season of 2005-06.

2.2.2 Finer scale selection of survey sites

Once the priority regions were selected, the primary strata used for specific site selection were vegetation type and landscape features. The currently available vegetation mapping (Bell 1998) is not designed to provide accurate detail of individual sites. Vegetation type alone could not be relied upon for site stratification as field inspection revealed significant errors in the modelling, particularly under-representation of creekline habitats. An effort was therefore made to sample the full topographic variation within each of the priority regions (i.e. to sample the range of aspects and positions in the landscape from exposed ridgeline to most sheltered gorge).

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

The location of access trails and the large amount of travelling time between areas (especially when walking in difficult terrain) limited selection of survey sites. Due to time and budgetary constraints and the fact that fauna survey is very labour intensive, not all spatial gaps in sampling could be filled. The most notable shortfall was the failure to access the range between Widden and Myrtle Creek, and between Myrtle Creek and the north-western boundary of the park.

Table 3 presents the area of each broad stratum and the corresponding survey effort for each fauna survey technique. Appendix A provides the specific AMG and survey techniques undertaken at each survey site, while Map 5 shows the placement of sites across the study area. The tables and map include all systematic surveys undertaken within the study area by DEC between 1997 and 2005 (i.e. during both CRA and BSP programs).

2.3 SURVEY METHODS

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

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

Broad strata (derived from Bell (1998) into the statewide vegetation classes of Keith (2004))	Area of strata (hectares)*	Proportion of study area occupied by strata (%)	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 owl call broadcast sites	No. of nocturnal streamside searches for frogs	No. of Elliott trap sites	No. of hairtube sites
Sydney Hinterland Dry Sclerophyll Forests	50445	27.389	33	37	15	16	11	16	4	5	4
Sydney Hinterland Dry Sclerophyll Forests (Sheltered)	45221	24.552	25	23	12	13	8	10	5	6	5
Southern Tableland Dry Sclerophyll Forests	22264	12.088	31	27	16	17	18	14	2	3	4
Western Slopes Grassy Woodlands (Shrubby)	18523	10.057	51	40	21	11	1	13	3	1	1
Western Slopes Dry Sclerophyll Forests	17779	9.653	8	10	3	1	0	2	0	0	0
Sydney Montane Dry Sclerophyll Forests	6052	3.286	12	13	4	5	5	6	3	1	4
Sydney Coastal Dry Sclerophyll Forests	3996	2.170	5	4	3	2	2	1	0	1	1
North Coast Wet Sclerophyll Forests	3759	2.041	9	8	3	0	3	3	2	0	1
Western Slopes Grassy Woodlands	2975	1.615	18	13	11	9	4	5	1	1	0
Western Slopes Dry Sclerophyll (Sheltered)	1866	1.013	0	0	0	0	0	0	0	0	0
Sydney Montane Heaths	1632	0.886	5	5	3	0	1	1	0	3	0
Central Gorge Dry Sclerophyll Forests (Sheltered)	1523	0.827	1	0	0	0	0	0	0	0	0
Northern Warm Temperate Rainforests	1459	0.792	3	4	0	1	0	0	0	0	0
Cleared	1402	0.761	2	2	1	5	2	4	0	1	0
Western Slopes Rocky Heath	1248	0.677	1	1	0	0	0	0	0	0	0
Southern Escarpment Wet Sclerophyll Forests	1017	0.552	8	6	4	1	0	0	0	0	0
Southern Tableland Grassy Woodlands	965	0.524	7	7	4	2	3	5	0	1	2
Central Gorge Dry Sclerophyll Forests	823	0.447	2	1	1	2	0	1	0	0	1
Southern Warm Temperate Rainforests	479	0.260	4	5	2	0	1	1	0	1	0
Dry Rainforests	327	0.177	0	0	0	0	0	0	0	0	0
Eastern Riverine Forests	234	0.127	2	0	0	3	0	0	0	0	0
Subtropical Rainforests	63	0.034	2	1	1	0	1	1	1	0	0
Tableland Grassy Woodlands	42	0.023	1	1	1	0	0	1	0	0	0
Coastal Tall Open Forests	28	0.015	1	1	2	0	1	0	0	1	0

Broad strata (derived from Bell (1998) into the statewide vegetation classes of Keith (2004))	Area of strata (hectares)*	Proportion of study area occupied by strata (%)	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 owl call broadcast sites	No. of nocturnal streamside searches for frogs	No. of Elliott trap sites	No. of hairtube sites
Alluvial Swamp	24	0.013	2	1	1	0	0	0	0	0	0
Montane Bogs	13	0.007	1	1	1	0	0	0	0	0	0
Basalt Herbfield	12	0.007	0	0	0	0	0	0	0	0	0
Montane Swamps	4	0.002	0	0	0	0	0	0	0	0	0
Sedgeland	3	0.002	0	0	0	0	0	0	0	0	0
Basalt Shrubland	1	0.001	0	0	0	0	0	0	0	0	0
Total	184179	100	234	211	109	88	61	84	21	25	23

* areas based on GIS data layers and do not equal gazetted area of reserve.

^ Includes sites established during Comprehensive Regional Assessment and Biodiversity Survey Priorities surveys. Transect spotlight surveys are not included in this table as these traverse a variety of vegetation types. Sixteen such censuses were undertaken during CRA surveys.

Note also that broad strata presented here are derived from modelled vegetation unit as mapped and do not always equal vegetation community in the field. In particular, gully forest and rainforest is not well mapped, and therefore appear under-sampled in the above table, while drier forest types appear over-sampled. In reality, gully habitats were sampled as part of this project in rough proportion to their occurrence in the field.

Table 2: Area of each broad strata (derived from Keith 2004) within north-western Wollemi National Park and corresponding allocation of systematic survey sites.

2.3.1 Systematic site-based methods

Site attributes

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

Diurnal bird survey

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

Diurnal herpetofauna search

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

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

Nocturnal site spotlighting survey

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

Harp trapping

While ultrasonic recorders were used principally to detect high-flying bat species, collapsible bat traps, known as harp traps (Tidemann and Woodside 1978), captured low-flying species (Plate 5). Two nights of trapping were conducted at each bat trap site, in spring and summer. Sites were selected for their perceived potential to interrupt bats along their flight paths, and were usually positioned on tracks or creeklines or in gaps between trees where adjacent vegetation may ‘funnel’ flying bats.

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

Bat ultrasonic (‘Anabat’) call recording

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

<u>CRA</u>

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

<u>BSP</u>

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 waterbodies, at cave entrances and along tracks. The Anabat was set to commence detection at dusk and turn off at dawn. During the night, a delay switch operated to turn on the recording device when bat activity was detected and then de-activate the device while no bat activity was occurring. The equipment was left in each location for one night only, then moved elsewhere. A 40 kilohertz calibration tone was recorded for a few seconds at the start and end of each recording session.

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

Nocturnal streamside search

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

Nocturnal call playback

Nocturnal birds and mammals are often detected only when they vocalise for territory or social contact, behaviour which can be elicited by broadcasting specific calls. A standard survey census involved broadcasting the calls of each of the four large forest owls - Powerful Owl (*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. The majority of censuses were undertaken in autumn and winter.

Elliott trapping

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

Hair tube sampling

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

2.3.2 Transect based methods

Transect spotlighting survey

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

2.3.3 Opportunistic methods

Predator and herbivore/insectivore scat and pellet collection

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

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

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

Searches of caves and overhangs

When come across, caves and overhangs were thoroughly searched with a head torch for animals such as cave-roosting bats, geckos and nesting birds, as well as for animal traces such as owl pellets and bat guano.

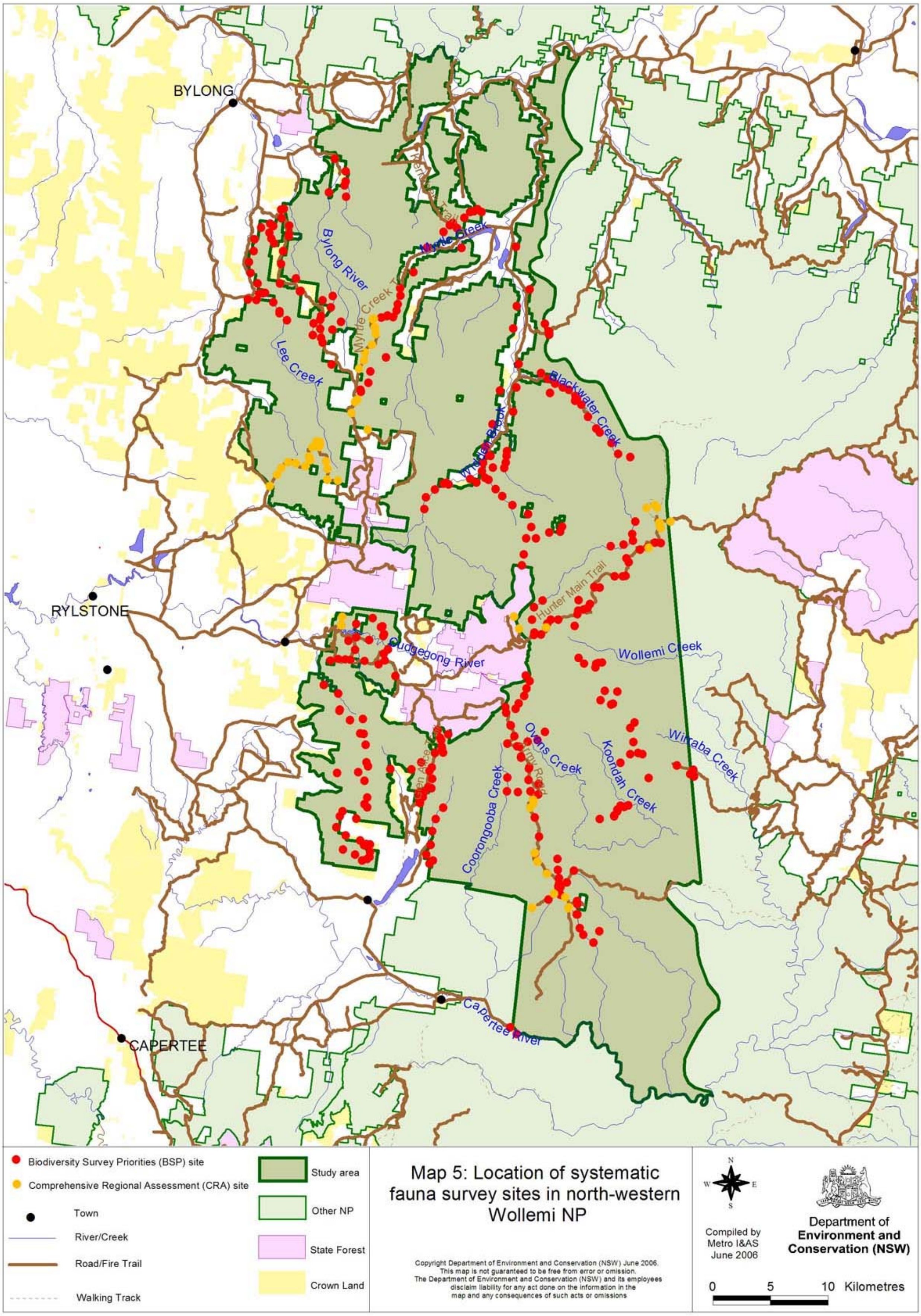
Incidental records

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

2.3.4 Targeted searches for Brush-tailed Rock-wallaby

After the sighting of an adult Brush-tailed Rock-wallaby (*Petrogale penicillata*) in Myrtle Creek in March 2006, further targeted surveys were commissioned to estimate the extent of wallaby occupation and the approximate number of individuals in the immediate vicinity of the sighting. These surveys were undertaken between the 22nd and 26th May 2006 and were funded by the Brush-tailed Rock-wallaby Recovery Team. The surveys included the following:

- Searches for Brush-tailed Rock-wallaby in shelter sites, sunning areas and connecting habitat corridors along Bylong River (near Bylong Trail crossing), Myrtle Creek (including slopes and clifflines east and west of the creek from Lovers Leap to the point where Myrtle Trail leaves the creekline), and Red Creek (from Widden Brook to 2.5 kilometres upstream)
- Searches for Brush-tailed Rock-wallaby scats in the above areas.
- Searches for predator and introduced herbivore scats in the above areas, including collection and analysis of predator scat contents. This was undertaken in an attempt to assess the level of threat posed to the Brush-tailed Rock-wallaby in these areas, and collect any evidence of direct predation.



Map 5: Location of systematic survey sites in north-western Wollemi National Park

2.4 SURVEY TIMING

As summarised above, systematic field surveys have been undertaken within north-western Wollemi National Park over a number of years. Table 3 summarises the timing of these surveys and the techniques that were undertaken in each period.

Survey program	Timing	Techniques employed
Comprehensive Regional Assessment (CRA)	January to May 1997	Diurnal bird census, reptile search, transect spotlighting, site spotlighting, 30 minute bat call detection, harp trapping, nocturnal call playback, nocturnal streamside search, hair tubes, elliott trapping, opportunistic methods
Biodiversity Survey Priorities (BSP)	August 2005	Nocturnal call playback, opportunistic methods
	September 2005 – February 2006	Diurnal bird census, reptile search, site spotlighting, harp trapping, all night bat call detection, nocturnal streamside search, nocturnal call playback, elliott trapping, opportunistic methods
	March – April 2006	Nocturnal call playback, hair tubes, opportunistic methods

Table 3: Timing of DEC systematic fauna surveys within north-western Wollemi National Park

2.5 DATA ANALYSIS

A small amount of exploratory multivariate data analyses were undertaken to identify patterns of diurnal bird and reptile occurrence in relation to major habitat types within the study area. The software package *Primer 5 for Windows* (version 5.2.9) was used for this purpose. The major vegetation classes into which sites were categorised for these analyses are: Heathland; Dry Sclerophyll Forest; Grassy Woodland; Sheltered Dry Sclerophyll Forest; Wet Sclerophyll Forest (grassy); Wet Sclerophyll Forest (shrubby); Rainforest; and Forested Wetland. To further elucidate patterns within the Dry Sclerophyll Forest group, sites were further categorised by underlying geology into: Narrabeen; Hawkesbury; and Permian. Only a subset of systematic survey sites were used, namely those that had both diurnal bird and diurnal herpetofauna censuses undertaken at them. Analyses were undertaken on the combined results of the bird and herpetofauna censuses undertaken at each site. Analyses were based on species presence-absence data, as this is not sensitive to fluctuations in abundance counts. For the diurnal birds, all records noted as 'above canopy' were excluded because it is not known if they were actually using the habitat or not. However, both 'on-site' and 'off-site' bird records were included. Analysing bird and reptile data simultaneously meant that some differences were primarily driven by bird species, and others by reptile species. Caution therefore had to be applied when interpreting the fauna groups separately, and to the separate discussion presented in Sections 3.3 and 3.4.

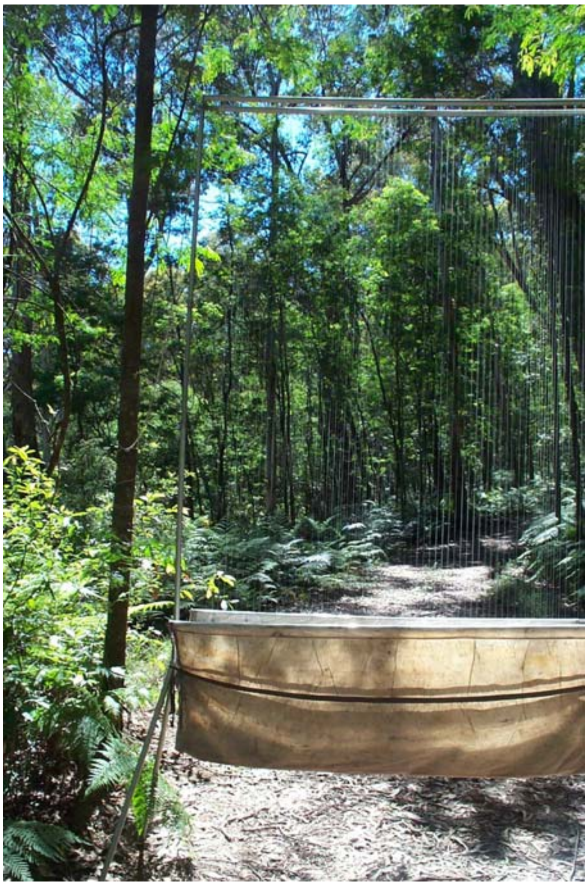


Plate 5: Harp trap placed across a fire trail to sample microbat species © DEC

Detail of the analyses undertaken is presented in Appendix B. In summary: similarity matrices were used to identify groups of sites that contained similar suites of birds and reptiles; analysis of similarities (ANOSIM) was used to test for differences between the bird and reptile fauna of the major habitat groups; and SIMPER was used to identify fauna species that characterise site groupings identified in the Similarity Matrices and ANOSIM.