MAMMAL SURVEYS IN THE FORESTS OF THE CARRAI PLATEAU AND RICHMOND RANGE IN NORTH-EAST NEW SOUTH WALES

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Mammal surveys were carried out on the Carrai Plateau and Richmond Range in north-east New South Wales between March 1988 and November 1989. The emphasis was placed on rainforest mammals, following the recognition by Adam (1987) that the species lists of mammals in the state's rainforests were incomplete and that more research was needed. The mammals were surveyed primarily by analysis of prey remains in Dog and Fox scats, collected from roads throughout the forests, and from bat trapping. The bat fauna at both the Carrai Plateau and Richmond Range is rich (10 species and nine species respectively, including the rare Golden-tipped Bat, *Kerivoula papuensis*, in the Richmond Range). Scat analysis revealed the presence of 24 native species on the Carrai Plateau, and on the Richmond Range there were 17 species, including high numbers of two pademelon species. Feral prey species are almost completely absent, although the Fox is an established predator in both areas. A sharp division was identified between the mammal faunas of closed and open forests. Differences were found also between the mammal fauna composition of the two rainforest sites, and with those of nearby eucalypt forests. The mammal fauna of New South Wales rainforests is distinct from open forests and future mammal surveys are needed to ensure an adequate level of knowledge to identify and conserve these areas.

Key words: mammal survey, dog scats, fox scats, Richmond Range, Carrai Plateau, rainforest, moist open forest, endangered species.

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ADAM (1987), in his nominations of New South Wales rainforest sites for the World Heritage List, noted that the species lists he had prepared were not 'in any way complete and final'. Such deficiencies increase the difficulty and precision of identifying areas of high conservation value and diminish the possibility of producing effective management plans for such areas.

In his nominations, Adam identified a number of sites within six disjunct centres of rainforest distribution. However, he did not suggest that the areas nominated for World Heritage listing were the sole rainforest remnants. Other sites may have been rich in fauna also and worthy of special consideration but did not meet the criteria of integrity by virtue of their tenure (Adam pers. comm. 1993). Identifying such areas remains an urgent task. For this reason, these mammal surveys were undertaken in four State Forests in north-east New South Wales as part of a broader study initiated by the National Rainforest Conservation Program to assess the fauna of New South Wales rainforests.

The Carrai Plateau forms part of the catchment for the Apsley-Macleay River System which had never been surveyed for mammals. The survey of this area complements the mammal surveys of Werrikimbe National Park and Mt Boss State Forest to the south (Denny and Press 1982) and the New England escarpment to the north (Robertshaw and Harden 1986).

The mammals of the upper Richmond Range, south of the Tweed volcano group (Adam 1987), were first surveyed by Calaby (1966). Gilmore (1987) compiled a literature review and Smith, Hines, Pugh and Webber (1989) documented the fauna of the area using literature records, unpublished records in the University of New England, and local naturalists and trapping surveys carried out by students. The only literature on rainforest bats of the north-east region are reports by Parnaby (1984, 1986). The survey reported here of the Richmond Range is complementary to the fauna surveys of Smith et al (1989) in that our methodological approach utilised scat-based mammal

survey and bat-trapping, two techniques not employed by Smith et al (1989).

STUDY AREAS

Each of the forests selected for survey has features of considerable interest. The Carrai State Forest (31°18'S 152°15'E) on the Carrai Plateau (altitude approximately 1000 m) contains a complex mosaic of forest types. These are principally warm temperate rainforest (simple notophyll evergreen vine forest), which had been almost completely logged by the late 1960s (Forestry Commission of NSW 1988), dry rainforest (microphyll vine forest), including the largest stand in New South Wales, moist open forest, and a few areas of subtropical rainforest (notophyll vine forest), grasslands and swamps. A forest in the adjacent Macleay River Valley, Boonanghi State forest (100–200 m altitude), was also surveyed to allow comparison with the adjacent high altitude Carrai Plateau (Fig. 1). Boonanghi State Forest has a forest structure of predominantly dry open forest with moist open forest and dry rainforest in the gullies and alongside creeks.

The northern part of the Richmond Range contains several large areas of subtropical rainforest (complex notophyll vineforest) (Fig. 2). These areas are found at low altitude (< 600 m) and represent forest types that are now limited in New South Wales. The vegetation and geology of the general area has been assessed by Floyd (1980) and the Forestry Commission of NSW (1987). Three areas were selected for detailed survey: the Cambridge Plateau Flora Reserve (28°50'S 152°40'E), Richmond Range State Forest; the Bungdoozle Flora Reserve (28°36'S

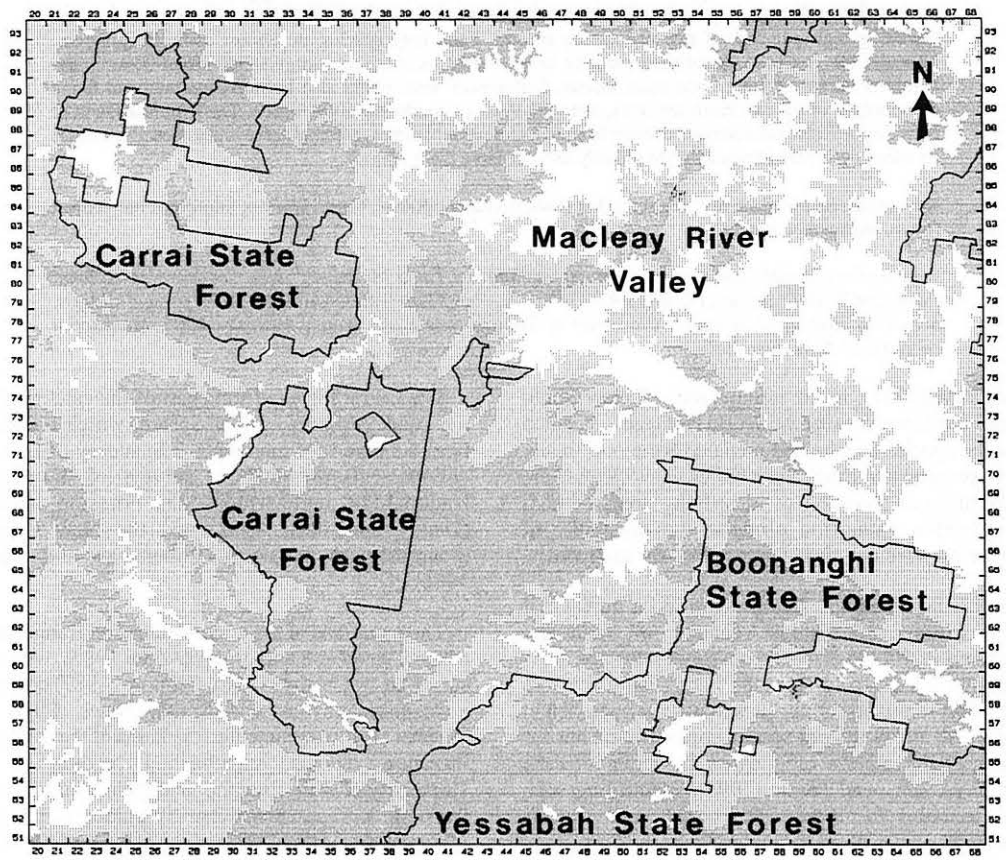

Fig. 1. Forest types of the Carrai Plateau, showing the boundary (solid line) of the Carrai and Boonanghi State Forests. The white represents cleared areas, the light shading represents dry open forest/woodland and the dark shading represents rainforest/moist open forest. Australian Grid Map References (1 km spacing) are shown on the border of the map.

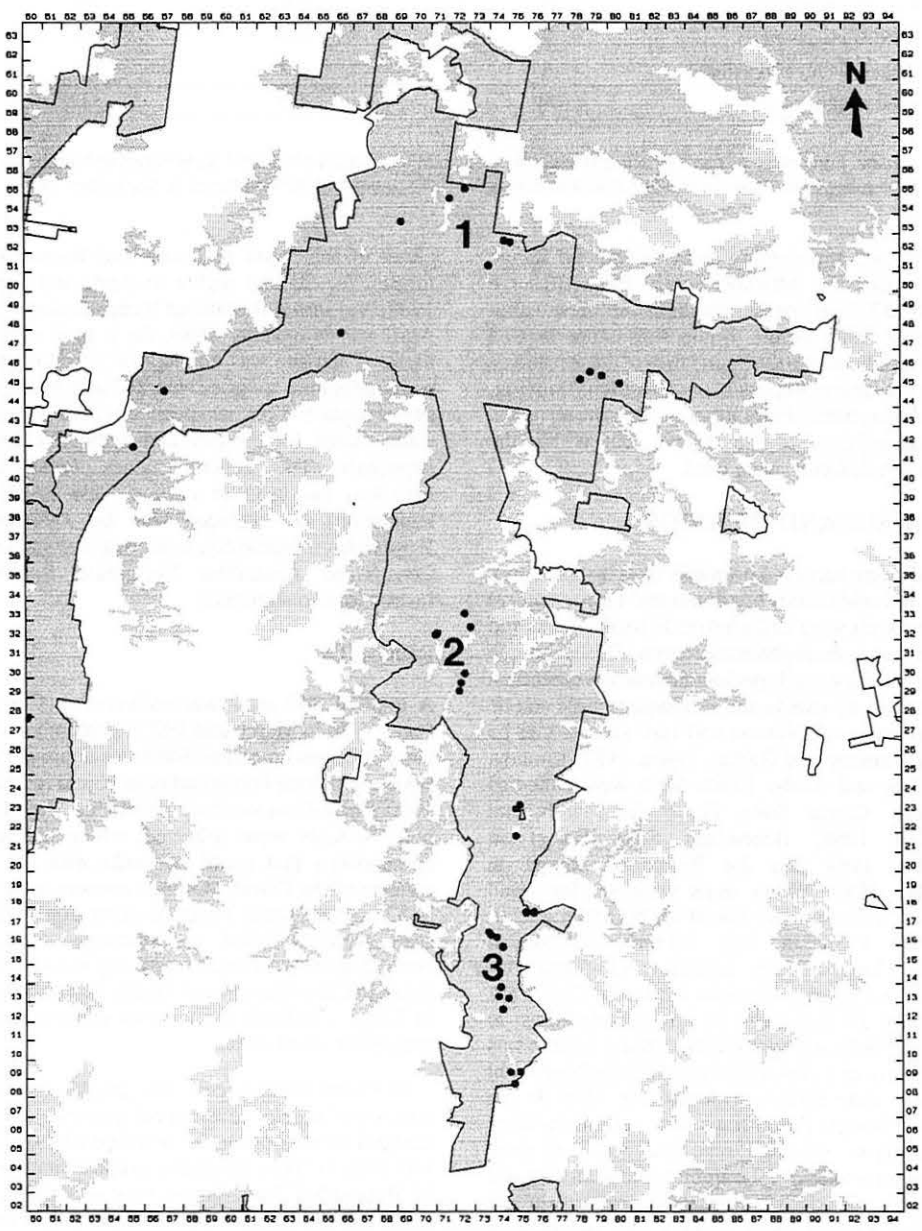

Fig. 2. Forest types of the Richmond Range, showing the boundary (solid line) of Richmond Range State Forest. The white represents cleared areas, the light shading represents dry open forest/woodland and the dark shading represents rainforest/moist open forest. Australian Grid Map References (1 km spacing) are shown on the border of the map. Numbers indicate the locations of the three study areas: **1**, Murray Scrub Flora Reserve; **2**, Bungdoozle Flora Reserve; **3**, Cambridge Plateau Flora Reserve. Circles indicate locations where bat traps were set.

Species	Boonanghi State Forest	Carrai State Forest	Richmond Range
Canis familiaris	43	63.9	74
Vulpes vulpes	20	10.0	10.6
Unidentified canid	31	18.3	14.4
Dasyurus maculatus	0	0.6	0.4
Isoodon macrourus	0	0.3	0.4
Other - mainly owl pellets	6	6.9	0.2
Total number of scats	74	340	547

Table 1. Percentage of predator scats, principally Dog and Fox, collected in Carrai State Forest in March and September 1988, Boonanghi State Forest in September 1988 and the Richmond Range in September 1989.

152°42'E) and surrounding areas, Richmond Range State Forest; the Murray Scrub Flora Reserve (28°29'S 152°29'E) and surrounding rainforest within Toonumbar State Forest. Some sites were located outside but adjacent to the boundaries of these reserves because access was impossible as a result of flooding. As the Murray Scrub Flora Reserve contains no roads, the roads adjacent to the reserve, but within the subtropical rainforest, were used.

MATERIALS AND METHODS

Mammals were surveyed primarily by analysis of prey remains in canid (*Canis familiaris* and *Vulpes vulpes*) scats. The scats were collected on all roads, tracks and roadside verges throughout the forests. This technique is highly efficient as all species of mammals other than bats are eaten by canids and if a large sample can be collected, even uncommon and rare species can be detected (Lunney and Barker 1986a, 1987; Lunney, Triggs, Eby and Ashby 1990). Scats were collected throughout Carrai State Forest in March and September 1988, Boonanghi State Forest in September 1988 and the Richmond Range in September 1989. Elliott traps were set for small mammals in Carrai State Forest for 80 trap nights in September 1988 in four habitats: subtropical rainforest, logged warm temperate rainforest, dry rainforest and riparian dry open rainforest. Cage traps were set for 20 trap nights in Carrai State Forest in September 1988 and spotlighting from a vehicle was undertaken over 11 km of firetrails in both Boonanghi and Carrai state forests in September 1988. In the Richmond Range, Elliott traps were set for a total of 400 trap nights and cage traps were set in all three locations for a total of 30 trap nights in February and April 1989. Spotlighting was undertaken on the Cambridge Plateau Flora Reserve and surrounding areas for 1 night each in April, September and November 1989.

Bats were caught in harp traps. These were set on flight paths (tracks and creek beds) during the dark phase of the moon in Carrai and Boonanghi state forests, for 80 trap nights in April and September 1988, and in the Richmond Range during February, April and November 1989, for a total of 171 trap nights. Each site was trapped for 1 to 3 nights. Bats were measured, weighed, marked and released at the site of capture. Voucher specimens of all species were taken except for the rare and distinctive *Kerivoula papuensis*. The generic names *Phoniscus* and *Eptesicus* (as used in current New South Wales legislation) are replaced here by *Kerivoula* and *Vespadelus* respectively, to accord with names in the Census of Australian Vertebrate Species (cf. Instructions to Authors).

RESULTS

A total of 340 scats was collected in Carrai State Forest, 148 in March and 192 in September 1988. Of these 301 scats contained 348 items of prey or carrion. Boonanghi State Forest had been baited for dogs with 1080 (monofluoroacetate) poison in May 1988, so only 74 scats were collected, which restricted the comparisons that could be made with the plateau country of the Carrai. Mammal remains were present in 52 of these scats. Twice as many dog scats as fox scats were collected in Boonanghi State Forest compared to six times as many dog scats as fox scats found in Carrai State Forest (Table 1). The percentages in Table 1 indicate the number of prey items as a proportion of all scats.

In Carrai State Forest, the graph of cumulative number of species levelled off quickly, and 88% of the total number of species was found by scat number 160 (Fig. 3). The cumulative graph of native species of Boonanghi State Forest was still rising at scat number 74 at a similar rate to that exhibited for Carrai State Forest. Twenty-four native species were found in Carrai State Forest, including four now classified as Vulnerable and Rare under the December 1992 revision of Schedule 12 of the *National Parks and Wildlife Act 1974*, which lists the endangered fauna

of New South Wales (Table 2). The discovery in Boonanghi State Forest of *Macropus parma* and *Thylogale thetis* confirm that these species persist in the low valley country of the north coast of New South Wales and both exist in a small forest surrounded by land that has been farmed for a century. The only species present in Boonanghi State Forest, but absent in Carrai State Forest, was the Yellow-bellied Glider, *Petaurus australis*.

A total of 547 scats was collected in the Richmond Range during September 1989 (Table 3). In all, 558 food items were identified in the 509 scats which contained mammalian remains. The scats were predominantly *C. familiaris* (Table 1), and seven times as many dog scats as fox scats were collected. This study confirmed the presence of the fox in rainforest areas. The presence of the Tiger, *Dasyurus maculatus*, was established by its distinctive scat shape (Lunney and Barker 1986a) and confirmed by hair in the scat.

Three species of small mammals were captured in Carrai State Forest using Elliott traps: *Rattus fuscipes*, *Antechinus stuartii* and *Melomys cervinipes*. *Rattus fuscipes* and *A. stuartii* were abundant in all habitats whereas only two *M. cervinipes* were captured, both in rainforest sites. The two mammals caught in cage traps (in logged warm temperate rainforest), were a male *D. maculatus* weighing 2 kg and one *Trichosurus caninus*.

Three species of small mammals were captured in Elliott traps in the rainforest areas of the Richmond Range: *R. fuscipes, A. flavipes* and *M. cervinipes*. *Antechinus stuartii* was located in adjacent eucalypt forest. Cage traps caught only the Northern Brown Bandicoot, *Isoodon macrourus*.

Many species were observed in the Carrai State Forest and the Richmond Range, but since their presence had been detected by scat analysis, only outstanding observations are recorded here. Most notable in the Carrai were very high density patches

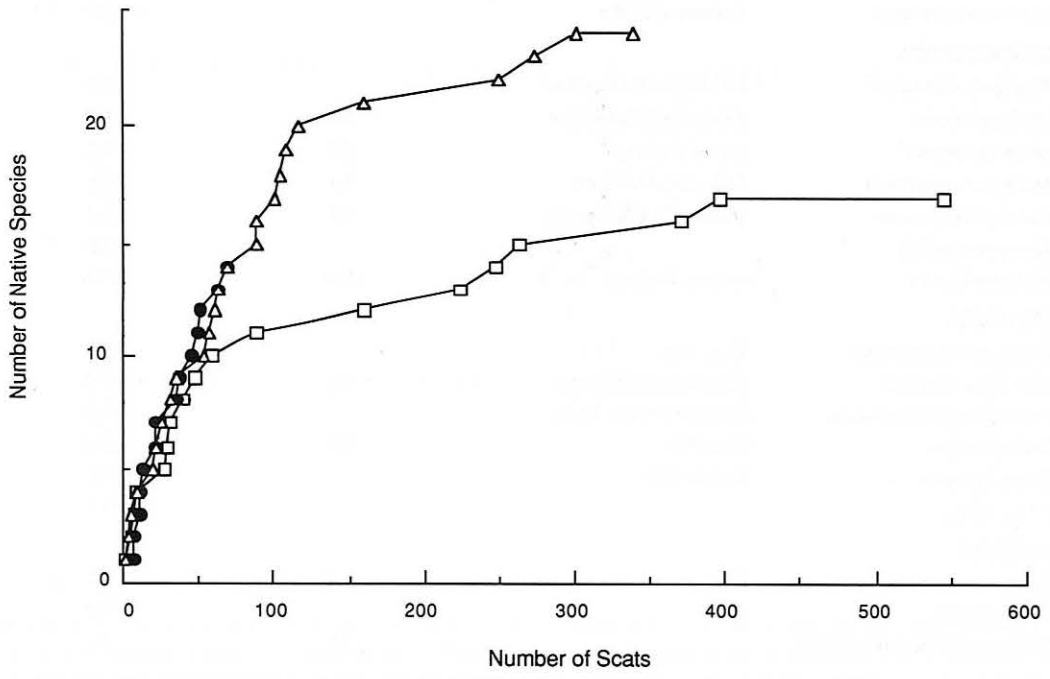

Fig. 3. Cumulative curves of the number of species identified by hair content analysis in 547 scats collected in the Richmond Range in September 1989 (□), 340 scats collected on the Carrai Plateau in March and September 1988 (△), and 74 scats collected in Boonanghi State Forest in September 1988 (●).

Species Name	Common Name	Boonanghi State Forest	Carrai State Forest
No mammals		25.7	7.9
Unidentified		4.7	3.5
MONOTREMATA			
Tachyglossus aculeatus	Short-beaked Echidna		1.2
DASYUROIDEA			
*Dasyurus maculatus**	Tiger Quoll		0.3
Antechinus flavipes	Yellow-footed Antechinus		0.9
Antechinus stuartii	Brown Antechinus	2.7	2.1
Antechinus species			0.3
Sminthopsis murina	Common Dunnart		0.6
PERAMELOIDEA			
Isoodon macrourus	Northern Brown Bandicoot	4.1	15.6
PHALANGEROIDEA			
Pseudocheirus peregrinus	Common Ringtail Possum	1.4	15.3
Petauroides volans	Greater Glider		2.1
Petaurus australis *	Yellow-bellied Glider	1.4	
Petaurus breviceps	Sugar Glider	2.7	2.4
Trichosurus vulpecula	Common Brushtail Possum	4.1	2.1
Trichosurus caninus	Mountain Brushtail Possum		1.2
T. vulpecula/caninus	Brushtail Possum	2.7	3.8
Cercartetus nanus	Eastern Pygmy Possum		0.9
Acrobates pygmaeus	Feathertail Glider		0.3
MACROPOIDEA			
*Thylogale stigmatica**	Red-legged Pademelon		1.2
Thylogale thetis	Red-necked Pademelon	6.8	1.5
*Macropus parma**	Parma Wallaby	2.7	1.2
Macropus rufogriseus	Red-necked Wallaby	4.1	1.8
Macropus giganteus	Eastern Grey Kangaroo	4.1	4.1
Macropus species			0.6
Wallabia bicolor	Swamp Wallaby	28.4	27.6
RODENTIA			
Hydromys chrysogaster	Water Rat		0.3
Melomys cervinipes	Fawn-footed Melomys	6.8	0.9
Pseudomys gracilicaudatus	Eastern Chestnut Mouse		0.3
Rattus fuscipes	Bush Rat	5.4	10.3
Rattus lutreolus	Swamp Rat		0.6
Rattus species			0.3
CANIDAE			
Canis familiaris	Dog	1.4	2.1
Vulpes vulpes	Fox		0.3
Total number of native species		13	24

Table 2. Percentage of 57 food items in 74 scats in Boonanghi and 348 food items in 340 scats in Carrai State Forests collected in 1988 containing mammal species. The percentages are based on the total number of scats, including those with no mammal remains or unidentified material. *Vulnerable and Rare under the Revision of December 1992 of Schedule 12 which lists the Endangered Fauna of New South Wales.

of the Greater Glider, *Petauroides volans*. There were up to three per tree in New England Blackbutt, *Eucalyptus andrewsii*, and between 1 and 15 per kilometre of fire trail were seen during spotlighting. Also observed in the Carrai were *Pseudocheirus peregrinus*, *T. caninus*, *T. vulpecula*, three *D. maculatus* and the dingo *C. f. dingo*. Whereas Carrai State Forest was found, both by spotlighting and scats, to be rich in possums and gliders, Boonanghi State Forest was depauperate in this group, and only one *T. vulpecula* was seen in 11 km of spotlighting.

In the Richmond Range, observation revealed two bandicoot species. *Isoodon macrourus* was found in both rainforest and non-rainforest, whereas *Perameles nasuta* was seen in non-rainforest only. This is the same result that Smith et al (1989) obtained. Four species of macropodid were seen in the rainforest (Table 4) and a further two species, *Potorous tridactylus* and *Macropus parryi*, were seen immediately adjacent. Smith et al (1989) also found six macropodid species, five in common with this study. They found the Black-striped Wallaby, *M. dorsalis*, but not the Eastern Grey Kangaroo,

Species Name	Common Name	CP	B	MS	% Scats
No mammals					7.1
Unidentified					0.9
MONOTREMATA					
Tachyglossus aculeatus	Short-beaked Echidna	x		x	1.1
DASYUROIDEA					
*Dasyurus maculatus**	Tiger Quoll		x		0.4
Antechinus stuartii	Brown Antechinus	x		x	0.7
Antechinus swainsonii	Dusky Antechinus		x	x	1.3
PERAMELOIDEA					
Isoodon macrourus	Northern Brown Bandicoot	x	x	x	3.3
PHALANGEROIDEA					
Pseudocheirus peregrinus	Common Ringtail Possum	x	x	x	9.7
Petauroides volans	Greater Glider	x			0.5
Petaurus breviceps	Sugar Glider		x		1.3
Trichosurus vulpecula	Common Brushtail Possum	x	x		2.6
T. vulpecula/caninus	Brushtail Possum	x	x	x	1.8
MACROPOIDEA					
*Thylogale stigmatica**	Red-legged Pademelon	x	x	x	6.0
Thylogale thetis	Red-necked Pademelon	x	x	x	3.5
Thylogale stigmatica/thetis		x	x	x	40.2
Macropus giganteus	Eastern Grey Kangaroo	x	x	x	2.2
Wallabia bicolor	Swamp Wallaby	x	x	x	18.1
RODENTIA					
Hydromys chrysogaster	Water Rat	x			0.2
Melomys cervipes	Fawn-footed Melomys	x	x	x	4.9
Rattus fuscipes	Bush Rat	x	x	x	3.1
CANIDAE					
Canis familiaris	Dog				0.9
Vulpes vulpes	Fox				0.2
BOVIDAE					
Bos taurus	Cattle				0.7
Total number of native species					18

Table 3. Percentage of 558 mammalian food items in 547 scats in the Richmond Range in September 1989. x Present in Cambridge Plateau (CP), Bungdoozle (B) and Murray Scrub (MS). *Vulnerable and Rare under the Revision of December 1992 of Schedule 12 which lists the Endangered Fauna of New South Wales.

Species	Common name	Area				Method of Detection			
		CP	B	MS	NR	BT	T	O	S
Nyctophilus gouldi	Gould's Long-eared Bat	x			x	x			
Miniopterus australis	Little Bent-wing Bat	x				x			
Chalinolobus gouldii	Gould's Wattled bat				x	x			
Chalinolobus morio	Chocolate Wattled Bat	x			x	x			
*Scoteanax ruepellii**	Greater Broad-nosed Bat	x	x			x			
Scotorepens orion	Little Broad-nosed Bat				x	x			
*Kerivoula papuensis**	Golden-tipped Bat				x	x			
Vespadelus pumilus	Little Cave Eptesicus	x	x	x	x	x			
Vespadelus darlingtoni	Large Forest Eptesicus			x		x			
*Dasyurus maculatus**	Spotted-tailed Quoll		x						x
Antechinus flavipes	Yellow-footed Antechinus	x			x		x		
Antechinus stuartii	Brown Antechinus				x		x		
Isoodon macrourus	Northern Brown Bandicoot x	x	x	x			x		
Perameles nasuta	Long-nosed Bandicoot				x			x	
*Phascolarctos cinereus**	Koala				x			x	
Pseudocheirus peregrinus	Common Ringtail Possum				x			x	
Petauroides volans	Greater Glider				x			x	
Trichosurus vulpecula	Common Brushtail Possum				x			x	
*Potorous tridactylus**	Long-nosed Potoroo				x			x	
Thylogale thetis	Red-necked Pademelon	x	x	x				x	
Macropus parryi	Whiptail Wallaby				x			x	
Wallabia bicolor	Swamp Wallaby	x		x				x	
Melomys cervinipes	Fawn-footed Melomys	x	x				x		
Rattus fuscipes	Bush Rat	x	x		x		x		
Canis familiaris dingo	Dingo	x	x	x				x	x

Table 4. Mammals trapped, observed or detected other than in scats in three rainforest areas and adjacent non-rainforest areas in the Richmond Range in April, September and November 1989. CP, Cambridge Plateau; B, Bungdoozle; MS, Murray Scrub; NR, non-rainforest (eucalypt forest); BT, Bat Trap; T, Elliott Cage Trap; O, Observation; S, Sign. *Vulnerable and Rare under the Revision of December 1992 of Schedule 12 which lists the Endangered Fauna of New South Wales.

M. giganteus, which was found in this study. One Koala, *Phascolarctos cinereus*, was sighted just to the north of the Cambridge Plateau in a Tallowwood, *E. microcorys* (AMG 4727 685607).

Eighty-three individuals of nine species of bats were captured in Carrai State Forest, and 12 individuals of five species were captured in Boonanghi State Forest (Table 5). There were 175 individuals of nine species caught in the Richmond Range (Table 4), with rainforest sites yielding six species. Bats constituted 29% of the native mammal fauna in Carrai State Forest, 26% of the native mammal fauna in Boonanghi State Forest and 38% of the mammals in the Richmond Range. Two bat species caught in Boonanghi State Forest were not caught in Carrai State Forest. Two species from Carrai and one species from Boonanghi State Forest are classified as Vulnerable and Rare under Schedule 12.

The capture of a male *Kerivoula papuensis* on a track beside Little Back Creek 5 km NNE of Dome Mountain was of great interest. This species is considered to be one of the rarest mammals in Australia (Lunney and Barker 1986b) and is classified as Vulnerable and Rare under Schedule 12 of the *National Parks and Wildlife Act* 1974. This was only the twenty-first specimen of this species recorded in Australia.

DISCUSSION

The results from this study point to differences between the mammal fauna composition of two separate rainforest sites, with differences between the rainforest and the nearby eucalypt forest. The absence in the Carrai Plateau rainforest-moist open forest complex of such distinctive species as the Koala, *Phascolarctos cinereus*, *Perameles nasuta*, *Petaurus australis*, the Brush-tailed Phascogale, *Phascogale*

tapoatafa, and the Long-nosed Potoroo, *Potorous tridactylus*, contrasts with the recorded presence of these species in a majority of the ten rainforest sites listed in Appendix VIII of Adam (1987). This contrast suggests that Adam's (1987, p 115) statement that the 'mammal species are reasonably well covered' for the rainforest sites nominated in 1987 for the World Heritage List is a misinterpretation based upon imprecise local records. Adam (pers. comm. 1993) pointed out that the responses to his requests for species lists for rainforest sites would have included all species present in the area without distinguishing between rainforest and eucalypt forest. However, Adam (1987) did recognize that the 'creation of a complete species list for all of New South Wales rainforests must await further research'. This study indicates the need for a more thorough and accurate assessment of rainforest mammal fauna.

The bat trapping revealed a rich bat fauna at both locations (Carrai, ten species; Richmond Range, nine species), and five species were collected in just 16 trap nights in Boonanghi State Forest. Together, the Carrai and Richmond Range had 12 species, and a further two species were added from Boonanghi. Thus the 12 species of bats in the two rainforest areas constituted 32% of the 38 species of native mammals; overall, the 14 species of bats constituted 32% of the 44 species reported in this study.

Subtropical lowland rainforest has an abundance of pademelons. The quantity of canid scats containing the two pademelon species indicates that they are the main prey items in the Richmond Range. By contrast, the Swamp Wallaby *Wallabia bicolor* is the predominant macropodid prey species on the Carrai Plateau, followed by the Northern Brown Bandicoot, *Isoodon macrourus*, and the Ring-tailed Possum, *Pseudocheirus peregrinus*, which also constitute a large proportion of the canid diet.

The low percentage occurrence of the Red-necked Wallaby, *Macropus rufogriseus*, on the Carrai Plateau, and its complete absence from the Richmond Range, suggests that this species is rare or absent in such habitats. The restriction of the Parma Wallaby, *M. parma,* to the Carrai and Boonanghi state forests suggests that its distribution is not centred on rainforest and does not include the Richmond Range rainforests. The absence of the Rufous Rat Kangeroo, *Aepyprymnus rufescens*, suggests that it is either very rare in, or absent from, the rainforest areas. The Long-nosed Bandicoot, *Perameles nasuta*, was absent from Boonanghi and Carrai State Forests, and the Richmond Range rainforests, but was seen in non-rainforest areas, pointing to a restricted distribution of this species in the ranges as well as the plateau country of north-eastern New South Wales. The low occurrence of the Bush Rat, *Rattus fuscipes*, in scats in the intact rainforest of the Richmond Range, and the fact that it was the fourth most common prey item on the Carrai Plateau, might reflect the low occurrence of *R. fuscipes* in intact rainforest or its greater vulnerability as prey in either disturbed or more open forest types. The presence of *Pseudomys* points to a restricted distribution of these rodent species. The absence of *P. oralis* from the scats on the Carrai plateau is consistent with its recognised rarity (a Threatened Species under Schedule 12), although it is known from the area (Read 1993).

The restricted distribution of the Yellow-bellied Glider, *Petaurus australis*, is consistent with its listing as Vulnerable and Rare on Schedule 12. Also,

Species	Boonanghi State Forest	Carrai State Forest
Rhinolophus megaphyllus	1	2
Tadarida australis		(heard only)
Nyctophilus gouldi	1	19
*Miniopterus australis**		18
Chalinolobus morio		6
Vespadelus darlingtoni		8
Vespadelus regulus		15
Vespadelus pumilus		7
Vespadelus vulturnus	8	4
Scotorepens greyii	1	
*Scoteanax ruepellii**	1	
*Falsistrellus tasmaniensis**		4
Total	12	83

Table 5. Number of bats caught in harp traps in Boonanghi (16 trap nights) and Carrai State (64 trap nights) Forests in September 1988. *Vulnerable and Rare under the Revision of December 1992 of Schedule 12 which lists the Endangered Fauna of New South Wales.

the restricted distribution of the Dusky Antechinus, *Antechinus swainsonii*, to only two of three locations in the Richmond Range, and its absence from both the Carrai and Boonanghi state forests is notable, as is the rarity of any *Antechinus* species in the Richmond Range and Carrai Plateau (with the possible exception of *A. stuartii*). These results with respect to *Antechinus* spp. can be interpreted in terms of their life history. In September, the *Antechinus* populations are at their lowest, consisting only of breeding females. However, the Carrai Plateau was also sampled in March which explains the higher percentage of *A. stuartii* at this location. The capture in Elliott traps of *A. flavipes* in the Richmond Range, but not *A. stuartii*, is attributed to the restricted area of trapping compared with the area that would have been covered by the dogs and foxes. On the Carrai Plateau, both *R. fuscipes* and *A. stuartii* were noted as common in all habitats, yet *R. fuscipes* occurred five times more often in the canid scats. This suggests that *Antechinus* spp. are a less frequent prey item in these forests.

The efficacy of scat collection as a mammal survey tool (except for bats) is demonstrated here for the forests of north-eastern New South Wales by the extensive species lists. The cumulative curves of the species identified by scat analysis is similar to that in Lunney, Triggs, Eby and Ashby (1990) and suggests that there is a common trend. Most species had been identified in the first 200 scats in both the Carrai and the Richmond Range, and thereafter new species diminished sharply per unit effort. The technique also established that both dogs and foxes are hunting in these rainforest areas, with dogs being the predominant predator.

Of note is the extremely low occurrence of stock and feral species recorded as food items. Only in the Richmond Range was the exotic species *Bos taurus* recorded, with an extremely low occurrence. This suggests that rainforest areas are not a haven for exotic prey species, and that areas which are largely intact are free of exotics such as rabbits, sheep, mice, goats and pigs. By contrast, fox scats made up 10% of the scats in Carrai State Forest, and 10.6% of scats in the Richmond Range, and points to the definite invasion of this exotic predator into rainforest, including intact rainforest.

This study has provided important baseline information about the mammal fauna composition of the rainforest in two locations in north-east New South Wales. It indicates also that the composition of the mammalian fauna of the remaining rainforests of New South Wales will prove to be distinctive, and different to that in the adjacent dry eucalypt forests. More research is required to establish the faunal composition in other rainforests in the state. This work should include moist, and dry, eucalypt forest adjacent to rainforest sites, and is essential for the proper identification and adequate conservation of the unique mammal communities of the forests of New South Wales.

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