

VERTEBRATE FAUNA SURVEY OF COOLAH TOPS



MARCH 1998 WITH DECEMBER 1998 ADDENDUM

A report compiled for the National Parks and Wildlife Service Mudgee Sub-District by the
Sydney Zone Comprehensive Regional Assessment (CRA) Unit

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SUMMARY

A survey for vertebrate fauna of the Coolah Tops Plateau and surrounding slopes was conducted over a 12 day period from the 2nd to the 13th of March 1998. The principle objectives of the project were to:

1. conduct a comprehensive and systematic survey of vertebrate fauna, including targeted searches for rare and endangered species, and species considered to be of local conservation priority;
2. ascertain if the broad forest types of the area identified by SFNSW (1995), represent a surrogate for unique fauna assemblages present in the study area;
3. compare the fauna assemblages of the National Park to adjacent crown and private lands to assist with the prioritisation of land acquisition;
4. identify any areas or species that may require special management consideration.

These aims were addressed using 24 standard fauna sites. Sites were replicated in each forest type present in the area, and aimed to complement data already collected by State Forests. Additional systematic searches for nocturnal and diurnal avifauna, frogs, bats and other mammals were conducted outside these sites. Incidental observations of vertebrate fauna were also recorded.

Multivariate analysis of faunal communities revealed little discrimination between forest types. Except for birds, there were no differences in fauna between any of the forest communities identified on the Plateau. There were, however, distinct differences in fauna between the broad landscape units identified by Binns (1997); Plateau Forest, Slopes Woodland, Riparian Forest and Swamp. These landscape units can potentially be used as surrogates for the different vertebrate fauna communities at Coolah Tops. The Plateau Forest contained species typical of the eastern forests of NSW, whereas Box eucalypt communities of the Slopes Woodland supported fauna more typical of western NSW. The Slopes Woodland and lowland Riparian environments and their associated faunal communities are not well represented within Coolah Tops National Park.

Seven species listed under the *Threatened Species Conservation (TSC) Act (1995)* were recorded. These were the Powerful Owl, Masked Owl, Barking Owl, Glossy Black-Cockatoo, Large Pied Bat (*Chalinolobus dwyeri*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Common Bent-wing Bat (*Miniopterus schreibersii*). Habitat for many of these includes the escarpment, Slopes Woodland or lowland watercourses that are outside of the National Park.

INTRODUCTION

BACKGROUND

Coolah Tops is a discrete basalt plateau of the Liverpool Ranges, situated approximately 100km north-northeast of the town of Mudgee. The elevation of the plateau ranges between 1000 and 1200m above sea level. The combination of relatively high rainfall and rich soil supports a tall open eucalypt forest. Selective logging operations, targeting the Silvertop Stringybark (*Eucalyptus laevopinea*) began in the early 1900's with the first licenses for sleeper cutters being issued in 1941 in what was formerly the Bundella and Warung State Forests (FCNSW 1982; M. Sharp pers. comm.). Logging continued until shortly before the Coolah Tops National Park was declared in 1996 (Sharp 1997). Low level sheep grazing of the plateau has occurred for most of this century, and has continued after the gazetting of the park by the large feral goat population. For more information regarding physical characteristics and prior management see FCNSW (1982). Coolah Tops National Park presently covers an area of 10 644 hectares. However a proportion of the plateau, and the majority of the slopes are still in private ownership or are leased crown land.

FLORISTICS

The floristics of Coolah Tops have been surveyed in detail by Binns (1997). Twenty-two communities based on species composition, vegetation structure and environment were distinguished using multivariate statistical techniques (Binns 1997). The vegetation of the region is mostly eucalypt dominated and the overall diversity is fairly low with 316 native and 37 naturalised vascular plant species (Binns 1997). Identified at Coolah Tops were four main landscape units, based on the floristics of the area: Plateau Forest, Slopes Woodland, Riparian Forest and Swamp. Predominant tree species of the **Plateau Forest** are Silvertop Stringybark (*Eucalyptus laevopinea*), Manna Gum (*E. nobilis*), Snow Gum (*E. pauciflora*) and Mountain Gum (*E. dalrympleana heptantha*) which occur mostly as tall open forest with a grassy understorey. **Slopes Woodland** contains Box communities including Yellow Box-Apple Box (*E. melliodora*-*E. bridgesiana*); Long-leaved Box (*E. nortonii*) and White Box (*E. albens*). These occur at slightly lower altitudes on the exposed slopes and foothills

of the plateau. These Box communities are often associated with a dense understorey of *Cassinia quinquefaria* and *Olearia elliptica*. **Riparian Forest** is found mostly at lower altitudes, along creek lines which are dominated by River Oak (*Casuarina cunninghamiana*) and Rough-barked Apple (*Angophora floribunda*). **Swamp** is characterised by thick Tea Tree (*Leptospermum gregarium* or *L. polygalifolium*) and occasional Black Sallee (*E. stellulata*) or Mountain Gum (*E. dalrympleana heptantha*). For more detailed information on the floristics of the Coolah Tops area, see Binns (1997) and SFNSW (1995).

PREVIOUS FAUNA SURVEY EFFORT

Previous surveys at Coolah Tops include work on bats (Coles *et al.* 1995), nocturnal fauna (Kavanagh 1994), and diurnal bird, mammal, reptile and amphibians (Shields *et al.* 1995). These surveys have been carried out for NSW State Forests for a timber management purpose. Fauna survey effort sought to address questions relating to the effects of timber harvesting on fauna. Consequently, limited effort was directed at sampling the full range of environments present in the area, such as the 'unproductive' rocky slopes and swamp communities.

The Plateau Forest, in particular, has been well surveyed. An additional aim of this study therefore sought to address inconsistencies and questions raised in previous fauna studies. One of the most interesting notes from a previous survey was a potential record of the Fawn-footed Melomys (*Melomys cervinipes*) based on analysis of hair sample from a predator scat (Shields *et al.* 1995). If confirmed, this would be a large western range extension. Shields *et al.* (1995) also surveyed for other fauna groups, finding thirteen species of reptile and six frogs. There were some inconsistencies between the species of reptile found by Shields *et al.* (1995) and the present study. These are addressed in the discussion.

Coles *et al.* (1995) caught ten species of insectivorous bat through harp trapping, mist netting and trip lining over dams. Coles *et al.* (1995) did not identify Little Forest Bat (*Vespadelus vulturinus*) from trapping, but found it to be common in the ultrasound recording. Another two species, the Little Broad-nosed Bat (*Scotorepens greyii*) and Eastern Forest Bat (*Vespadelus pumilus*) were not trapped but thought to be possibly present from the ultrasound recordings. As these species would be at the limits, or

outside their known range (Parnaby 1992), Coles *et al.* (1995) suggested that further work should be targeted to confirm their presence. We aimed to clarify these issues through extensive harp trapping, mist netting and trip lining as well as ultrasound recordings.

Kavanagh (1995) conducted an extensive survey for owls and other nocturnal fauna at 30 sites on the plateau, detecting two Powerful Owls and a Masked Owl, all within Silvertop Stringybark dominated forests. Of the arboreal mammals, the Greater Glider (*Petauroides volans*) was found to be the most abundant, with some records of Sugar Gliders (*Petaurus breviceps*) and Common Ringtail Possum (*Pseudocheirus peregrinus*) and a single Feathertail Glider (*Acrobates pygmaeus*).

PROJECT AIMS

As stated in the summary, the principle aims of the project were as follows:

1. conduct a comprehensive and systematic survey of vertebrate fauna, including targeted searches for rare and endangered species, and species considered to be of local conservation priority;
2. ascertain if the broad forest types, or landscape units of the area can be used as a surrogate for fauna assemblages present at Coolah Tops;
3. compare the fauna assemblages of the National Park to adjacent crown and private lands to assist with the prioritisation of land acquisition;
4. identify any areas or species that may require special management consideration.

METHODS

IDENTIFICATION OF BROAD VEGETATION COMMUNITIES

Nine separate habitat types of the Coolah Tops Plateau and slopes have been identified and mapped by SFNSW (1995), based on the forest types described in FCNSW (1989). In addition to these, several different communities were surveyed outside the mapped area. Sites outside the mapped area were assigned a forest type through consulting 'Forest Types in New South Wales' (FCNSW 1989). Below, forest types are grouped into the landscape units within which they occur:

Plateau Forest

Forest Type (FCNSW 1989)	description
138 Snow Gum + 15% other	Dominant Snow Gum (<i>E. pauciflora</i>) with some Black Sallee (<i>E. stellulata</i>), Manna Gum (<i>E. nobilis</i>) and Mountain Gum (<i>E. dalrympleana heptantha</i>). At Coolah Tops this forest type forms tall open forest up to 30m in height.
140 Mountain/Manna Gum and Snow Gum	Manna Gum (<i>E. nobilis</i>), Mountain Gum (<i>E. dalrympleana heptantha</i>) and Snow Gum (<i>E. pauciflora</i>) forming a tall forest community.
159 Mountain/Manna Gum	Manna Gum (<i>E. nobilis</i>) and Mountain Gum (<i>E. dalrympleana heptantha</i>) as tall open forest.
167 Silvertop Stringybark Mountain/ Manna Gum	Silvertop Stringybark (<i>E. laevopinea</i>) dominant with some Manna Gum (<i>E. nobilis</i>) and Mountain Gum (<i>E. dalrympleana heptantha</i>). Tall forest of high site quality. Targeted for selective logging until recently.
167a Silvertop Stringybark + 15% other	Silvertop Stringybark (<i>E. laevopinea</i>) dominant with some Snow Gum (<i>E. pauciflora</i>), Manna Gum (<i>E. nobilis</i>) or Mountain Gum (<i>E. dalrympleana heptantha</i>). Targeted for selective logging.

Slopes Woodland

Forest Type (FCNSW 1989)	Description
167/171 Silvertop Stringybark/ Yellow Box	Silvertop Stringybark (<i>E. laevopinea</i>) with Yellow Box (<i>E. melliodora</i>) occurring on the more sheltered slopes and lighter, slightly lower fertility soils.
175 White Box	White Box (<i>E. albens</i>) occurring as open woodland on exposed slopes and foothills with the occasional Kurrajong (<i>Brachychiton populneus</i>) and Rough-barked Apple (<i>Angophora floribunda</i>) as a sub-canopy.
176 White Box - Silvertop Stringybark	White Box (<i>E. albens</i>) and Silvertop Stringybark (<i>E. laevopinea</i>) co-dominant on more exposed slopes as open woodland with occasional Long-leaved Box (<i>E. nortonii</i>), Kurrajong (<i>Brachychiton populneus</i>) or Rough-barked Apple (<i>Angophora floribunda</i>) as a sub-canopy.

Riparian

Forest Type (FCNSW 1989)	Description
211 River Oak	Along creek lines at lower altitudes where River Oak (<i>Casuarina cunninghamiana</i>) is a clear dominant. Other canopy species include Rough-barked Apple (<i>A. floribunda</i>) and Silvertop Stringybark (<i>E. laevopinea</i>).
167/171 Silvertop Stringybark/ Yellow Box	Silvertop Stringybark (<i>E. laevopinea</i>) with Yellow Box (<i>E. melliodora</i>) occurring on the more sheltered slopes and lighter, slightly lower fertility soils. This is included in the Riparian Landscape Unit and in the Slopes Woodland as there were 167/171 sites in both.

Swamp

Forest Type (FCNSW 1989)	Description
231 Swamp	Usually as dense stands of Tea Tree (<i>Leptospermum gregarium</i> and/or <i>L. poligalifolium montanum</i>) with occasional Black Sallee (<i>E. stellulata</i>) or Mountain Gum (<i>E. dalrympleana heptantha</i>). Swamps occur at headwaters of creeks and have standing water and sphagnum.

Other communities that occur at Coolah Tops are; 103 Apple Box (*E. bridgesiana*), which was not sampled with formal survey sites due to its restricted distribution, and community 216 Grassland, which is not a natural community on the Plateau.

SITE SELECTION

Sites were replicated at least twice in each of the forest types (Table 1). Where possible, a proportion of sites in each community were located outside the boundaries of Coolah Tops National Park (Figure 1). An attempt was made to spatially separate sites of each habitat type as much as possible, and sites were located at least one kilometer apart to maximise independence of sampling. With locations of NPWS sites complementing those of State Forests, a thorough coverage of the park area has been achieved. Only a small portion in the center of the park has no standard sites, due to extremely poor access to the area. However, it is assumed that the habitat types in this gap are represented elsewhere in the park, and therefore sufficiently sampled.

Table 1: Broad habitat types identified in Coolah Tops (SFNSW 1995). For each habitat type is shown the number of systematic (standard and additional systematic censuses) survey sites, the number of sites found in Coolah Tops National Park and the number on other tenure.

Forest Type	Mapped vegetation type (SFNSW)	Number of standard sites (all methods)	Number of additional systematic censuses	Number of sites in Coolah Tops National Park	Number of sites off NPWS land
Plateau Forest					
Snow Gum + 15% other	138	2	3	1	1
Mountain/Manna & Snow Gum	140	2	8	2	0
Mountain/Manna Gum	159	4	2	2	2
Silvertop Stringybark - Mountain/Manna Gum	167	4	12	4	0
Silvertop Stringybark + 15% other	167a	2	4	0	2
Slopes Woodland					
White Box	175	2	0	0	2
Silvertop Stringybark/ Box	176	2	2	0	2
Silvertop Stringybark/ Yellow Box	167/171	0	1	0	0
Riparian					
Silvertop Stringybark/ Yellow Box	167/171	2	0	0	2
River Oak	211	2	2	0	2
Swamp					
Swamp	231	2	0	2	0
Total Sites		24	34	11	13

All sites were surveyed between the 2nd and the 13th of March 1998. The weather conditions of this period were warm and sunny with maximum temperatures of between 25°C and 35°C on most days. Nights were cool, with minimum temperatures of between 5°C and 13°C. Although there was a light shower of rain on the plateau on the 4th, the area was experiencing an extended period of dry weather (M. Sharp pers. comm.). This has important implications on the results of particularly the frog searches in this survey. The weather conditions at the time of individual census, including cloud cover, wind direction and strength, were recorded and are available on the NPWS BSS database. The vegetation type of each of the 24 sites, based on the map of vegetation communities, is given in Table 2 (SFNSW 1995). This table also lists the actual vegetation of the 2 ha lot based on site attribute proformas that were completed at each site (available in full on the NPWS BSS database). For some sites, the mapped vegetation type and the actual vegetation of the site were not identical, for example YB22.

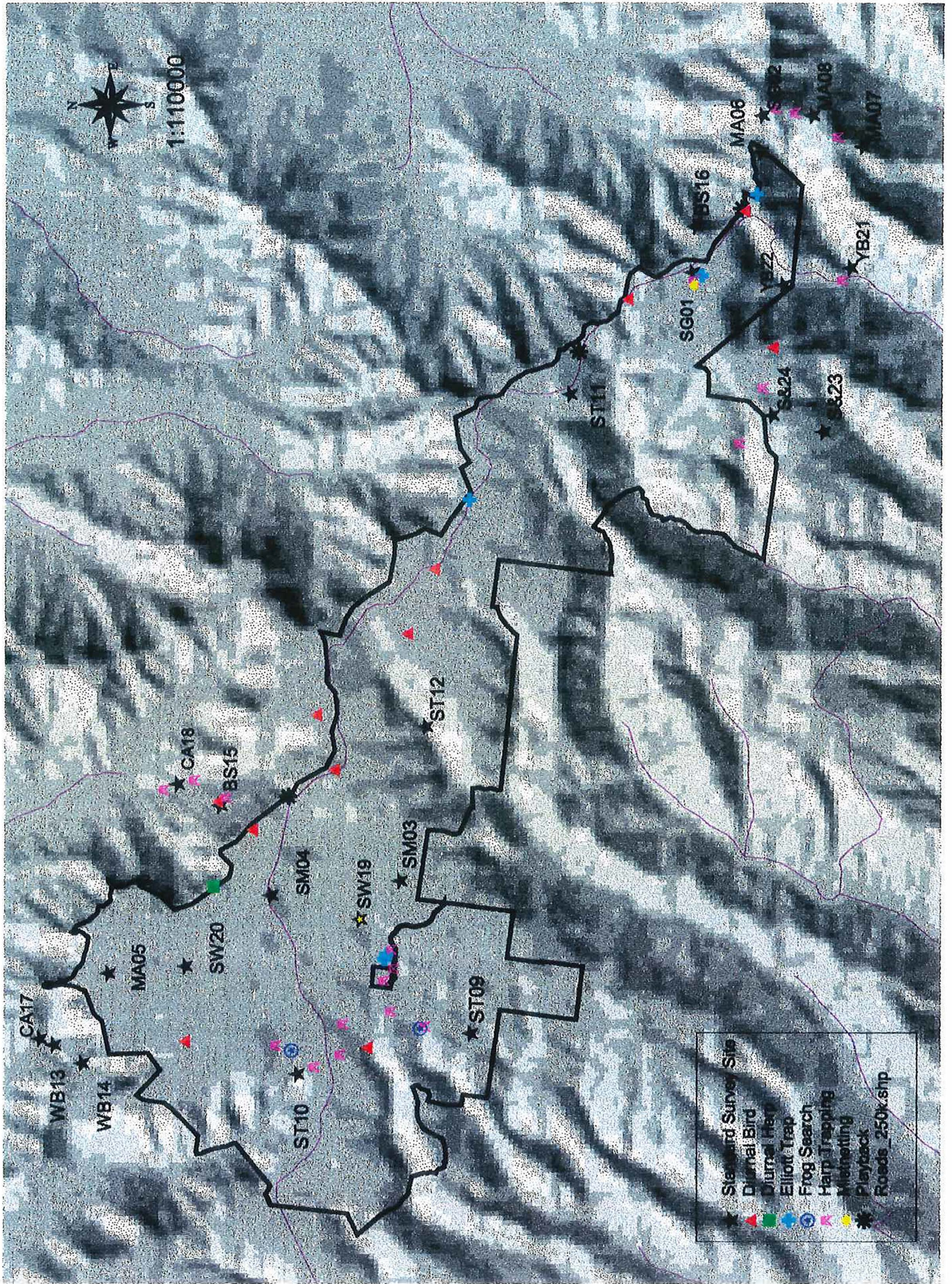
Table 2: Summary of the dominant tree and shrub species, and growth form of the shrub and ground layer, recorded at the 24 systematic survey sites.

Site name	Mapped Vegetation Type (SFNSW)	Dominant Tree Species	Dominant shrub species	Dominant shrub growth form	Dominant ground layer growth form
Plateau Forest					
SG01	138	<i>Eucalyptus pauciflora</i>	<i>Acacia dealbata</i>	Mixed	Tussock grass (<i>Poa sieberiana</i>); Vine (<i>Smilax australis</i>)
SG02	138	<i>E. pauciflora</i>	Fern; <i>A. dealbata</i>	Fern	Tussock grass (<i>Poa</i>); Fern
SM03	140	<i>E. nobilis</i> ; <i>E. dalrympleana heptantha</i> ; <i>E. laevopinea</i>	<i>A. dealbata</i>	Mixed	Herb/Grass
SM04	140	<i>E. laevopinea</i> ; <i>E. nobilis</i> ; <i>E. dalrympleana heptantha</i>	<i>A. dealbata</i>	Mixed	Tussock grass (<i>Poa</i>)
MA05	159	<i>E. nobilis</i> ; <i>E. dalrympleana heptantha</i>	<i>A. dealbata</i>	Mixed	Herb/Grass
MA06	159	<i>E. nobilis</i>	none	none	Fern, Vine, Herb/Grass
MA07	159	<i>E. laevopinea</i> ; <i>E. nobilis</i> ; <i>E. dalrympleana heptantha</i>	none	none	Fern, Vine, Herb/Grass
MA08	159	<i>E. laevopinea</i> , <i>E. nobilis</i> ; <i>E. dalrympleana heptantha</i> ; <i>E. pauciflora</i>	<i>Acacia spp.</i>	Heathy	Fern, Tussock Grass, Herb/Grass
ST09	167	<i>E. laevopinea</i>	<i>Acacia spp.</i>	Heathy	Fern, Herb/Grass
ST10	167	<i>E. laevopinea</i>	none	none	Herb/Grass
ST11	167	<i>E. laevopinea</i>	<i>A. dealbata</i>	Mixed	Tussock Grass, Vine (<i>Smilax australis</i>)
ST12	167	<i>E. laevopinea</i> ; <i>E. dalrympleana heptantha</i>	<i>Acacia melanoxylon</i>	Mixed	Tussock Grass, Fern (<i>Pteridium esculentum</i> + others), Herb/Grass (<i>Urtica incisa</i>)
S&23	167a	<i>E. laevopinea</i>	<i>A. dealbata</i>	Heathy	Tussock Grass
S&24	167a	<i>E. laevopinea</i> ; <i>E. nobilis</i> ; <i>E. dalrympleana heptantha</i>	<i>A. melanoxylon</i> ; <i>A. dealbata</i>	Heathy	Tussock Grass

Table 2: Summary of the dominant tree and shrub species, and growth form of the shrub and ground layer, recorded at the 24 systematic survey sites at Coolah Tops

Site name	Mapped Vegetation Type (SFNSW)	Dominant Tree Species	Dominant shrub species	Dominant shrub growth form	Dominant ground layer growth form
Slopes Woodland					
WB13	175	<i>E. albens</i> (+ <i>Angophora floribunda</i> & <i>Brachychiton populneus</i>)	<i>Cassinia quinquefaria</i>	Heathy	Herb/Grass
WB14	175	<i>E. albens</i> (+ <i>A. floribunda</i> & <i>Brachychiton populneus</i>)	<i>Cassinia quinquefaria</i>	Heathy	none
BS15	176	<i>E. laevopinea</i> ; <i>E. albens</i>	<i>Cassinia quinquefaria</i> , <i>Olearia elliptica</i> , <i>Callistemon sieberi</i>	Heathy	Herb/Grass
BS16	176	<i>E. laevopinea</i> ; <i>E. albens</i> ; <i>E. nortonii</i>	<i>Cassinia quinquefaria</i>	Heathy	Herb/Grass
Riparian					
CA17	211	<i>Casuarina cunninghamiana</i> ; <i>A. floribunda</i>	<i>Pittosporum undulatum</i>	Mesic	Fern, Herb/Grass (<i>Urtica incisa</i>)
CA18	211	<i>C. cunninghamiana</i> ; <i>A. floribunda</i>	<i>Olearia elliptica</i>	Mixed	Fern, Herb/Grass (<i>Urtica incisa</i>)
YB21	167/171	<i>C. cunninghamiana</i> ; <i>E. melliodora</i> , <i>A. floribunda</i>	<i>P. undulatum</i>	Mixed	Fern, <i>Urtica incisa</i>
YB22	167/171	<i>C. cunninghamiana</i> ; <i>Allocasuarina torulosa</i> ; <i>Ang. floribunda</i>	<i>P. undulatum</i>	Mixed	Fern, <i>Urtica incisa</i>
Swamp					
SW19	231	none	<i>Leptospermum spp.</i>	Heathy	Herb/Grass
SW20	231	isolated <i>E. stellulata</i>	<i>Leptospermum gregarium</i> ; <i>Hakea microcarpa</i>	Heathy	Herb/Grass
S&23	167a	<i>E. laevopinea</i>	<i>A. dealbata</i>	Heathy	Tussock Grass
S&24	167a	<i>E. laevopinea</i> ; <i>E. nobilis</i> ; <i>E. dalrympleana heptantha</i>	<i>A. melanoxylon</i> ; <i>A. dealbata</i>	Heathy	Tussock Grass

Figure 1: Location of CRA survey sites. Site names for systematic sites only



SURVEY METHODS

Methods generally followed those stipulated by the NSW National Parks and Wildlife Service Biodiversity Co-ordination Unit (NPWS 1997) for the Comprehensive Regional Assessment (CRA) fauna surveys. Due to the specific aims of this project there were some alterations to do with site selection which followed slightly different priorities. Rather than sampling the moisture gradient within strata, at Coolah Tops the priorities were spatial separation of sites, and targeting habitats not well sampled by State Forests of NSW. This meant that considerable effort went into sampling land adjacent to the National Park. Sites were standard two hectare plots within a forest type. Diurnal birds, herpetofauna and frogs were censused as per standard methodology. Bird surveys comprised of a 20-minute search within each site. Diurnal herpetofauna covered a one-hectare sub-plot of the site, and frogs were searched for at all creek and swamp sites for one person hour. Spotlighting for arboreal mammals was undertaken at 11 two kilometer transects within a forest type and not necessarily relating to survey sites. Harp trapping for bats was carried out on site when an appropriate flyway existed, otherwise the forest type at the locality of a harp trap was noted. Hair tubing was not undertaken on all sites or transects. SFNSW surveys covered the Plateau using this method, therefore private and leasehold land not previously sampled was targeted. Coolah Tops has also been extensively surveyed for owls using State Forest methodology (Kavanagh 1995). Owl call playback census was therefore not a priority for this survey. Survey sites for owls aimed to fill gaps in the State Forest survey and were conducted off-park as much as possible. The same methods as Kavanagh (1995) were so that these data sets could be compared in the final analysis. Elliott trapping for small mammals was not necessarily site related. The principle aim with this method was to try to confirm the presence of Fawn-footed Melomys (*Melomys cervinipes*), and hence particular effort was directed towards likely Melomys habitat (see section on Elliott trapping).

STATISTICAL ANALYSIS

Differences in fauna assemblages between mapped forest types (SFNSW 1995) and landscape units (Binns 1997) were analysed using multivariate statistics. The statistical program PRIMER (Clarke and Warwick 1994) was used to perform non-metric MDS (Multi-Dimensional Scaling) and ANOSIM (Analysis Of Similarity). For the purposes of these analyses, it was assumed that all sites were independent from one another. All data was transformed using 4th root transformation which changes all species abundances to within the same boundaries. This prevents very abundant species having an undue influence on the outcome (Clarke and Warwick 1994). The fauna assemblages analysed were diurnal birds, diurnal herpetofauna, owls and arboreal mammals from nocturnal call playback, harp trapping and arboreal mammals from transect spotlighting. Statistical techniques were not applied to bat ultrasound recordings, elliot trapping, or nocturnal streamside searches as the low number of species precluded analysis of any kind.

To determine if there were differences in the fauna assemblages between forest types or landscape units, non-metric multidimensional scaling (MDS) was used to examine broad patterns in fauna. Then, ANOSIM (a procedure analogous to ANOVA but for multivariate data) was used to test for overall differences and pairwise comparisons of the fauna assemblages between forest types and landscape units. If forest types or landscape units are a reliable broad surrogate for fauna assemblages, then each type should support an identifiable and unique assemblage of species.

Where differences between forest types or landscape units were detected, an analysis of which species contributed to these differences was performed using SIMPER (Clarke, 1993). Although no formal hypothesis testing is possible with this exploratory procedure, it does give levels of similarity within forest types or landscape units, and levels of dissimilarities between forest types or landscape units. One-way analysis of variance (ANOVA) was used to test for significant differences between the bird, reptile and bat diversity and richness of NPWS Estate and other tenures. It was also used to examine whether there were significant differences between the bird, reptile and bat species richness or diversity in each landscape unit.

RESULTS

SPECIES RICHNESS AND DIVERSITY

For each site, the richness and diversity of species was calculated on the results of the diurnal bird census, diurnal herpetofauna and harp trapping. Richness was taken as the number of species present from each fauna group at a site, and diversity was calculated using Simpsons index. This accounts for the differing abundance of species present, as well as richness. ANOVA were conducted on richness and diversity with factors being landscape unit (Plateau, Slopes Woodland, Riparian, Swamp) and tenure (on park, off park). More species of Diurnal birds were found in Riparian (mean 16) than in Slopes Woodland (mean 11.6) ($F = 1.67$; $df. 3$; $p = 0.05$, Fishers LSD). Plateau and Swamp had species richness between these (means 12.7 and 15 respectively). Additionally, birds were significantly more diverse on park than off ($F = 4.79$; $df. = 1$; $p < 0.03$). The herpetofaunal community displayed no significant difference in diversity or richness with regards to landscape unit or land tenure. Significantly more species of bats were trapped in Riparian environments than in the Plateau Forest (one-way ANOVA, contrast analysis: $p = 0.01$), however there were no other significant differences in the bat community regarding landscape unit or land tenure.

DIURNAL BIRD CENSUS

A total of 83 species of birds were recorded during the survey period, including the Glossy Black-Cockatoo which is listed on schedule 2 of the TSC Act (Appendix 1). Nine raptors including Wedge-tailed Eagle, Little Eagle, Brown Goshawk and Brown Falcon were observed on the Plateau. Some species were only seen in the Box communities of the Slopes Woodland, for example the Black-chinned Honeyeater, Speckled Warbler and Fuscous Honeyeater.

An MDS performed on the data from Diurnal Bird Census is presented as Figure 3. Three sites were excluded from this analysis. These were WB13, and BS33 which were too close to other sites to be considered independent, and ST31 which had few species recorded due to adverse weather conditions at the time of the survey. Each point in the graph represents a survey site, and the relationship of sites to one

another in terms of their bird assemblages can be judged by the proximity of points to one another. ANOSIM comparing forest types showed that Silvertop Stringybark was significantly different to the Swamp and Yellow Box sites ($p = 0.05$ for both). The three Silvertop Stringybark (+15% other) sites had a high level of similarity (63.24). SIMPER showed the most typical birds were the Spotted Pardalote, White-browed Scrub-wren, Yellow-faced Honeyeater, Striated Thornbill and White-throated Treecreeper, and also the migratory Rainbow Bee-eater. This was significantly different to the bird community in Snow Gum ($p = 0.03$) and Mountain/Manna Gum ($p = 0.03$) sites (Table 3).

Figure 3: Bivariate scattergram from a non-metric MDS of Bray-Curtis similarities in bird assemblages from Diurnal Bird Census at Coolah Tops and surrounding areas. Stress of 0.26. Different colours represent Landscape Units. Blue = Riparian; Black = Plateau Forest; Red = Swamp; Green = Slopes Woodland.

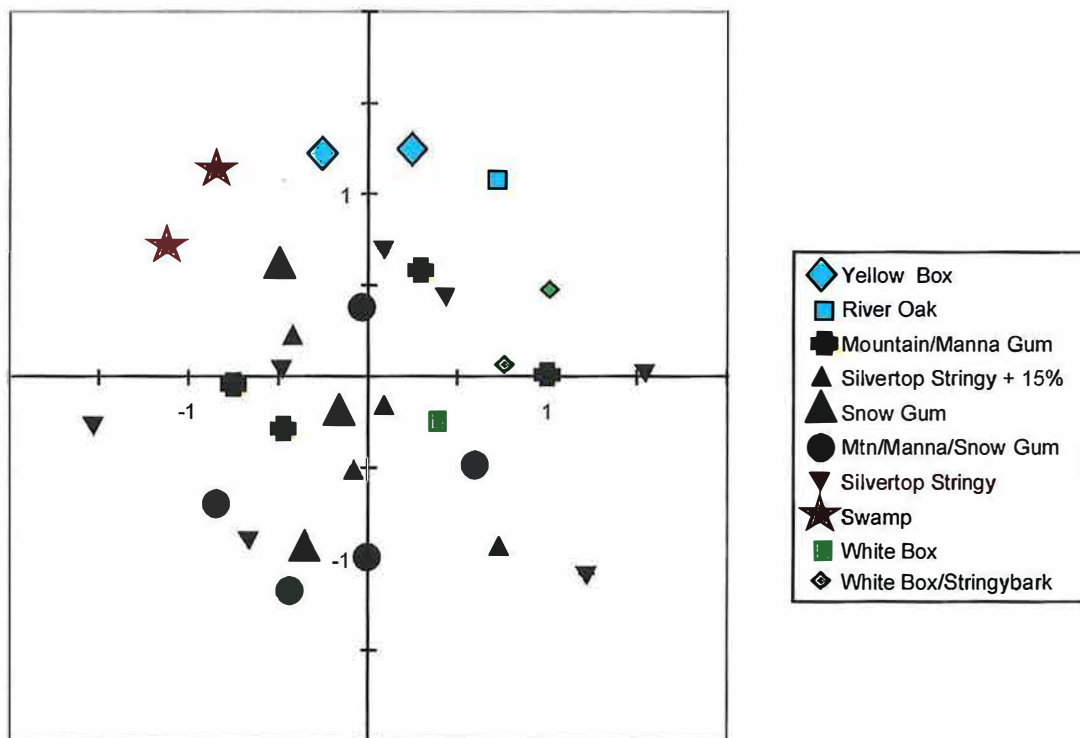


Table 3. Average dissimilarities (Bray-Curtis) in diurnal bird assemblages between forest types at Coolah Tops. Asterix denotes a significant difference (ANOSIM $p < 0.05$). Values in parentheses are average similarities within forest types.

	White Box/ Stringybark	Mtn/Manna Gum	Silvertop Stringybark + 15%	Snow Gum	Mtn/Manna/ Snow Gum	Silvertop Stringy	Swamp	Yellow Box
White Box/ Stringybark (56.37)								
Mtn/Manna Gum (55.65)	43.25							
Silvertop Stringybark + 15% (63.24)	50.40	45.79*						
Snow Gum (55.44)	55.06	44.26	43.81*					
Mtn/Manna/Snow Gum (50.67)	57.03*	47.04	46.34	44.57				
Silvertop Stringy (45.83)	49.33	49.75	48.62	49.21	52.22			
Swamp (56.04)	59.9	52.42	58.44	47.73	57.12	58.38*		
Yellow Box (53.78)	54.4	53.50	53.13	50.70	59.40	54.02*	50.19	

An ANOSIM was then performed to test for broad difference between the landscape units. Average dissimilarities and significant differences are indicated in Table 4. Plateau Forest was significantly different to both the Riparian and the Swamp bird communities.

Table 4. Average dissimilarities (Bray-Curtis) in diurnal bird assemblages between landscape units at Coolah Tops. Asterix denotes a significant difference (ANOSIM $p < 0.05$). Values in parentheses are average similarities within landscape units.

	Plateau Forest	Slopes Woodland	Riparian	Swamp
Plateau Forest (51.81)				
Slopes Woodland (60.15)	49.41			
Riparian (56.07)	54.50*	54.28		
Swamp (56.04)	55.69*	58.13	51.40	

TRANSECT SPOTLIGHTING

Five species of arboreal mammal were found during the present survey. In order of abundance these were the Greater Glider, Common Ringtail Possum, Sugar Glider, Common Brushtail Possum and Feathertail Glider (Appendix 3). Greater Gliders were exceptionally abundant on the Plateau. The other gliders, Sugar and Feathertail Gliders, were not found in the Slopes Woodland or Riparian environments. Common Ringtail Possum were found both on and off the Plateau. Common Brushtail Possum were only observed in the Slopes Woodland and lowland creeks.

The two kilometer spotlight transects were analysed for differences in arboreal mammals using non-metric MDS (figure 4) and ANOSIM. ANOSIM testing for differences between forest types was significant ($R = 0.41$; $p = 0.03$), however, pairwise comparisons showed no significant difference between any of the individual forest types. ANOSIM on landscape units, however, found the Plateau Forest as a whole (depicted in black in figure 4) was significantly different to the Slopes Woodland ($R = 0.728$, $p = 0.01$) (Table 5). No two kilometer transects were undertaken in Swamp or in Riparian vegetation.

Figure 4: Bivariate scattergram from a non-metric MDS of Bray-Curtis similarities in arboreal mammals from Transect Spotlighting at Coolah Tops and surrounding areas. Stress of 0.01. Blue = Riparian; Black = Plateau Forest; Red = Swamp; Green = Slopes Woodland.

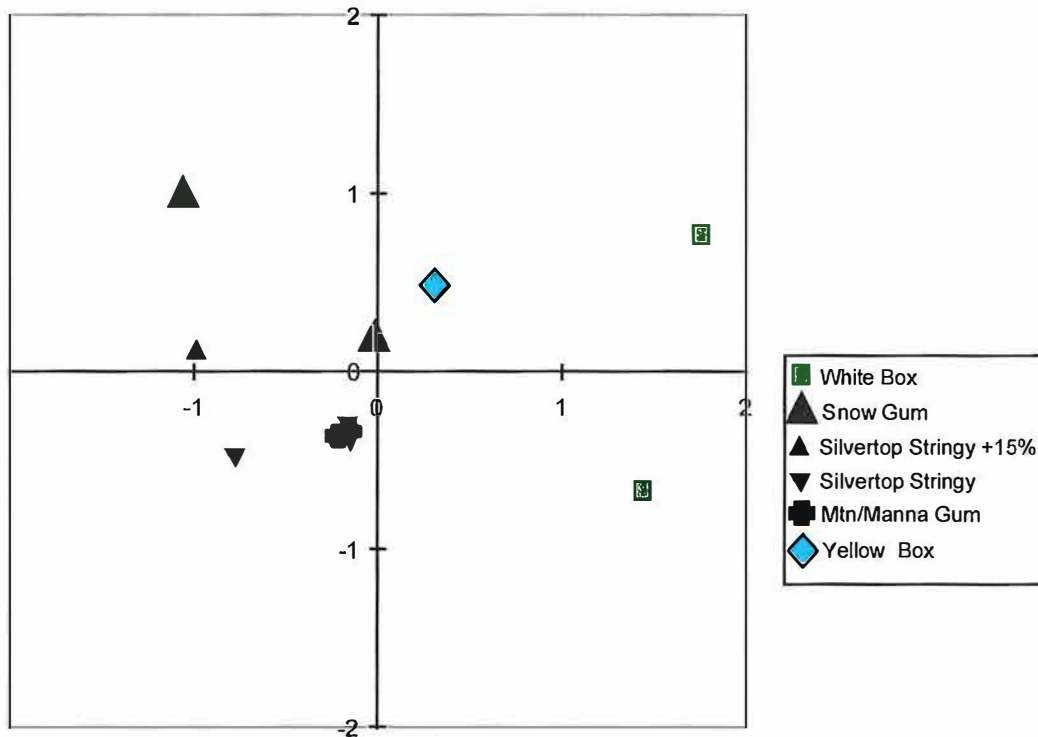


Table 5. Average dissimilarities (Bray-Curtis) in arboreal mammals from Transect Spotlighting between landscape units at Coolah Tops. Asterix denotes a significant difference (ANOSIM $p < 0.05$). Values in parentheses are average similarities within landscape units.

	Plateau Forest
Plateau Forest	(73.62)
Slopes Woodland	64.28*
	(50.16)

HARP TRAPPING

A total of nine species of bat were trapped in the current survey, mostly by harp trapping (Plate 2), but also by mist netting and trip lining over dams. There were three species of Wattled Bat (Large Pied Bat, *Chalinolobus dwyeri*, Gould's Wattled Bat, *C. gouldii*, Chocolate Wattled Bat, *C. morio*), two species of Long-eared Bat (Gould's Long-eared Bat, *Nyctophilus gouldi*, Lesser Long-eared Bat, *N. geoffroyi*), two Forest Bat (Large Forest Bat, *Vespadelus darlingtoni*, Little Forest Bat, *V. vulturnus*), the Eastern False Pipistrelle, *Falsistrellus tasmaniensis* (Plate 1) and Common Bent-wing Bat, *Miniopterus schreibersii* (Appendix 2). One other species, the White-striped Mastiff Bat, *Nyctinomus australis* was not trapped but identified as present by its distinctive audible call. Three of these species are listed on schedule 2 of the NSW Threatened Species Conservation Act. These are the Large Pied Bat, Eastern False Pipistrelle and Common Bent-wing Bat.

Differences in bat assemblages between sites are illustrated in figure 5. ANOSIM showed no significant differences between forest types, however a significant R value ($R = 0.28$; $p = 0.013$). Landscape units, however, were different in the bat communities with Riparian distinct from Plateau Forest ($p = 0.03$) and Swamp communities ($p = 0.05$) (Table 6).

Figure 5: Bivariate scattergram from a non-metric MDS of Bray-Curtis similarities in insectivorous bats from Harp Trapping at Coolah Tops and surrounding areas. Stress of 0.12. Blue = Riparian; Black = Plateau Forest; Red = Swamp; Green = Slopes Woodland.

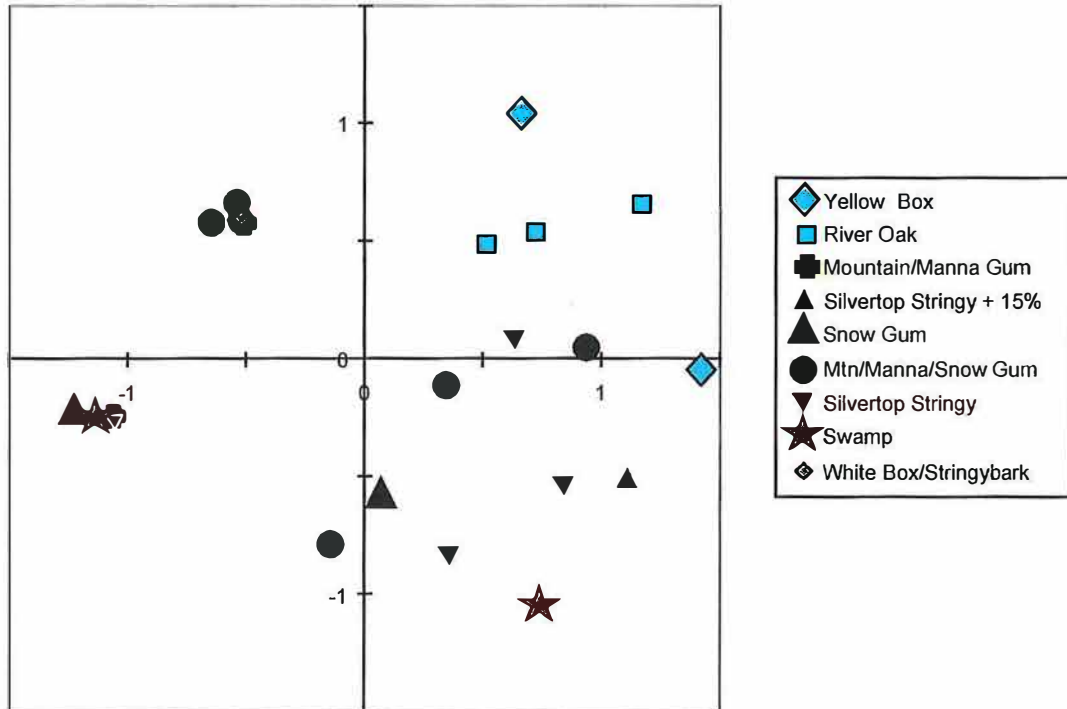


Table 6. Average dissimilarities (Bray-Curtis) in harp trapping results between landscape units at Coolah Tops. Asterix denotes a significant difference (ANOSIM $p < 0.05$, Global R = 0.28). Values in parentheses are average similarities within landscape units.

	Plateau Forest	Riparian	Swamp
Plateau Forest (53.26)			
Riparian (63.28)	58.24*		
Swamp (28.18)	48.50	67.17*	

BAT ULTRASONIC CALL ANALYSIS

Insectivorous bats were also sampled using ultrasonic call identification. Five species were identified through this method. All species identified by call, aside from the White-striped Mastiff Bat, were also trapped. Ultrasonic detection was undertaken at all systematic sites apart from SM03 due to a tape malfunction. Results for systematic sites are given in Table 7. Bat records were variable on the Plateau, but Slopes Woodland and Riparian sites had consistently low numbers of species identified. No statistical analysis was carried out on the results of the ultrasonic call analysis due to unequal effort and difficulties in separating some species.

Table 7. Results of bat ultrasound call analysis. Systematic Plateau sites ST09, S&23, MA06, Slopes Woodland sites WB13 and BS15 and Riparian YB21 and CA17 had no calls that could be positively identified and are hence not listed below.

	White-striped Mastiff Bat	Goulds Wattled Bat	Large Forest Bat	Little Forest Bat	Eastern False Pipistrelle	Nyctophilus spp.
CA18					X	
BS16	X					
YB22	X					
WB14	X					
SW19	X	X				
SW20	X					
SW87	X	X	X			
ST10	X					
ST11			X	X		X
ST12			X			
ST85			X	X		
ST89	X		X			
ST90	X	X	X	X	X	X
ST92	X	X	X	X		
S&24			X		X	X
SM04	X	X				
SM88	X	X	X	X		X
MA05	X					
MA86			X			
MA07			X	X		
MA08		X	X			
SG02	X		X			
SG93		X	X	X		
SG91	X	X	X	X	X	

NOCTURNAL CALL PLAYBACK

This survey technique included an hour of listening and spotlighting for arboreal mammals, as well as playing owl calls and listening for response. Five species of nocturnal birds were found. The Southern Boobook was very abundant with 48 records. Other species, in decreasing order of abundance, were the Tawny Frogmouth, Australian Owlet-nightjar, Powerful Owl and one record of the Masked Owl (Appendix 1).

Data collected during this survey by nocturnal call playback was statistically analysed excluding data collected by Kavanagh (1995). Fauna groups in the analysis were all nocturnal birds and arboreal mammals, which were sampled in the initial hour-long listening period. The MDS of this data is presented as Figure 6. ANOSIM between forest types found no significant differences but analysis of landscape units revealed some significant results (Global R = 0.61; $p = 0.001$). There is clear separation between Plateau Forest (in black) and Slopes Woodland ($p = 0.004$) and Plateau Forest and Riparian Forest ($p = 0.033$) (Table 8).

Figure 6: Bivariate scattergram from a non-metric MDS of Bray-Curtis similarities in arboreal mammals and owls from **Nocturnal Call Playback** at Coolah Tops and surrounding areas, March 1998 only. Stress of 0.08. Blue = Riparian; Black = Plateau Forest; Red = Swamp; Green = Slopes Woodland.

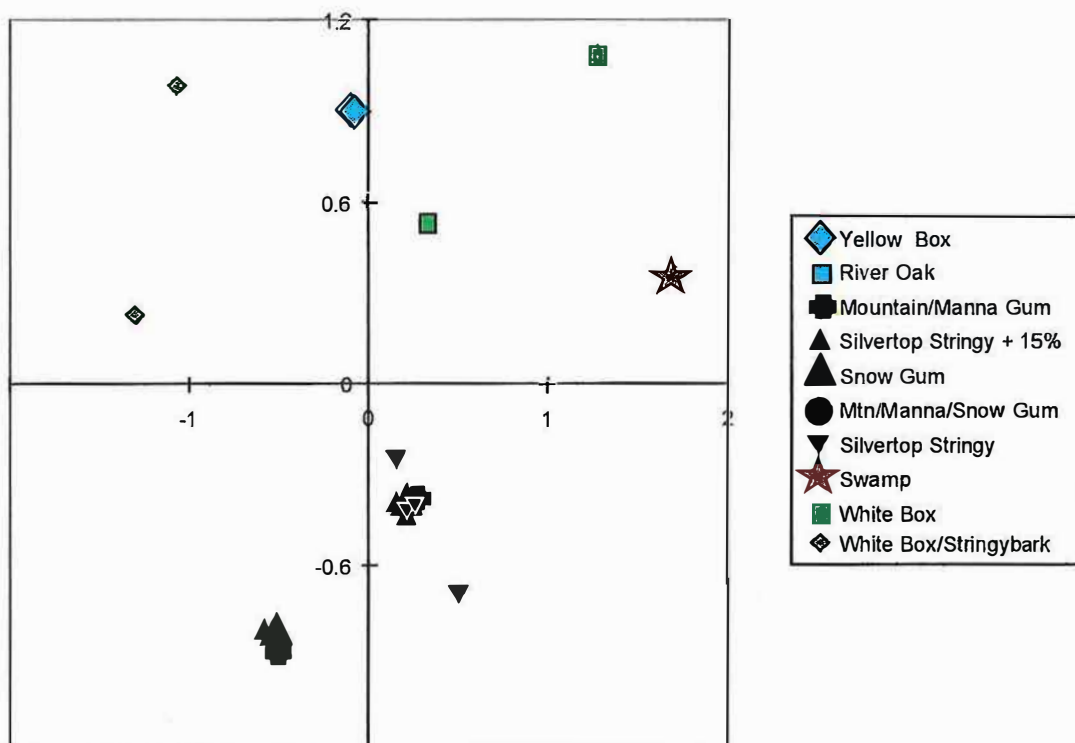


Table 8. Average dissimilarities (Bray-Curtis) in **nocturnal call playback** results between landscape units at Coolah Tops. Asterix denotes a significant difference (ANOSIM $p < 0.05$). Global $R = 0.633$, $p < 0.001$. Values in parentheses are average similarities within landscape units.

	Plateau Forest	Riparian	Slopes Woodland
Plateau Forest (78.10)			
Riparian (85.71)	47.54*		
Slopes Woodland (50.40)	50.94*	40.28	

ELLIOTT TRAPPING

Elliott trapping at 10 different localities over 636 trap nights yielded two species of small mammal, the Brown Antechinus (72 captures) and two captures of the introduced Black Rat (Table 9). In addition, three Cunninghams Skink (*Egernia cunninghami*) were caught incidentally at the Pinnacles site, WB14. Due to the low diversity of small mammals, no formal analysis was performed on these results.

Table 9. Captures of small mammals at sites at Coolah Tops from 636 trap nights using type A Elliott traps baited with peanut butter and rolled oats.

SITE or locality description	Easting	Northing	Date	Brown Antechinus (<i>Antechinus stuartii</i>)	Black Rat (<i>Rattus rattus</i>)
WB14, Pinnacles	216630	6489550	05/03/98	1	0
			06/03/98	1	0
			07/03/98	1	0
SW20, Swamp	218650	6487400	05/03/98	1	0
			06/03/98	1	0
			07/03/98	3	0
Snow Gum woodland	218800	6483250	04/03/98	2	0
			05/03/98	3	0
			06/03/98	1	0
			07/03/98	3	0
Norfolk Island Swamp	218900	6483200	07/03/98	3	0
Talbragar River headwaters	223650	6482400	12/03/98	1	0
			13/03/98	2	0
Snow Gum, Warung Forest Rd.	228400	6481500	11/03/98	4	0
			12/03/98	1	0
			13/03/98	1	0
YB22, Branch Crk	232900	6474950	11/03/98	5	0
			12/03/98	5	0
			13/03/98	4	1
Cattle Crk headwaters	233100	6476650	09/03/98	3	0
			10/03/98	1	0
Old Jemmys Crk Flora Reserve	234800	6475500	12/03/98	2	0
			13/03/98	6	0
MA06, Mountain/Manna Gum near Shepherds Peak	235680	6475420	11/03/98	6	0
			12/03/98	8	0
			13/03/98	3	1
Total				72	2

HAIR TUBES

Hair tubes were primarily laid in areas outside the boundaries of the National Park to avoid repeating work already undertaken by SFNSW. Results from this method were poor, with a very low strike rate. No hair tubing had previously been conducted in the Box communities of the Slopes Woodland. There were two 2-kilometer hair tube transects in the Slopes Woodland. One along Jemmy's Crk Rd in Yellow Box/Silvertop Stringybark, and another on the Ardgour property in White Box/Silvertop Stringybark. There were no returns from either of these transects. Sites off the Plateau in Slopes Woodland or Riparian environments were YB22, YB23, WB13, WB14, CA17, CA18 and BS15. Apart from some Cow (*Bos taurus*) nose bristles on site WB13, there were no results. On the Plateau, hair tubes were laid in a two kilometer transect along Gemini Rd through Silvertop Stringybark (+ 15% other) outside the boundaries of the park. There was one record of a Brown Antechinus (*Antechinus stuartii*) from this transect. Sites sampled on the Plateau were S&23 and S&24 also on Gemini Rd which had several strikes but no positive identifications. Also ST12 on the Talbragar River headwaters where there was hair from a Dog or Dingo (*Canis familiaris*) and possibly a Swamp Wallaby (*Wallabia bicolor*).

DIURNAL HERPETOFAUNA SEARCHES

Twenty species of reptile were detected in the current survey (Appendix 4). Half of these were not known previously from the Coolah Tops area. The records for the skink, *Lampropholis caligula*, are a significant western range extension for the species. The most abundant taxa was the skinks, with 14 out of the 20 species of reptile belonging to this group. Other than skinks there were two dragons (Jacky Lizard and Eastern Bearded Dragon), two snakes (Red-bellied Black Snake and Eastern Brown Snake), a single gecko (Robust Velvet Gecko). A single monitor (Lace Monitor) was observed in private land outside the National Park.

Sites where searches for diurnal herpetofauna were conducted are mapped in terms of their reptile assemblages in Figure 7. As with the birds, site WB13 was excluded as it was too close to other sites to be considered independent (Figure 1). There is little separation in terms of forest type. ANOSIM of reptile assemblages in forest types found no significant differences, however landscape units again were significantly different ($R = 0.221$; $p = 0.03$). The Plateau Forest was significantly different in terms of its reptile fauna than the Slopes Woodland ($p = 0.027$). Similarities within landscape units, and dissimilarities between landscape units are given in Table 10.

Figure 7: Bivariate scattergram from a non-metric MDS of Bray-Curtis similarities reptiles from *Diurnal Herpetofauna Searches at Coolah Tops and surrounding areas, March 1998 only*. Stress of 0.23. Blue = Riparian; Black = Plateau Forest; Red = Swamp; Green = Slopes Woodland.

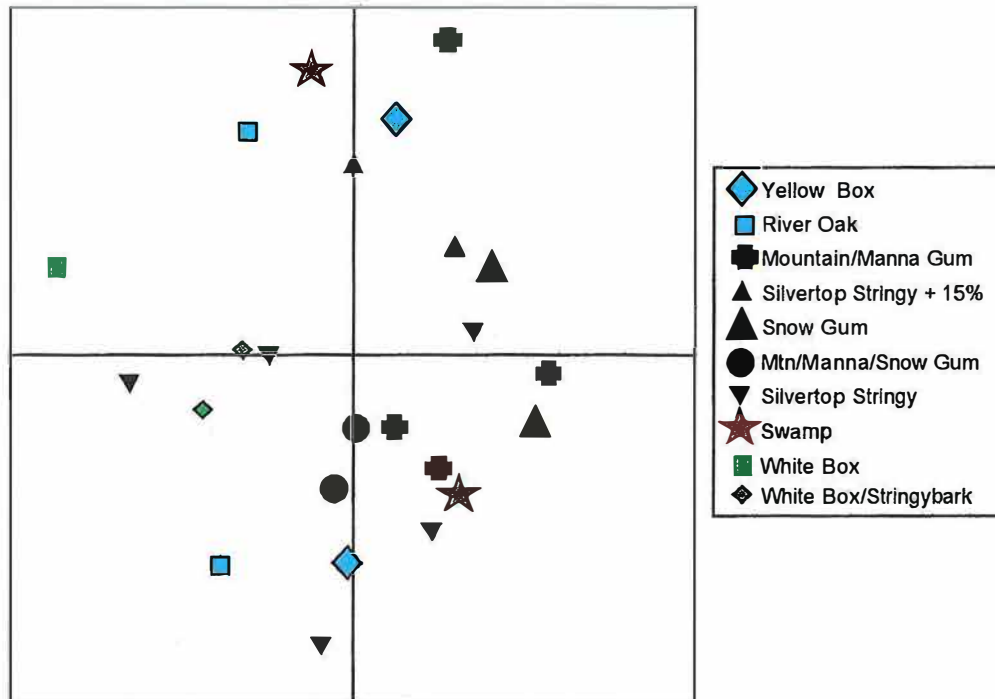
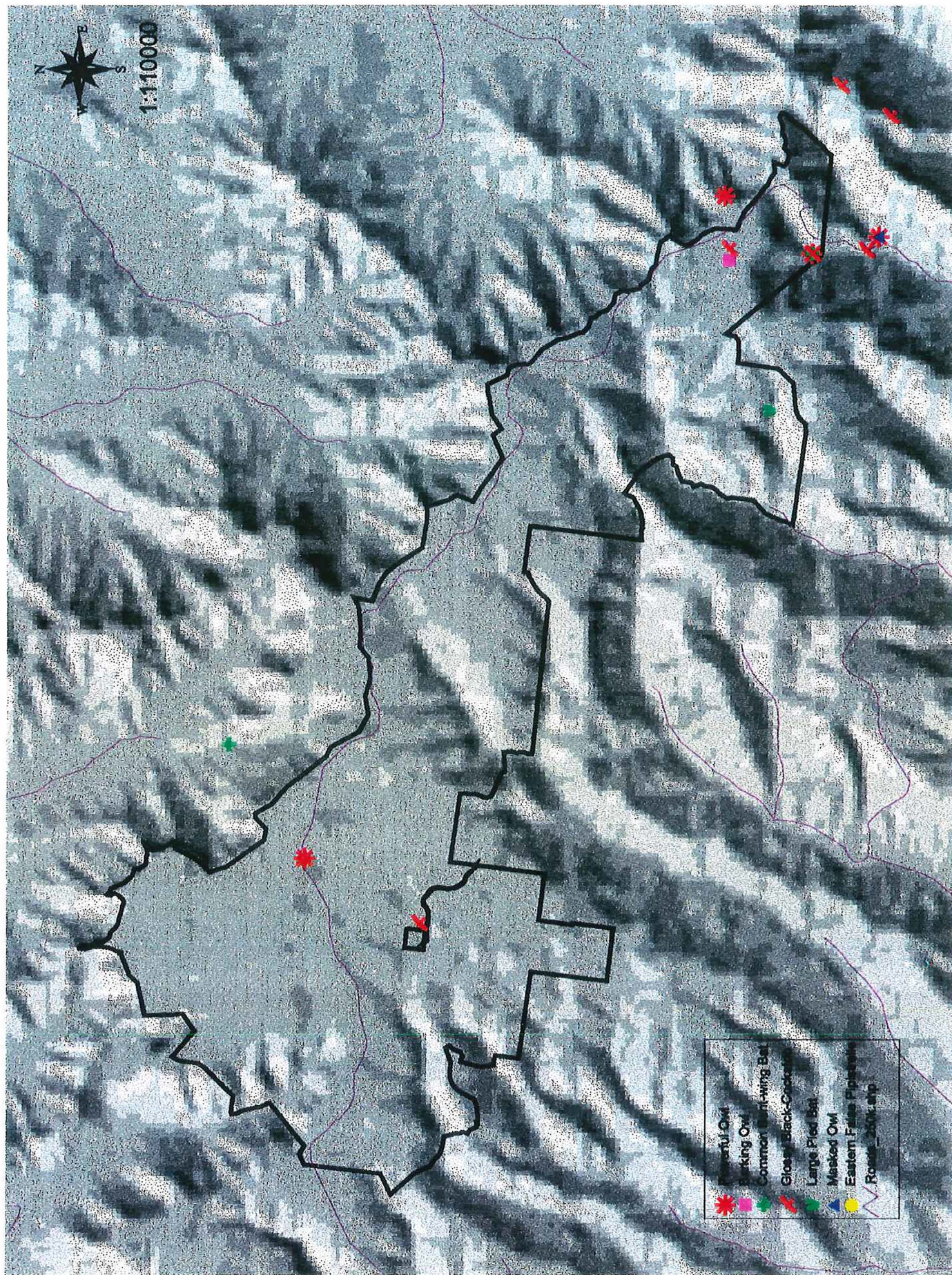


Table 10. Average dissimilarities (Bray-Curtis) in *diurnal herpetofauna* between landscape units at Coolah Tops. Asterix denotes a significant difference (ANOSIM $p < 0.05$). Values in parentheses are average similarities within landscape units.

	Plateau Forest	Slopes Woodland	Riparian	Swamp
Plateau Forest (49.40)				
Slopes Woodland (51.33)	61.90*			
Riparian (39.25)	56.45	60.15		
Swamp (30.29)	51.95	56.62	62.16	

Figure 2: Locations of species of regional significance recorded in Coolah Tops





Eastern False Pipistrelle (*Falsistrellus tasmaniensis*). TSC Act, Schedule 2.



Harp traps used to capture insectivorous bats across road near Norfolk Island Creek.



Cunningham's Skink (*Egernia cunninghami*).



Large Pied Bat (*Chalinolobus dwyeri*). TSC Act, Schedule 2. This species was only encountered once in the National Park.



Anomalopus leukartii is a legless lizard with no common name. One individual was found north of the National Park.



Lampropholis calignula (TSC Act, Schedule 2) is a small skink with no common name. Coolah Tops is a western range extension for the species. It was common within the National Park.

DISCUSSION

This section discusses the results of the survey, and the results of the statistical analysis for each of the fauna groups. Where they exist, differences between forest types or landscape units are addressed, and possible reasons for these differences are suggested. The management of endangered species is considered in a separate section, as is the management of feral species at Coolah Tops.

DIURNAL BIRDS

Generalists

Many of the bird species at Coolah Tops are generalists and likely to be found in any of the forest types or landscape units present. The most abundant species all fell into this category, including the Crimson Rosella, Striated Thornbill, Sulphur-crested Cockatoo, Spotted Pardalote and Yellow-faced Honeyeater with over 100 individuals of each being recorded across all forest types. Other species that did not appear to be restricted to any particular habitat were Pied Currawong, Red-browed Finch, Australian King-Parrot, White-naped Honeyeater, Brown-headed Honeyeater and White-eared Honeyeater. Also, amongst the small insectivorous birds the Buff-rumped Thornbill, Brown Thornbill, Grey Fantail, Spotted Pardalote, Striated Pardalote, White-browed Scrubwren and Silvereve were equally common throughout the Plateau, Slopes and Riparian environments (Appendix 1).

The super-abundance of one of these generalists deserves special attention. Large numbers of Sulphur-crested Cockatoo gathered at night in the canopy of the Plateau forest. Sulphur-crested Cockatoo are not usually common in forested country and it is possible that the high numbers within Coolah Tops National Park are an artefact of the surrounding farmland where they are prolific.

Plateau Forest

Forest types of the Plateau were found to exhibit some differences in their bird communities. The Silvertop Stringybark community 167/171 was found to have a significantly different bird assemblage to Snow Gum and Mountain/Manna Gum (Table 3). The results of the SIMPER indicate that while many species were common to all three communities, such as the Striated Thornbill, Spotted Pardalote and

White-browed Scrub-wren, there were a few species that were characteristic of a forest type. For instance, the Rainbow Bee-eater was present on two of the three Silvertop Stringybark (+15% other) sites, and nowhere else on the Plateau. This species favours open country (Pizzey & Doyle 1980), and at Coolah Tops it was predominantly found in such environments (Appendix 1). Its occurrence on the Plateau is curious, and perhaps simply an artifact of the time of year. In February-March the Rainbow Bee-eater is migrating and likely to be traveling through uncharacteristic habitat (Pizzey & Doyle 1980). Alternatively, the sites where it was found on the Plateau are the most recently logged (Figure 1). This disturbance may have influenced the species composition, favouring species that prefer open environments.

Other forest types of the Plateau were fairly homogenous in their bird communities. Aside from the universally present Thornbills and Pardalotes, species typical of the Plateau Forests were the Red Wattlebird, Satin Flycatcher, Noisy Friarbird and Bassian Thrush. As a landscape unit, the Plateau bird community was significantly different to the Riparian environments of the lowlands, and the Swamps (Table 4). Similarly the ANOVA on bird species richness shows Riparian and Swamp environments generally had higher species counts than Plateau or Slopes Woodland. This is presumably because Swamp and Riparian sites exhibit a confluence of species from creek and more open environments (Appendix 1).

Other interesting points about the Plateau bird community were that Little Lorikeet and Musk Lorikeet, while not restricted to this area, were concentrated around flowering Mountain Gum and Silvertop Stringybark. Raptors were also diverse on the Plateau with Wedge-tailed Eagles, Little Eagle, Brown Goshawk, Brown Falcon all observed.

Slopes Woodland

The Slopes Woodland landscape unit has a very distinctive suite of birds. These birds were generally typical of the western slopes and ranges, including Black-chinned Honeyeater, Fuscous Honeyeater, Noisy Miner, Double-barred Finch, Brown Treecreeper, Weebill and Speckled Warbler. Statistical analysis found no differences between the various Box forest types that comprise the Slopes Woodland

landscape unit (Silvertop Stringybark/Yellow Box, Silvertop Stringybark/White Box, White Box). Given the structural similarities of these woodlands, similarity in bird species is easily explained. The lack of any difference between the Slopes Woodland as a whole, and other landscape units (Table 4) is more perplexing, given the number of unique species. It seems, however, that most of these unique bird species were recorded outside the standard 20 minute surveys on which the statistical analyses are based, thus explaining the lack of significant difference. When standard survey data is examined in conjunction with results obtained opportunistically, Slopes Woodland is readily identified as unique.

Other open-country species seen in the woodland and semi-cleared country outside of the park were the introduced European Starling, the Eastern Rosella and Red-rumped Parrot, the Australian Hobby, Black-shouldered Kite, Nankeen Kestrel, and Whistling Kite. These species are often associated with natural and human created grasslands and roadsides (Pizzey & Doyle 1980).

Riparian

In areas where dense, mesic vegetation occurred along lowland creeks, bird assemblages were dominated by species that are common in forests of the east coast. Plant species along the creeks were often the same as those seen on the coast, such as *Pittosporum undulatum*. Bird species in this assemblage include Rufous Fantail, Golden Whistler, Brown Gerygone, Eastern Yellow Robin, Red-browed Finch and Superb Fairy-wren, reflecting the greater level of cover on these sites (Appendix 1). There were no significant differences in the bird communities of the forest types in the Riparian landscape unit (Silvertop Stringybark/ Yellow Box and River Oak). The Yellow Box bird assemblage, however, was significantly different from the Silvertop Stringybark (167) of the Plateau (Table 3) and subsequently overall, Riparian was different from the Plateau landscape unit (Table 4). This is because the Riparian environments had the majority of species present on the Plateau in addition to other species that require dense understorey vegetation.

The endangered Glossy Black-Cockatoo (Threatened Species Conservation Act 1995, Schedule 2) was observed in lowland Riparian environments. At Coolah Tops, the Glossy Black-Cockatoo feeds only on *Allocasuarina torulosa* which grow along creeks

and in dry woodland at lower elevations (Binns 1997). On Branch Creek, site YB22, two Glossy Black-Cockatoo were observed feeding on the fruit of this tree species (Figure 2). Glossy Black-Cockatoo were also recorded on the Plateau where the dense forest may be utilised for nesting or roosting. The *A. torulosa* stands that occur in Riparian and Woodland habitats are likely to be the most critical resource for the bird.

Swamp

The two swamp sites exhibited a diverse bird community that was significantly different to Silvertop Stringybark (167) and to the Plateau as a whole. The lack of canopy provided habitat for open country and the dense *Leptospermum* thickets contained Superb Fairy-wren and Red-browed Finch, and the adjacent forest contained the typical forest species and edge specialists.

Other

A Peregrine Falcon nesting site was recorded on a section of rocky escarpment in private land east of the park. Information on other bird species that could not easily be assigned to a landscape unit can be found in Appendix 1.

NOCTURNAL BIRDS

Three large forest owls were recorded during the present survey period. The Powerful Owl, listed on schedule 2 of the Threatened Species Conservation Act, was heard calling on four occasions, only one of which was inside the boundaries of the park (Figure 2). This complements data by Kavanagh (1995) who recorded one Powerful Owl near Norfolk Falls, and another two in the old Warung Tops Flora Reserve. Given the greater effort that has gone into surveying the Plateau for owls, the number detected in lowland environments is significant. The second species of large forest owl recorded was the Masked Owl. A Masked Owl in the vicinity of Jemmy's Creek in Yellow Box woodland can be added to Kavanagh's (1995) records of a Masked Owl around Norfolk Falls and another on the Plateau at the start of Jemmy's Crk Rd. The frequency of large forest owls detected in woodland, along with the differences in arboreal mammals, contributed to the significant differences in the nocturnal fauna assemblages between Plateau and lowland sites (Table 8).

The Barking Owl was perhaps the most significant species recorded in the present survey. A single Barking Owl was observed roosting during the day in a Snow Gum on Gemini Rd. This is a significant new record for the park with concern over the conservation status of this species in New South Wales. The three large forest owl at Coolah Tops are discussed in more detail in the section 'management of endangered species'.

The most common species of nocturnal bird was the Southern Boobook, with 48 recordings across all habitat types. Barn Owls were heard and observed on several occasions in or near their preferred habitat of open country and farmland (Pizzey & Doyle 1980). Australian Owlet-nightjar were recorded at seven localities both on and off the Plateau. Tawny Frogmouth were also common but were not recorded off the Plateau.

MAMMALS - ARBOREAL MAMMALS

Generalists

The only species of arboreal mammal that was in equivalent numbers on and off the Plateau was the Common Ringtail Possum (*Pseudocheirus peregrinus*). The proportion of Ringtail Possums, however, was much greater in the Slopes Woodland, due to the near absence of Greater Gliders (*Petauroides volans*). Three Feathertail Gliders (*Acrobates pygmaeus*) were recorded. One individual was found in Box Woodland at the Pinnacle Lookout on the Madgewick Property. Other observations were in taller Mountain/Manna/Snow Gum forest near Norfolk Falls Hut. Although known to occur in both woodland and forest, this omnivorous glider is said to prefer mature, wetter vegetation (Woodside 1995). Additionally, Woodside (1995) suggests that when Feathertail Gliders do occur in open forest, they may still require access to the resources of more complex forests to survive.

Plateau Forest

Greater Gliders were exceptionally abundant on the Plateau at Coolah Tops. A total of 553 Greater Gliders were observed during the twelve day survey period. The highest densities were found in old growth Mountain/Manna Gum forest at Spring

Hills, the property adjoining the eastern boundary of the park. Very high densities were also found in unlogged Silvertop Stringybark forest in the old Jemmys Creek Flora Reserve. Almost 100 Greater Gliders were observed in a single two kilometer transect through Spring Hills which is likely to rival the highest densities of Greater Gliders found anywhere in NSW. Interestingly, the Greater Gliders at Coolah Tops are noticeably smaller than elsewhere in the state. In contrast to the Plateau Forest, Greater Gliders were almost completely absent from Slopes Woodland. Similarly, also restricted to the Plateau was the Sugar Glider (*Petaurus breviceps*), a species common in open forest in the coastal region of eastern Australia. The presence of Sugar Gliders, the absence of Common Brushtail Possum and the abundance of Greater Gliders on the Plateau resulted in the significant differences found between the Plateau and lowland landscape units in the analysis of assemblages detected during transect spotlighting (Table 5) and nocturnal call playbacks (Table 8).

Slopes Woodland

Lowland vegetation types contained Common Ringtail Possums (*Pseudochierus peregrinus*) and Common Brushtail Possums (*Trichosurus vulpecula*), and far sparser densities of arboreal mammals generally. Common Ringtails were frequently observed on the plateau as well as on the slopes. Common Brushtail Possums, however, were not found on the Plateau. Kavanagh (1995) also did not find Brushtail Possums on the Plateau during arboreal mammal surveys at 30 sites.

MAMMALS - INSECTIVOROUS BATS

Generalists

Ten species of bat were identified through mistnetting and trip-lining over dams, harp trapping and ultrasonic call detection (Table 7; Appendix 2). Many of these were generalists and recorded in Plateau Forest, Slope Woodland, Riparian and Swamp landscape units. For example, two species of *Chalinolobus*, the Chocolate Wattle Bat (*C. morio*) and Gould's Wattle Bat (*C. gouldii*) were recorded in good numbers across all habitat types, as were Gould's Long-eared Bat (*Nyctophilus gouldi*), Lesser Long-eared Bat (*N. geoffroyi*) and White-striped Mastiff Bat (*Nyctinomus australis*).

The Little Forest Bat (*Vespadelus vulturinus*) was trapped on the Plateau and in lowland Riparian environments. This species was not trapped by Coles *et al.* (1995), but was common in their ultrasonic call analysis. Coles *et al.* (1995) did, however, record large numbers of a similar species, the Southern Forest Bat (*V. regulus*). We did not trap any Southern Forest Bats, and forearm measurements reported in Coles *et al.* (1995) suggest that they may have mistaken Little Forest Bats for Southern Forest Bats (C.R. Williams pers. comm.; G. Hoye pers. comm.). This may also explain the inconsistency between ultrasound and trapping results of Coles *et al.* (1995). Bat ultrasound recordings for this survey substantiated our trapping results, confirming the presence of Little Forest Bats and Large Forest Bats. There were several calls that were in the overlap between Large Forest Bats and Southern Forest Bats, however, there were no calls that were definitely Southern Forest Bats, calling into question previous records of this species at Coolah Tops.

The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) (Threatened Species Conservation Act 1995, Schedule 2) (Plate 1) was caught at two locations on the Plateau. One was caught trip-lining over the dam on Gemini Rd in Snow Gum Forest, and two individuals at the dam on Warung Rd at site SM04. Call detection also found it present at Silvertop Stringybark sites on Gemini Rd and near the Cox's Creek Picnic Area, and at the lowland site CA18 on Bundella Crk, on the Ardgour property (Table 7). Calls that were probably Eastern False Pipistrelle were also recorded at Tamalie Crk (site CA17), but this was not confirmed.

Plateau Forest and Swamp

The Plateau has a fairly homogenous bat fauna with no significant differences between any of the forest types of the Plateau, or the Swamp (Table 6). For this reason, in this section Plateau and Swamp will be discussed together. From the trapping results, the most abundant species on the Plateau was the Large Forest Bat (*Vespadelus darlingtoni*). Of the 89 Large Forest Bat caught, only one was in a lowland environment. Call analysis substantiated this pattern, with no Large Forest Bat identified from lowland areas (Table 7). The differential abundance of this species on and off the Plateau contributes to the significant difference between trapping results at Riparian and Plateau or Swamp communities (Table 6). In general, results from ultrasonic call detection at Plateau sites were quite variable. The greatest species

richness from bat calls were at Plateau sites, but in contrast to this, several Plateau sites had no calls that could be positively identified (Table 7). Overall, however, a far greater proportion of Plateau sites than Slopes Woodland or Riparian sites had calls on the tape. This may translate to a greater abundance of insectivorous bats at these sites, however, difficulties in separating the calls of some species, and the unequal effort directed towards the Plateau confound any assumptions we might make.

A single Large Pied Bat (*Chalinolobus dwyeri*) (Threatened Species Conservation Act 1995, Schedule 2) (Plate 4) was caught on the Plateau, outside the National Park in Silvertop Stringybark on Gemini Rd. This species has a distinctive call that should be readily identifiable if the species is present (C.R. Williams pers. comm.). No calls of this species were recorded in the present survey, nor was it detected by Coles *et al.* (1995). One record for Large Pied Bat does exist from near Norfolk Falls in 1986 by Glenn Hoye (cited in Coles *et al.* 1995). This cumulative evidence suggests the Large Pied Bat is rare within the Coolah Tops National Park and surrounding environments.

Riparian

The lowland Riparian environments had substantially and significantly different captures of bats to the Plateau and Swamps (ANOSIM; Table 6). Aside from the absence of the most common Plateau species, the Large Forest Bat, there was one species found only in Riparian environments (Appendix 2). This was the Common Bent-wing Bat (*Miniopterus schreibersii*) (Threatened Species Conservation Act 1995, Schedule 2) which was found only at lowland watercourses through Box Woodland. Coles *et al.* (1995) did not find this species during their survey but identified it as possibly occurring. This species has a call that is difficult to distinguish from some of the Large Forest Bat and hence results from call detection were unable to support these results. This species roosts in caves and forages in well forested valleys. For more information, see the section on Management of Endangered Species.

A note should be made that a possible ultrasonic call recording of the western ranging species, *Nyctophilus timoriensis* was taken at lowland Riparian site YB21 on Jemmys Creek. Coles *et al.* (1995) identifies this species as potentially occurring on the Liverpool Plains. Further trapping in lowland environments should clarify this.

OTHER MAMMALS

Generalists

There were many other species of mammal at Coolah Tops that were not surveyed by standardised techniques, these are discussed here. Some were generalists, being recorded in the Plateau, Slopes and Riparian landscape units, such as the Eastern Grey Kangaroo (*Macropus giganteus*). This was the only macropod that was common both in the Plateau Forest and in the Open Woodland of the slopes and lowlands. Another generalist, the Common Wombat (*Vombatus ursinus*) were recorded throughout the study area. The introduced predator, the Fox (*Vulpes vulpes*) was encountered frequently on and off the Plateau. No Dogs or Dingoes (*Canis lupis familiaris/dingo*) were observed, however hair identified as Dog or Dingo was collected in hair tubes on the Talbragar River. Scats from this species were also found throughout the area, though not enough information was collected to determine if they prefer any particular habitat.

Plateau

Two species of macropod appeared to be mostly confined to the forests of the Plateau (Appendix 3). They were the Swamp Wallaby (*Wallabia bicolor*) and Red-necked Wallaby (*Macropus rufogriseus*). Both of these species are known to prefer to relatively dense vegetation, with access to open areas (Calaby 1995; Merchant 1995). There was no census specifically dedicated to assessing the abundance of macropods, and no statistical analysis undertaken. Both of these species, however, appeared to be common across the Plateau.

Elliott trapping was only conducted on the Plateau, targeting Fawn-footed Melomys (*Melomys cervinipes*). This species was identified as likely present from hair analysis undertaken as part of State Forests surveys (Shields *et al.* 1995). A total of 636 trap nights across the Plateau revealed only two species: Brown Antechinus (*Antechinus stuartii*) and the introduced Black Rat (*Rattus rattus*), although a Bush Rat (*Rattus fuscipes*) was seen opportunistically on Warung Rd. Brown Antechinus were common in all habitats trapped, while only two Black Rats were found (Table 9). The absence of the Fawn-footed Melomys was not surprising. Redhead (1995) cites the known distribution of Fawn-footed Melomys as being the far north coast of NSW,

and coastal Queensland, although more recently they have been found in fauna survey work by State Forests in the Wattagans and Gloucester. If present at Coolah Tops it would be a considerable range extension, and given the extensive Elliott trapping that has been carried out in this survey and previously, it may be that the hair analysis from Shields *et al.* (1995) was not correct. Another record from a previous work that failed to be substantiated in the current survey was that of the Yellow-footed Antechinus (*Antechinus flavipes*). Although rocky environments where this species might occur were not targeted, traps were set along the basalt escarpment at the Pinnacles. Only Brown Antechinus (*A. stuartii*) and Cunninghams Skinks were caught at this site (Table 9).

Slopes Woodland

A fourth species of macropod, the Common Wallaroo (*Macropus robustus*), was only seen in Open Woodland off the Plateau. Evidence of a Short-beaked Echidna (*Tachyglossus aculeatus*) was found in Box Woodland on private property to the north of the park (site BS16). Of the introduced species, Feral Goats (*Capra hircus*) were found throughout the area, but particularly in rockier areas, and in the Slopes Woodland. Rabbits were seen occasionally in the open woodland and semi-cleared agricultural land.

Hair tubing was largely targeted towards the Slopes Woodland which had not been surveyed by this technique previously. Limited success was achieved with hair tubes, particularly in the lowlands, with few tubes capturing an analysable amount of hair. Box communities were often almost devoid of ground cover, possibly exacerbated by the dry weather and overgrazing by goats. The lack of ground cover is likely to translate into a lack of cover for small mammals, hence the poor success rate. The sites and hairtubes on the Plateau had slightly greater success, perhaps reflecting the greater ground cover in these areas, and a greater density of mammals.

Riparian/Swamps

Evidence of Feral Pig (*Sus scrofa*) activity was present at all swamps and along many of the creeks through the Plateau and Slopes. In particular, the Swamp site SW20 and the sites on Branch and Jemmys Creek (YB21 and YB22), appeared heavily used.

REPTILES

New Species

Coolah Tops was found to have diverse and interesting reptile fauna. Ten species not previously known from the area were found. These were the unusual skink *Lampropholis caligula* (no common name) (Plate 6); Tree Skink (*Egernia striolata*); Cunninghams Skink (*Egernia cunninghamii*) (Plate 3); Eastern Bearded Dragon (*Pogona barbata*); Robust Velvet Gecko (*Oedura robusta*); Wall Skink (*Cryptoblepharus virgatus*); Boulenger's Skink (*Morethia boulengeri*); *Anomalopus leukartii* (no common name) (Plate 5); *Pseudemoia pagenstecheri* (no common name) and *Hemiergis decresiensis* (no common name). Many of these new species were found on the previously undersurveyed rocky outcrops, while it appears that *Hemiergis decresiensis* may have been incorrectly identified in Shields *et al.* (1995) as *Saiphos equalis*, which was not found in the present survey. Additionally, Shields *et al.* (1995) found the Tussock Skink (*Eulepis entrecasteauxii*), however, the population that includes those found at Coolah Tops has now been reclassified as *Pseudemoia pagenstecheri* (Cogger 1996).

Plateau Forest

The various forest types of the Plateau were found to have a fairly homogenous reptile community (Figure 7; Appendix 4). Plateau Forest was typified by the presence of *Hemiergis decresiensis*, *Pseudemoia pagenstecheri*, Weasel Skinks (*Saproscincus mustelina*), *L. caligula*, and Red-throated Skinks (*Bassiana platynota*). These are all species of the eastern forests of NSW, and the absence of these species from the Slopes Woodland contributes to the significant differences found between these two environments (Table 10). *Lampropholis caligula* is a small litter dwelling skink (Plate 6) and its presence at Coolah Tops is an important western range extension for the species. It has escaped detection in past surveys probably because it is very similar to the Delicate Skink (*L. delicata*). Prior to this survey it was known only from Middlebrook Crk near Wingen (D. Andrew pers comm), Barrington Tops and Ben Halls State Forest (Swan 1990). A specimen of *L. caligula* from Coolah Tops has now been lodged with the Australian Museum. Interestingly, 55 *L. caligula* eggs were found on site MA06, suggesting that females communally nest (A.P. Dudley, pers. comm.). This behaviour is known from other *Lampropholis*, but has not been

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recorded previously for this species.

Slopes Woodland

Two of the more interesting species found were *Anomalopus leukartii*, a fossorial legless lizard (Plate 5), and Boulengers Skink (*Morethia boulengeri*). These were found only in the lowland *Eucalyptus albens* forest of the Madgewick property, to the north-west of the National Park. Both of these are species of the western slopes of NSW, and would not be expected in the more mesic forest of the plateau. Another species found only in woodland was the Wall Skink (*Cryptoblepharus virgatus*) which, though not confined to the west, prefers wooded habitats (Swan 1990).

Riparian and Swamp

Only two species of reptile were closely associated with water courses. The Water Skink (*Eulamprus quoyii*) was common along the dry stream beds. Also, one of the two species of snake found at Coolah Tops, the Red-bellied Black Snake (*Pseudechis porphyriacus*) was seen at SW19 at Norfolk Island Swamp, on Jemmy's and Branch Crk and Bundella Crk on the Ardgour property. This species is known to eat frogs and other reptiles and for this reason is often found near swamps, creeks and lagoons (Cogger 1996). It may be that the Red-bellied Black Snakes are preying on the abundant Water Skink population.

Rocky Outcrops

A final assemblage of reptiles is associated with the basalt outcrops that surround the plateau. Cunninghams Skink, Tree Skink, Whites Skink, Copper-tailed Skink (*Ctenotus taeniolatus*) and the Robust Velvet Gecko (*Oedura robusta*) were found living under rocks or in the crevices of the escarpment. The isolated nature of the Coolah Plateau means that these rock dwelling reptiles may have been separated from other population for some time. Cunninghams Skinks at Coolah Tops showed substantial differences in appearance to those from elsewhere (A.P. Dudley, pers. comm.). It is thus possible that that the Coolah Tops population is a different species or subspecies, but this will require further work to determine.

Other

Species that did not appear to be closely aligned with a particular habitat type were

the Jacky Lizard (*Amphibolurus muricatus*), Delicate Skink, Eastern Bearded Dragon (*Pogona barbata*) and Eastern Brown Snake (*Pseudonaja textilis*). One Lace Monitor (*Varanus varius*) was seen in *Eucalyptus albens* woodland on lowlands adjacent to the National Park.

FROGS

Only two species of frog were recorded during this survey, the Common Eastern Froglet (*Crinia signifera*) and the Brown Toadlet (*Pseudophryne bibronii*). The lack of frog activity is assumed to be a result of a prolonged dry period in the area (M. Sharp pers. comm.). The usual summer rains had not fallen, and many of the usually permanent lowland creeks were completely dry, and creekside groundcover vegetation was dead or dying.

Frogs are best censused after good rains in spring or early summer when both sexes are active, and males of many species are calling. The mating call of male frogs, from which they are easily identified, is species specific. By the time this survey was conducted, the nights on the plateau were cold, and it was too late in the season for many species of frogs to be detected. Both species that were found are tolerant of cold weather and are known to call in winter. Shields *et al.* (1995) found an additional four species: Peron's Tree Frog (*Litoria peronii*); Lesueur's Tree Frog (*Litoria lesueuri*); Eastern Banjo Frog (*Limnodynastes dumerilii*); Spotted Grass Frog (*Limnodynastes tasmaniensis*). It is assumed that all of these species were still present but not active due to the cool dry conditions at the time of the survey, and the drought of the preceding months.

All areas of swamp surveyed had Brown Toadlets (*P. bibronii*) calling in reasonable numbers. This species calls from under leaf litter or thick ground cover, several individuals being found within clumps of sphagnum moss at Coolah. This species is often found calling far from water, laying its eggs in leaf litter rather than in pools. There the eggs remain dormant until a flush of water washes them into a stream. The Common Eastern Froglet a resilient species, was calling at dams and some streams on the plateau. This species does require water to lay eggs, but is tolerant of adverse conditions and will call throughout winter.

MANAGEMENT ISSUES

Management of Endangered Species

Six endangered species were found at Coolah Tops and the adjoining properties. There were two species of owl, the Powerful Owl and Masked Owl, three species of insectivorous bat, the Large Pied Bat, Eastern False Pipistrelle and Common Bent-wing Bat and the Glossy Black-Cockatoo. Additionally, the Barking Owl has been nominated for listing under Schedule 2 of the NSW Threatened Species Conservation Act (1995) and is currently under review.

Three of the four records of the Powerful Owl were outside the boundaries of the park in Slopes Woodland. The single record of the Masked Owl was also outside the park, in Yellow Box/ Silvertop Stringybark near site YB21 on Jemmys Creek. This can be added to the records from Kavanagh (1995) of a Powerful Owl near Norfolk Falls, and two from the northern edge of the Plateau in the old Warung Tops Flora Reserve. Kavanagh (1995) also found a Masked Owl near Norfolk Falls, and one in the region at the start of Jemmy's Creek Rd. When these survey results are combined these large forest owls are seen to occur both on and off the Plateau. Given the greater effort that has gone towards sampling the Plateau, the four records from the Slopes Woodland are significant. There is clearly an abundance of potential prey on the Plateau, and so the off park records are curious. Each species is known to have large home ranges (Kavanagh 1995), which may include several landscape units. It may be that the capture of arboreal mammals is easier in the open Box Woodlands than in the dense Plateau Forests. It should be noted that this survey was conducted outside the peak breeding season for Powerful Owl when they are most likely to respond.

The Barking Owl, found roosting in a Snow Gum near Gemini Rd, is a new record for Coolah Tops. While this species is not currently listed as threatened, it is widely regarded to be rarer in NSW than any of the other large forest owls. It is predominantly a western species that prefers open forest and woodland (Slater *et al.* 1986; Kavanagh 1995). It is possible that the Barking Owl is using the dense Plateau Forest as a day roosting site, and foraging in preferred habitat that surrounds the

Plateau. Hence, the management of these endangered owls will clearly have to consider the role of the unconserved Box Woodlands as key habitat for the maintenance of Barking Owl populations at Coolah Tops.

As only a single Large Pied Bat was caught, in Silvertop Stringybark outside the park boundaries on Gemini Rd, little can be inferred about its habitat use in the area. One other record of a Large Pied Bat exists from the park from Norfolk Falls in 1986 (Cited in Coles *et al.* 1995). This species has a relatively easily recognised call that was not identified from any of the bat ultrasound tapings from this, or the survey by Coles *et al.* (1995). Large Pied Bat roost in caves during the day and forage at night below the forest canopy (Hoye & Dwyer 1995). The level of survey effort in both State Forests and the current survey suggests that the Large Pied Bat is very rare at Coolah Tops. The Eastern False Pipistrelle is at the western extent of its range at Coolah Tops. It is a large, highly mobile bat which is thought to forage above the forest canopy. It is known to roost in holes in eucalypts (Phillips 1995).

The third species of endangered bat found, the Common Bent-wing Bat, was only caught over water on lowland watercourses in the Coolah Tops area. Like the Large Pied Bat, this species roosts in caves, often in very large numbers (Dwyer 1995). At Coolah Tops it presumably roosts in caves in the basalt escarpment of the plateau, none of which are currently in the reserve. Common Bent-wing Bats are known to forage in valleys and along water courses (Dwyer 1995), perhaps explaining their absence from the Plateau.

Therefore, the roosting sites of two of these endangered bats, and the foraging habitat of one, are not in National Park. Management of local population of these species will have to account for critical habitat features, the escarpment and lowland creeks, that currently exist outside the park boundaries. While control over these lands is obviously limited while they exist in private ownership, perhaps visitation to any caves found to be important roosts or maternity sites should be discouraged.

Management issues surrounding the sixth endangered species also involves the lowland surrounding the Plateau. The Glossy Black-Cockatoo has a specialised diet, only feeding on certain species of *Allocasuarina*. At Coolah Tops only *A. torulosa* was

found and grows only in the poorly conserved Slopes Woodland - particularly the Yellow Box/ Silvertop Stringybark community. A pair of Glossy Black-Cockatoos were observed feeding at the site YB22 on Branch Creek. Glossy Black-Cockatoos were also seen on the Plateau, and they may use the forest for nesting and roosting. Consequently, management of this species within the park will have to take into account the management of their food source outside the park boundaries. Aside from the threat of land clearance on these unprotected lowlands, other factors to consider include grazing by cattle and feral goats which may prevent recruitment of young *A. torulosa*. Also, *Allocasuarina spp.* are well known to be fire sensitive. The ease with which this tree species is killed by fire has important implications for the management of the Glossy Black-Cockatoo.

Management of Introduced Mammals

This survey found six species of feral mammal found at Coolah Tops. These were the Black Rat (*Rattus rattus*), Rabbit (*Oryctolagus cuniculus*), Goat (*Capra hircus*), Pig (*Sus scrofa*), Dog (*Canis familiaris*), and Fox (*Vulpes vulpes*). The Black Rat and the Rabbit were both recorded in small numbers. Only three Black Rat were caught despite 636 Elliott trap nights. These low densities suggest that neither species is likely to be a problem at Coolah Tops. However, it is possible the Fox is suppressing Rabbit numbers, this should be taken into account when managing the sizable Fox population (Banks *et al.* 1998). The frequency with which Fox were encountered during this survey, despite a program of 1080 baiting, is cause for concern given that Fox are known to prey on native species.

No feral Dogs were observed during this survey period, however they are known from the area and Dog scats were collected on roads throughout the forest. Feral Goats (*Capra hircus*) were encountered throughout the area, but particularly in rockier areas, and in the Slopes Woodland where the damage they are causing to the understorey and ground cover is obvious. Heavy grazing by goats may affect populations of other species through alteration of the structure of the understorey and impeding regeneration of the overstorey. Goats are also known to compete with Brush-tailed Rock-Wallabies (*Petrogale penicilata*) for the use of caves. However, no Brush-tailed Rock-Wallabies were found at Coolah Tops in 1995 despite an intensive

search with aircraft of the escarpment (Shields *et al.* 1995). Feral Pig (*Sus scrofa*) are also a problem at Coolah Tops and in the surrounding lands. All swampy areas and water courses were heavily trampled and excavated. Pigs are also known to turn habitat logs and rocks to prey on small vertebrates, including snakes and frogs (Pavlov 1995).

CONCLUSIONS

This survey has demonstrated that:

1. Mapped forest types from SFNSW (1995) do not appear to be a reliable surrogate for fauna communities.
2. The different landscape units identified by Binns (1997) support unique and identifiable fauna assemblages.
3. Greater Gliders are found in exceptional numbers in Plateau Forest.
4. The Plateau supports a population of *Lampropholis caligula*, which represent a significant western range extension for this species.
5. Some priority species were recorded outside the boundaries of the park, and many of the priority species require habitats that are not represented within the current reserve.
6. The diversity and richness of fauna species in the National Park would be well augmented by the addition of habitats from Slopes Woodland and lowland Riparian environments.
7. The priorities for land acquisition based on fauna values clearly extends first to non-Plateau environments not already represented in the reserve.
8. Although the effect of disturbance was not analysed in this study, it would seem logical that where habitats already included in the Park are to be added, preference should be given to those least disturbed.

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Appendix 1- Birds at standard survey sites at Coolah Tops, and incidental (other) sightings.

	SG01	SG02	SM03	SM04	MA05	MA06	MA07	MA08	ST09	ST10	ST11	ST12	WB13	WB14	BS15	BS16	CA17	SW19	SW20	YB21	YB22	S&23	S&24	Other	Total		
Australasian Grebe																									4	4	
Australian Hobby																										1	1
Australian King-Parrot			1														2					2	2	1		5	13
Australian Magpie				1				3	1										10	1						15	31
Australian Owlet-nightjar													1	2					1							3	7
Australian Raven								1	2		1	1	1	1			1			1		1				7	17
Barking Owl																										1	1
Barn Owl														1					1							1	3
Bassian Thrush												1														2	3
Black-chinned Honeyeater																										1	1
Black-faced Cuckoo-shrike			1																3	1						11	16
Black-shouldered Kite																										2	2
Brown Falcon																										5	5
Brown Gerygone																					1	1					2
Brown Goshawk																										1	1
Brown Thornbill	1	3	1	2	1	2	1	4			5	5	1	4	2	2	1	1	1			1	1	2		34	75
Brown Treecreeper													1	1	3						1					7	13
Brown-headed Honeyeater						10			12				12				1									8	43
Buff-rumped Thornbill			1		3		1		5	6			1		2		3	3			3					8	36
Cicadabird																										2	2
Collared Sparrowhawk																										2	2
Common Starling																										1	1
Crimson Rosella	2	1	5	2	9	4	3	2	3	2	4	1	1	5	2	3			2	4	7		1			41	104
Double-barred Finch																										9	9
Dusky Woodswallow																				9						5	14
Eastern Rosella																										7	7
Eastern Spinebill			3	1	1	1	1	1	4			2	2	1			1	2	1	2	2	1	1	2		9	38
Eastern Yellow Robin	1	1				1					1			2				4	1	1		2				8	22
Fan-tailed Cuckoo																										1	1
Fuscous Honeyeater																2	1									2	5
Galah									2																		2
Glossy Black-Cockatoo								2	3																	6	13

Appendix 1: Birds at standard survey sites at Coolah Tops, and incidental (other) sightings (continued).

	SG01	SG02	SM03	SM04	MA05	MA06	MA07	MA08	ST09	ST10	ST11	ST12	WB13	WB14	BS15	BS16	CA17	SW19	SW20	YB21	YB22	S&23	S&24	Other	Total	
Golden Whistler					1															1	1				3	
Grey Butcherbird			1	1		1				1								1		2					6	13
Grey Fantail	5		2	1	1	1	2		1	2	1	4	1	3	8	2	1	1	2	2	1	1	1	1	29	72
Grey Shrike-thrush					1		1			1		1	1	1			1	1		1	1			1	7	18
Laughing Kookaburra												1	4				1	1					1		10	18
Little Eagle																									2	2
Little Lorikeet							2	2								2				4					14	24
Little Raven																									14	14
Masked Lapwing																									1	1
Masked Owl																					1					1
Mistletoebird	1		1										1	2			1		1					1	4	12
Musk Lorikeet	2	1	2			2	2	12	2		2					2			7	3		1	10	47	95	
Nankeen Kestrel																									8	8
Noisy Friarbird	1		2	1	1	2	2	6	1		16	1		1		1		1	1	1		1			34	73
Noisy Miner																									4	4
Peregrine Falcon							1																		1	2
Pied Butcherbird																									4	4
Pied Currawong		1	1	2		1		1	1		1	1	1	1				3	2			1	1	21	39	
Powerful Owl				1												1				1	1					4
Rainbow Bee-eater													1		5			1						10	57	74
Red Wattlebird	6	3	5	4	1	3	1	7	2	2	1	1		1				4	7			1	4	45	98	
Red-browed Finch				2									2				1	2	2	1	5				17	32
Red-browed Treecreeper	5	2	2		2		2	1	2	1	1	1					1			1			1		13	35
Red-rumped Parrot																									1	1
Richard's Pipit																									1	1
Rufous Fantail			1									3										1			1	6
Rufous Whistler																	2		1						1	4
Sacred Kingfisher		1																	1		1				2	5
Satin Bowerbird																									1	1
Satin Flycatcher					1																					1
Scarlet Robin							1							1										1	4	7
Shining Bronze-Cuckoo																									1	1

Appendix 1: Birds at standard survey sites at Coolah Tops, and incidental (other) sightings (continued).

	SG01	SG02	SM03	SM04	MA05	MA06	MA07	MA08	ST09	ST10	ST11	ST12	WB13	WB14	BS15	BS16	CA17	SW19	SW20	YB21	YB22	S&23	S&24	Other	Total	
Silvereye	2	3	13									5	1					8		2	4	2			19	59
Southern Boobook	1						2		2	1				1			1	4		2	1			1	32	48
Speckled Warbler																									2	2
Spotted Pardalote	1	1	1	1	7	2	2	4	3	2		3	3	5	8	8	3	1	2	2	1	4	3	41	108	
Spotted Quail-thrush		4				1				2															8	15
Striated Pardalote			1	1	4	1	1	1				1		1		2	2	1	1			1	2	2	14	36
Striated Thornbill	4	3	3	8	2	10	3	4		6	13	4	1	2	6	3			12	5	1	3	3	46	142	
Sulphur-crested Cockatoo	5	1	1	11	1	4	1	3	7	4	1		3	1		2		2	1			3	3	70	124	
Superb Fairy-wren		3	3		3	2	1	1				1					1	2	4	2	1	2		11	37	
Tawny Frogmouth				1		1												1	1						18	22
Tree Martin																			2						26	28
Wedge-tailed Eagle					1					3		2		4		2		2	2						16	32
Weebill													3													3
Welcome Swallow																			3						8	11
Whistling Kite																									2	2
White-browed Scrubwren	3	3	3	4	5	7	1	2			4	3	1	3			2	3	2	2	2	5	3	26	84	
White-eared Honeyeater		1	1		4		3		1	1		1	3	2	7		1	2	3		1				6	37
White-faced Heron																									2	2
White-naped Honeyeater		2	1		7	1	1		5	1		2	1		11	3	2		4	2	5	1			35	84
White-throated Needletail			2						3																61	66
White-throated Treecreeper	2	1	1	1	2		1	1	1	2	1	2	2	4	1	2	2	2	1			1	2	2	18	52
White-winged Chough										10															20	30
Yellow-faced Honeyeater		4	2	2	9	2	2	3	2	3		5	2	2	2	8	2	5	9	1	1	4	3	54	127	
Yellow-tailed Black-Cockatoo						1	1																		8	10
Grand Total	42	44	58	46	78	49	41	65	60	50	54	53	49	52	52	51	39	71	91	50	40	39	55	1099	2328	

Appendix 2: Bats caught in traps at standard survey sites and additional trap sites (other) at Coolah Tops.

		SG01	SG02	SM03	SM04	MA07	BS16	CA17	SW19	SW20	YB21	YB22	S&23	Other	Total
<i>Chalinolobus dwyeri</i>	Large Pied Bat													1	1
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat				5					5				9	19
<i>Chalinolobus morio</i>	Chocolate Wattled Bat				4			1		3				34	42
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle				2									1	3
<i>Miniopterus schreibersii</i>	Common Bent-wing Bat											4		2	6
<i>Nyctinomus australis</i>	White-striped Mastiff-bat	2	1		1	1	2	1	3		1	1	1	6	20
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat			1				3						19	23
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat							3				1		6	10
<i>Vespadelus darlingtoni</i>	Large Forest Bat				58					3		2		26	89
<i>Vespadelus vulturnus</i>	Little Forest Bat				3			3				3		33	42
Grand Total		2	1	1	73	1	2	11	3	11	1	11	1	137	255

Not all data processed?
Why not?
DA.

Appendix 3: Mammals other than bats recorded at systematic sites at Coolah Tops, and incidental records (other).

	SGD1	SGD2	SM03	SM04	MA05	MA06	MA07	MA08	ST09	ST10	ST12	WB13	WB14	BS16	CA17	SW19	SW20	YB21	YB22	S&23	S&24	Other	Total	
<i>Acrobates pygmaeus</i> Feathertail Glider																						3	3	
<i>Antechinus stuartii</i> Brown Antechinus						17					3		3					5		14			31	73
<i>Rattus fuscipes</i> Bush Rat																							1	1
<i>Canis familiaris</i> Dingo and Dog (feral)																							1	1
<i>Capra hircus</i> Goat (feral)		2					1					2	1		2		2						14	24
<i>Macropus giganteus</i> Eastern Grey Kangaroo								1				1			3	5							45	55
<i>Macropus robustus</i> Common Wallaroo												2											8	10
<i>Macropus rufogriseus</i> Red-necked Wallaby				1	3			2	3										1		1		15	26
<i>Oryctolagus cuniculus</i> Rabbit																							6	6
<i>Petauroides volans</i> Greater Glider	5	4				7	19		5	4	6						2	1		3	6	491	553	
<i>Petaurus breviceps</i> Sugar Glider									1							1							17	19
<i>Pseudocheirus peregrinus</i> Common Ringtail Possum													1						1				53	55
<i>Rattus rattus</i> Black Rat						1														1			0	2
<i>Sus scrofa</i> Pig (feral)					1			1								1	1	1	1				5	11
<i>Tachyglossus aculeatus</i> Short-beaked Echidna														1									0	1
<i>Trichosurus vulpecula</i> Com. Brushtail Possum													1		1								5	7
<i>Vombatus ursinus</i> Common Wombat			1				1	1	1							2		1		1	1		17	26
<i>Vulpes vulpes</i> Fox									1								1	1				1	10	14
<i>Wallabia bicolor</i> Swamp Wallaby			1										1							1			15	18
Grand Total	5	6	2	1	4	25	22	4	11	4	9	5	8	1	6	10	10	6	17	5	8	737	906	

Appendix 4: Reptiles found at standard sites at Coolah Tops, and incidental records (other).

	SW19	ST09	SM03	SW20	SM04	ST04	MA05	WB13	CA17	WB14	BS15	CA18	ST11	SG01	ST12	S&23	S&24	MA06	YB21	YB22	MA07	MA08	SG02	BS16	ST36	other.	Total		
Jacky Lizard (<i>Amphibolurus muricatus</i>)						2		1																			5	11	
<i>Anomalopus leuckartii</i>																												1	1
Red-throated Skink (<i>Bassiana platynota</i>)				1			1								1					2		4	3	1		1	7	21	
Wall Skink (<i>Cryptoblepharus virgatus</i>)								1	1	2																		4	
Copper-tailed Skink (<i>Ctenotus taeniolatus</i>)										3		1								1					1	6	3	15	
Cunninghams Skink (<i>Egernia cunninghami</i>)						2				4		1														1	5	13	
Tree Skink (<i>Egernia striolata</i>)										1																		4	5
Whites Skink (<i>Egernia whitii</i>)										1																1	5	7	
Eastern Water Skink (<i>Eulamprus quoyii</i>)		1	3		1							2	1		15		4		2	3				2			6	40	
<i>Hemiergis decresiensis</i>			1	3	2	5	1	6	1			3	4	2		3	1			2			2		4	1	8	49	
<i>Lampropholis caligula</i>				1				1											59			1		1			1	64	
Delicate Skink (<i>Lampropholis delicata</i>)			3									1																4	
Boulenger's Skink (<i>Morethia boulengeri</i>)																												1	1
Robust Velvet Gecko (<i>Dedura robusta</i>)																												1	1
Eastern Bearded Dragon (<i>Pogona barbata</i>)																												2	2
Red-bellied Black Snake (<i>Pseudechis porphyriacus</i>)	1											2								3	2							2	10
<i>Pseudemoia pagenstecheri</i>		22	1	4	3		1							5	8	1				1		2	3	8		2	9	70	
Eastern Brown Snake (<i>Pseudonaja textilis</i>)																												1	1
Weasel Skink (<i>Saproscincus mustelinus</i>)												1			2	3	2			1	1	1	2	3			4	20	
Lace Monitor (<i>Varanus varius</i>)																												1	1
Grand Total	1	24	10	8	9	5	9	3	1	14	3	12	3	5	29	5	6	59	12	6	8	10	15	5	12	62	340		

ADDENDUM TO
**THE VERTEBRATE FAUNA OF
COOLAH TOPS**



DECEMBER 1998

A report compiled for the National Parks and Wildlife Service Mudgee Sub-District by the
Sydney Zone Comprehensive Regional Assessment (CRA) Unit

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SUMMARY

A follow-up survey of the vertebrate fauna of Coolah Tops National Park was conducted between the 14th and the 18th of December 1998. This survey complements the NPWS fauna survey done in March 1998. The objectives of this project were to fill gaps in the existing survey effort, both temporal and spatial. This involved:

1. revisiting sites previously surveyed for amphibians, and conducting nocturnal streamside searches at new sites to reassess the frog populations under non-drought conditions
2. collection of predator scats for hair analysis
3. relocating a known roost site of the Barking Owl, and searches for additional roost sites for the collection of pellets
4. sampling the streams of the Coolah Tops plateau and slopes for aquatic vertebrates

The findings of this survey corroborate those of the March 1998 survey. The wet weather of this trip was significantly better for sampling the frog fauna of the Park. In total, 23 systematic sites were censused for their amphibian fauna. Six species of frog were found, four more than on the previous survey. A new species for the National Park is Verreaux's Tree Frog (*Litoria verreauxii*), which was found in a dam on Warung Rd.

Twelve species were identified from hair and other remains in scats and pellets. Foxes (*Vulpes vulpes*) were the main predators, consuming 10 different species of mammal. Over 84% of Fox scats contained the remains of native species, mostly *Petaurus breviceps/norfolkensis* (probably Sugar Gliders), and Swamp Wallaby (*Wallabia bicolor*). A bandicoot, almost certainly the Long-nosed Bandicoot (*Perameles nasuta*) was also identified from within Fox scats. This is an important record as bandicoots have not been observed in previous surveys and this record is at the extreme western edge of their range.

The Barking Owl roost site on Gemini Road was found to be still in use. Pellets

INTRODUCTION

This survey aimed to complement the work done in the main fauna survey in March 1998. Firstly, gaps in the existing survey effort were identified. A major gap appeared to be in the sampling of the amphibian fauna. Frogs are best sampled in wet weather conditions when the males are calling, and both sexes are active. The fauna survey of Coolah Tops and surrounding areas in March 1998 was conducted at the end of an extended drought period. As a result of this, only two species of frog were recorded, the Common Eastern Froglet (*Crinia signifera*) and Brown Toadlet (*Pseudophryne bibronii*). A survey by Shields *et al.* (1995) in 1994 was also conducted in fairly dry conditions, with only an additional four species found. These were the Eastern Banjo Frog (*Limnodynastes dumerilii*), Peron's Tree Frog (*Litoria peronii*), Spotted Grass Frog (*Limnodynastes tasmaniensis*) and Lesueur's Tree Frog (*Litoria lesueuri*). Both reports mention that additional frog species are potentially to be found if sampling was conducted under more appropriate conditions. Preceding this follow-up survey Coolah Tops was experiencing above average rainfall, hence conditions were much better for sampling the frog communities.

Another source of data that remained relatively unexplored at Coolah Tops was predator scats and pellets. Many mammals can be readily identified to species level through analysis of microscopic cross-sections of hair and other remains in scats and pellets. Information can be gained on what prey species inhabit the area, and what are the main species that constitute the diet of predators. This may be particularly important in areas where there are a high number of introduced predators, such as Foxes or Cats. Coolah Tops has previously been identified as having a large Fox population (see March 1998 report) and information on their diet may help with management strategies. We are also able to get information on our native predators, such as the Owls. The March 1998 survey identified a roost site for the Barking Owl off Gemini Rd in the eastern end of the park. The Barking Owl has recently been added to the NSW *Threatened Species Conservation Act* (TSC Act). Few roost sites are known for this species in NSW, and little is known about its diet (Rod Kavanagh, pers comm). Pellets from this roost site were collected and the contents analysed with the view to understanding the diet of this species in the vicinity of Coolah Tops.

METHODS

SURVEY METHODS

The first half of the 5-day survey concentrated on the western portion of the park, and the second part investigated the eastern section of the park. Census techniques followed BSCU guidelines for the CRA fauna surveys (NPWS 1997). Nocturnal work was conducted with two teams working consecutively on nocturnal streamside searches with a total of one person-hour spent at each site. Four types of amphibian habitat were sampled. These were 1) fast flowing steep drainages (eg. Branch Ck; Munmurra River headwaters) 2) shallow, flat creeks (eg. Jemmy's Ck; Tamalie Ck headwaters) 3) swamps 4) dams. At each locality, the start time, temperature and humidity were recorded. The AMGs of nocturnal streamside searches are given in appendix 1.

Roads and rocky outcrops were searched for predator scats and owl or raptor pellets. Scats and pellets were bagged and labelled with relevant details. Samples were sent to Barbara Triggs for analysis of hair and bone material.

Streams were sampled for aquatic fauna with standard mesh fish traps, and traps made from inverted PET bottles. Sites were selected on the Plateau and on the slopes and lowland watercourses in an attempt to sample the full diversity of aquatic fauna in the area. The watercourses sampled are listed in Table 3. Reference specimens of fish species were preserved and lodged with the Australian Museum.

Additional searches carried out included Diurnal Herpetofauna Searches, and nocturnal searches of rocky outcrops for geckos. In addition to the systematic survey techniques, all fauna sighted incidentally were recorded and are listed in Appendix 2.

Table 1: Frog records from the 23 nocturnal streamside searches. Site names follow those used in the March 1998 report for existing sites, or are named systematically for new frog sites (FROG 1-15). Habitat types are coded: 1) fast = fast flowing steep drainages, 2) shallow = shallow, flat creeks; 3) swamps 4) dams. Full site details are given in Appendix 1.

Site name	Habitat	Brown Toadlet	Common Eastern Froglet	Peron's Tree Frog	Lesueur's Tree Frog	Verreaux's Tree Frog	Eastern Banjo Frog
SM04	dam		11	1			
FROG1	shallow		5	4			
FROG2	shallow	3	30				
SW19	swamp		12	2			
ST10	shallow		15				
FROG3	fast		8				
FROG4	shallow		3				
FROG5	swamp		30				1 (tadpole)
SW20	swamp	1	10	2			
FROG6	shallow		10				
FROG7	fast		2				
ST12	fast						
FROG8	dam		34	1			
FROG9	swamp		300+	3			
FROG10	dam		100				
FROG11	fast						
FROG12	dam		15	3			
YB22	fast						
FROG13	shallow		6				
FROG14	shallow		3		2		
MA05	shallow		30				15 (tadpoles)
SM04	dam		15			10	
FROG15	dam		17				



Plate 1: Common Eastern Froglet (*Crinia signifera*), Tamalie Crk headwaters. This species was the most common frog within Coolah Tops National Park. It was present within all potential frog habitats surveyed.



Plate 2: Eastern Banjo Frog (*Limnodynastes dumerilii*), Warung Rd. Tadpoles of this species were found in some of the slower flowing streams on the Plateau.



Plate 3: Metamorph Verreaux's Tree Frog (*Litoria verreauxii*), dam on Warung Rd. This species is a winter breeder, and is never found far from permanent water.



Plate 4: Dam, Warung Rd where Verreaux's Tree Frogs were found. This is the only known locality of this species at Coolah Tops. Recorded calling at this dam were also Peron's Tree Frogs, and Common Eastern Froglets.



Plate 5: Lesueur's Tree Frog (*Litoria lesueurii*) Jemmy's Creek. Two individuals of this species were found at Jemmy's Creek. No Lesueur's Tree Frog were found on the Plateau.



Plate 6: Jemmy's Creek near where the Lesueur's Tree Frog were found. This photograph depicts typical habitat of the species. No other species of frog were found at this creek.



Plate 7: *Pseudemoia pagenstecheri*, Norfolk Island Creek. This newly described species is common within the Park at Coolah Tops.



Plate 8: *Hemiergis decresiensis*, Norfolk Island Creek. The individuals of this species found at Coolah Tops are unusual due to their dark colouration and lack of markings. They are common within the Park.

PREDATOR SCAT AND PELLET ANALYSIS

Twelve prey species were identified from hair and other remains in predator scats and pellets. The results for this are presented as Table 2. Barbara Triggs identified hair from one scat as definitely Bandicoot, and probably the Long-nosed Bandicoot (*Perameles nasuta*). Identification of hairs as belonging to bandicoot is reliable, however, distinguishing between the species can be more difficult. There is one other species that could conceivably occur in the area, the Northern Brown Bandicoot (*Isoodon macrourus*), though given that its known range is significantly to the east of Coolah Tops, it is considered that Long-nosed Bandicoot is the most likely.

Table 2: A summary of predators and prey species identified from scats and pellets at Coolah Tops National Park. An additional species, Eastern Grey Kangaroo, was identified from hair collected on a fence. The number of scats in which a species was found is given in parentheses.

Prey Species	Barking Owl (<i>Ninox connivens</i>)	Wedge-tailed Eagle (<i>Aquila audax</i>)	Fox (<i>Vulpes vulpes</i>)
Bandicoot			x (1)
Brush-tailed Possum			x (1)
Feathers	x		
Goat			x (2)
Greater Glider			x (2)
Rabbit		x (1)	x (2)
Red-necked Wallaby			x (1)
Ring-tailed Possum			x (2)
Sheep		x (2)	
Sugar Glider	x (several)		
Sugar/Squirrel Glider			x (7)
Swamp Wallaby			x (5)
Wombat			x (1)

AQUATIC FAUNA CENSUS

Five species of fish were identified from the trapping in creeks in the National Park. These were the Ornate Mountain Galaxias (*Galaxias olidus*), Cox's Gudgeon (*Gobiomorphus coxii*), Short-finned Eel (*Anguilla australis*) and Long-finned Eel (*Anguilla reinhardtii*). An additional species identified was the freshwater crayfish *Cherax destructor*, which was common throughout the streams of the Plateau.

Table 3: Creeks trapped or spotlit during the survey, and the species of aquatic vertebrate recorded. Most sites were on the plateau and were in headwaters and tributaries of the rivers and creeks listed. A cross indicates the presence of a species.

Creek name	Number of sites	Ornate Mountain Galaxias	Cox's Gudgeon	Short-finned Eel	Long-finned Eel
<i>Plateau</i>					
Bald Hill Creek headwaters	2	x			
Cattle Creek headwaters	1			x	
Cox's Creek headwaters	2	x			
Munmurra River Headwaters	1				
Norfolk Island Ck headwaters	3	x			
Rocky Creek headwaters	1	x			
Talbragar River headwaters	1	x			
Tamalie Creek headwaters	1	x			
<i>slopes/lowlands</i>					
Branch Creek	1		x	x	x
Jemmy's Creek	2		x	x	

DISCUSSION

FROGS

Frog diversity

Six species of frog were found in this survey of Coolah Tops National Park. This included three species of Tree Frog (Peron's Tree Frog, Lesueur's Tree Frog and Verreaux's Tree Frog), and three species of ground dwelling frogs (Common Eastern Froglet, Eastern Banjo Frog and Brown Toadlet). Despite the wet weather conditions, all species aside from the Common Eastern Froglet and Peron's Tree Frog were rare. Some possible reasons for this are discussed later.

The frog community at Coolah Tops is similar to assemblages typically found further east. This is in keeping with the overall environment of Coolah Tops which in general appears to be an island of east coast flora and fauna surrounded by the western influenced Liverpool Plains.

Verreaux's Tree Frog has not been recorded at Coolah Tops previously. In this part of New South Wales this species is usually a winter breeding frog, although it may be found active at any time of year (K. Madden pers obs). Verreaux's Tree Frogs are rarely found away from permanent water (Barker *et al.* 1995). Approximately ten metamorph Verreaux's Tree Frogs were found around the edges of a dam on Warung Rd (Plates 3 & 4). There were many more tadpoles in the dam. No adult frogs were observed or heard calling. It is probable that the Coolah Tops population of this species bred some months before during late winter or early spring.

Frog habitats

The different types of habitat sampled were observed to support different species of frog. The four amphibian habitats sampled at Coolah Tops were 1) fast flowing steep drainages (Branch Ck; Munmurra River headwaters) 2) shallow, flat creeks (Jemmy's Ck; Tamalie Ck headwaters) 3) swamps 4) dams. No frogs were found at any of the fast flowing, steep creeks. These creeks occur on the slopes of the National Park, are

well shaded and contain cold water. The speed of the water flow meant there were few sites for tadpoles to develop without being washed downstream. Those pools of water that were available were deep and invariably contained fish - the major predator of tadpoles. The Common Eastern Froglet was the only species found at all the other types of habitat. This is a ubiquitous species with a wide range of ecological tolerances. Peron's Tree Frog preferred dams and the slow flowing, shallow headwaters on the Plateau. Eastern Banjo Frog tadpoles were only observed in pools of water in the slow flowing Plateau creeks, though several adults were found crossing roads in the western section of the Park (Plate 2). Verreaux's Tree Frog was only found at one dam, though it might be assumed that they use still pools of water in creeks in the same manner. Lesueur's Tree Frog, also known as the Rocky River Tree Frog, was only found in Jemmy's Creek (Plates 5 & 6). It is possible that this species does not occur on the Plateau as it was not located or heard there despite intensive searches.

Brown Toadlet were found only in areas of swamp. The three individuals located site Frog 2 on Rocky Creek were calling from an area of swamp adjacent to the actual creek. This species does not rely on a stable water source for breeding, and is rarely found in the vicinity of permanent creeks. Males call from beneath leaf litter, or as was observed at Coolah Tops, from within sphagnum moss. Females lay a few well-developed eggs in a damp position where they remain until rain flushes them into a pond (Barker *et al.* 1995). There has been recent concern that the Brown Toadlet is suffering a decline. Only a few individuals of this species were recorded calling during this survey, however, they were relatively common in swampy areas during the March 1998 survey. This is because this species is primarily a late summer through winter breeder (Barker *et al.* 1995; Cogger 1997). Brown Toadlet are known to be common on other basalt plateaus, such as Mount Coricudgy. Other than that, Brown Toadlet seem to prefer flat lowlands to sandstone environments which are dominated by the closely related Red-crowned Toadlet (*Pseudophryne australis*) (K. Madden, pers obs).

General

Frogs are difficult to survey systematically. The absence of a species at a site on a particular night can not be confidently classed as a real absence. Sites need to be

visited under a range of weather conditions and through several seasons to get a comprehensive species list for an area. The initial NPWS survey of Coolah Tops National Park in March 1998 found only two species of frog, this being an artefact of the dry conditions preceding the survey. This survey has confirmed the continued presence of all species found in the survey by Shields *et al.* (1995) aside from the Spotted Marsh Frog (*Limnodynastes tasmaniensis*). This is a common species in farmland, and it is possible that it was not actually observed on the Plateau, but in the surrounding cleared land. Additions were also made to the species list of the National Park, however, these were fewer than predicted. There may be several reasons for this. Firstly, Coolah Tops National Park suffers extremes in temperatures, reaching above 40 degrees Centigrade in summer and below freezing in winter. This may be outside the ecological tolerances of many of the species that would otherwise inhabit an area of equivalent rainfall. Secondly, basalt derived soils are very acidic. Frogs have permeable skins and some species may not be able to withstand low pHs. Mount Coricudgy is a high rainfall basalt cap that has an almost identical frog fauna (K. Madden, pers obs.). Thirdly, the prolonged dry period that ended in 1998 may have reduced the populations of some species to an undetectable level. As was noted earlier, all species aside from two were scarce. Most adult frogs observed during this trip were presumably mature before the drought. A successful breeding season this summer should see the populations of all species of frog increase. A final possibility is that feral pigs could be impacting on the frog populations by turning logs and rocks used for shelter and consuming frogs.

PREDATOR SCAT AND PELLET ANALYSIS

Twelve species were identified in predator scats and pellets. Predators were Fox, Wedge-tailed Eagle and Barking Owl. Interestingly, no scats were identified as potentially belonging to Dogs (*Canis lupus familiaris*) or Dingoes (*Canis lupus dingo*). It is uncertain whether this reflects a low population of Dogs or Dingoes within the park. Certainly, no wild Dogs or Dingoes were observed, while numerous Foxes were seen during spotlighting and other night work.

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AQUATIC FAUNA CENSUS

There were four species of native fish trapped or observed within Coolah Tops National Park (Table 3). Ornate Mountain Galaxias were only found on the Plateau, while Cox's Gudgeon was only found in creeks at lower elevations. There were many juveniles of both Cox's Gudgeon and the Galaxiid, indicating that both species are breeding after the extended dry period that ended in mid/late 1998. Some large individuals were estimated to be several years in age (G. Turner, pers comm). These animals presumably survived the drought in the few puddles of water that remained. No introduced species of fish were found during the survey. Feral species such as the Brown Trout (*Salmo trutta*) and Mosquito Fish (*Gambusia affinis*) are known to affect populations of native freshwater fish (Koehn & O'Connor 1994).

Ornate Mountain Galaxias (*Galaxias olidus*)

The galaxiids make up an important component of the Australian fish fauna, with approximately 20 species having been described (McDowall 1980). Galaxiids are an ancient group of fish with an interesting distribution, occurring in South America, New Zealand, New Caledonia and South Africa as well as Australia - lands that once made up part of Gondwana.

The Ornate Mountain Galaxias is a small, heavily built galaxiid that may be quite variable in appearance (McDowall 1980). It is known to exist at high elevations in both coastal and inland drainages in the south east of Australia (McDowall 1980; Rutzou *et al.* 1994). It is a poorly understood species although it is known to prefer small, clear, flowing streams, spawning in spring or early summer (Cadwallader & Backhouse 1983; Rutzou *et al.* 1994). It is thought to be threatened by trout, declining where these fish are present (McDowall 1980). In this study the Ornate Mountain Galaxias was found above 1000m. It was found in fast flowing, clear creeks, such as Rocky and Cox's Creek, which appear to be typical habitat of the species (Koehn & O'Connor 1990). The Ornate Mountain Galaxiid has a patchy, discontinuous distribution and is considered likely to be vulnerable or threatened, with more research needed to clarify their conservation status (Lake 1971; Koehn & O'Connor 1990).

They are considered to be secure in their numbers by Koehn and O'Connor (1990).

Long-finned Eel (Anguilla reinhardtii)

This species is a large eel, commonly 1.5 metres in length and 14kg in weight. It can be distinguished from the Short-finned Eel by a dorsal fin that starts well before the anal fin. It is blotched olive-brown dorsally and laterally. It is known from Cape York to Tasmania, also New Caledonia and Lord Howe Island (McDowall 1980). Its life history is similar to the Short-finned Eel, with larvae spending 1-3 years as part of the pelagic plankton. As glass eels, Long-finned Eel move into estuaries and then upstream in response to decreasing salinity, often moving over damp ground to circumnavigate barriers (Koehn & O'Connor 1990).

This species was not found on the Plateau at Coolah Tops, though it may occur there in some of the deeper pools or dams. Koehn and O'Connor (1990) list its conservation status as secure and widespread.

CONCLUSIONS

This follow-up survey of the vertebrate fauna of Coolah Tops complements the work initiated in March 1998. Data collected in the second survey substantiated many of the findings of the earlier report. Some of the additional findings are listed below.

1. Six species of amphibian were located within the study area. Four of these were uncommonly encountered (less than 4 locations) including Verreaux's Tree Frog, which is a new species for the area.
2. Foxes are consuming at least ten different species of mammal. Most Fox scats contained the remains of native species, with only 8% composed of rabbit.
3. The Barking Owl roost site on Gemini Road was still in use. Pellets contained only Sugar Glider remains and feathers.
4. The overlap in the diet of the Barking Owl and the Fox may be cause for concern.
5. Four species of native fish were found. Cox's Gudgeon was only found at lower elevations while the Ornate Mountain Galaxiid was only at high elevations. No introduced species of fish were observed.
6. Further research in the Coolah Tops region should focus on the slopes and lowlands surrounding the Plateau. However, continued collection and analysis of scats and pellets would be valuable.

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Mammals

<i>Capra hircus</i>	Goat
<i>Macropus giganteus</i>	Eastern Grey Kangaroo
<i>Macropus rufogriseus</i>	Red-necked Wallaby
<i>Nyctinomus australis</i>	White-striped Mastiff Bat
<i>Oryctolagus cuniculus</i>	Rabbit
<i>Perameles nasuta</i>	Long-nosed Bandicoot
<i>Petauroides volans</i>	Greater Glider
<i>Petaurus breviceps</i>	Sugar Glider
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum
<i>Rattus rattus</i>	Black Rat
<i>Sus scrofa</i>	Pig
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna
<i>Trichosaurus vulpecula</i>	Common Brushtail Possum
<i>Vombatus ursinus</i>	Common Wombat
<i>Vulpes vulpes</i>	Fox
<i>Wallabia bicolor</i>	Swamp Wallaby

Aquatic Fauna

<i>Anguilla australis</i>	Short-finned Eel
<i>Anguilla reinhardtii</i>	Long-finned Eel
<i>Cherax destructor</i>	Freshwater Crayfish
<i>Galaxias olidus</i>	Ornate Mountain Galaxias
<i>Gobiomorphus coxii</i>	Cox's Gudgeon