

Mammals of Clouds Creek, North-Eastern New South Wales, and their Distribution in Pine and Native Forests

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ABSTRACT

A survey was made of mammals in an area of 118 km² in Clouds Creek State Forest in north-eastern N.S.W. This area is being converted to *Pinus* spp. Twenty-seven species of indigenous mammals and seven introduced species were recorded. The distribution of these species in native and pine forest indicated that only *Rattus rattus*, *R. lutreolus* and *Mus musculus* inhabited pine forest (4-7 years old) exclusively, although this association was less obvious in older pines (25 years old) where they were trapped only on the periphery.

Changes in the habitats resulting from forestry practices influenced the distribution and abundance of mammals in the area. Individuals of *Rattus fuscipes* and *Macropus rufogriseus* were able to survive in pine plantings and their associated grasslands. No individuals of *Trichosurus caninus* or *T. vulpecula* used pine areas exclusively and they are dependent on adjacent native forest. Other phalangers were sighted only in native forest, including altered habitat such as grazed woodland. No populations of either *Antechinus stuartii* or *Melomys cervinipes* were found away from native forest and the latter species was trapped only in moist forest.

Macropods were similarly sensitive to habitat changes. *Macropus giganteus* was widespread in both native and pine areas, *Thylogale thetis* occurred on the pine periphery and *M. parma*, *T. stigmatica* and *Aepyprymnus rufescens* were restricted to closed and tall open forests.

INTRODUCTION

Tyndale-Biscoe and Calaby (1975) used the eucalypt forests of southern Australia to illustrate the dependence of certain mammals on specific forest types. They stressed the scarcity of information on distribution of Australian fauna with respect to vegetation type.

Calaby (1966) surveyed a large area of the upper Richmond and Clarence Rivers and demonstrated that north-eastern N.S.W. had a diverse mammalian fauna. Much of this area has been included as a target area in various proposals for a woodchip industry currently being considered for northern N.S.W. In addition, native forests are being cleared for the planting of exotic pines.

This paper reports on a long, intensive survey of a small area of highly productive native forest and of pine plantations in northern N.S.W. Emphasis is made of the distribution of the more abundant species between vegetation types.

STUDY AREA AND METHODS

In 1968 an ecological study of two possum species, *Trichosurus caninus* and *T. vulpecula*, was commenced in an area of forest that was partially being converted to *Pinus* spp. (How, 1972). This study was extended in 1975 to include the small mammals in the area. The study area was visited regularly from

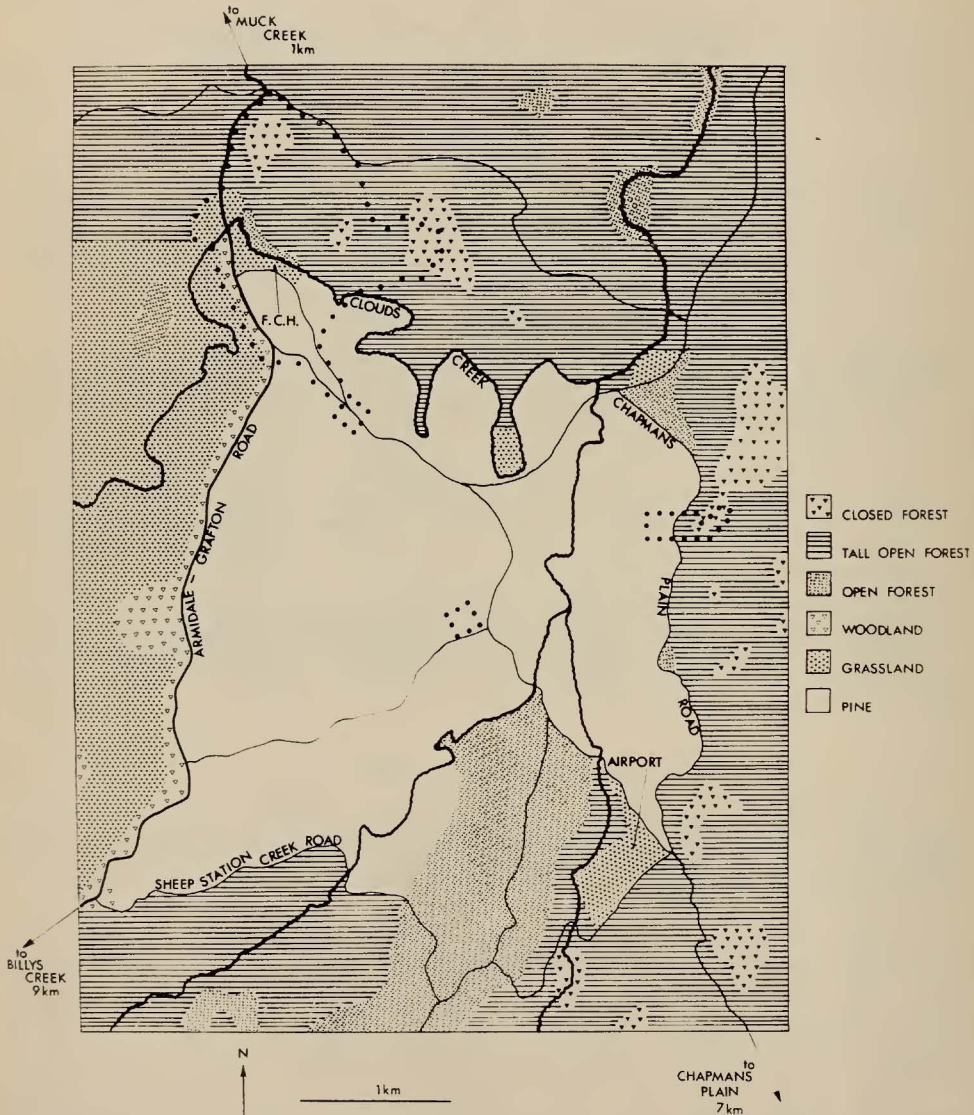


Fig. 1. Map of the Clouds Creek area showing the localities mentioned in the text. Solid circles enclose areas of fixed trap localities.

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1968, except for a period from January 1972 to August 1974. During the five and a half years spent in the area, various methods were used to assess the mammal populations, including live trapping, break-back trapping, spotlighting, the collection of roadkills and chance sightings.

STUDY AREA

The study area of 118 km² is at Clouds Creek (30° 05' S, 152° 37' E) in north-eastern N.S.W. (Fig. 1). Clouds Creek is situated on the eastern escarpment of the New England Tableland, about 120 km north-east of Armidale, and is on the northern edge of the Dorrigo Plateau, 24 km north-east of Dorrigo. Based on the classification of Specht (1970), four types of tree-dominated communities occur in the area. These are closed forest, tall open forest, open forest and woodland; pine plantation and grassland communities also occur in the study area.

Small areas of closed forest occur to the north and the east of the pine plantation. Species commonly found in this association are Coachwood (*Cerato-petalum apetalum* D. Don) and Sassafras (*Doryphora sassafras* Endl.) along with several others of commercial value. A southern area of closed forest was cleared in early 1970 and planted with pines.

In the transitional zone between closed forest and tall open forest, Brush Box (*Tristania conferta* R. Br.) is prominent, while tall open forest in the area is dominated by Tallowood (*Eucalyptus microcorys* F. Muell.), Sydney Blue Gum (*E. saligna* Sm.), White Mahogany (*E. acmenoides* Schau), Dunns White Gum (*E. dunni* Maiden) and Turpentine (*Syncarpia glomulifera* Sm.).

There is a large area of open forest to the north-west of the plantation dominated by Blackbutt (*E. pilularis* Sm.), while the area immediately to the south of the Forest Commission Headquarters (F.C.H.; Fig. 1) was New England Blackbutt (*E. campanulata* Baker and Smith) and Camerons Stringybark (*E. cameronii* Blakely and McKie), as codominants prior to its clearing in 1970.

Grazed woodland to the west of the F.C.H. is mainly Broadleafed Stringybark (*E. caliginosa* Blakely and McKie) and Ribbon Gum (*E. viminalis* Labill.). Along the creek Water Gum (*Tristania laurina* R. Br.) forms a dense association.

Grasslands in the region range from the "anomolous grassland communities associated with rainforest on basalt" (Baur, 1962) to improved pasture with white clover.

The central feature of the study area was the pine plantation. *Pinus elliottii* Engel. and *P. taeda* L. were first planted in 1950-51. Planting was recommenced in 1965 mainly with *P. taeda* but other species, *P. radiata* D. Don. and *P. patula* Schl et Cham. were also planted.

The principle climatic features are the cold dry winter and the wet summer months. The lowest minimum temperature over the 25 years previous to 1972 was -11.1°C and the highest maximum temperature was 39.5°C. Rainfall is

concentrated over the summer months; 55 per cent of the average annual rainfall of 1443 mm falls between November and March.

LIVE TRAPPING

Live trapping for small mammals was with Elliott folding aluminium traps (Elliotts Scientific Co., Upwey, Victoria) baited with a mixture of peanut butter and rolled oats. Medium sized mammals were trapped with three sizes of open-mesh wire traps. Two sizes of non-collapsible traps (Mascot Wire Works, Enfield, N.S.W.) 61 x 30 x 30 cm and 76 x 30 x 30 cm, and one size of collapsible trap (Tomahawk Live Trap Co., Tomahawk, Wisconsin, U.S.A.) 66 x 22 x 22 cm were used. These were usually baited with apple but on occasions peanut butter and rolled oats, tinned dog food, bread, and bread and honey were used.

There were 30,500 trap nights with the open-mesh traps of which 500 trap nights were on survey work, the remainder being in fixed locations. There were 10,621 trap nights with small mammal traps in fixed locations and 2,624 trap nights on survey work. The majority of the survey work where traps were either moved daily or every two days to a new location was generally on road edges separating pine and native vegetation.

Small mammals were individually marked by toe clipping and possums by ear nicks.

BREAK-BACK TRAPPING

Certain pine areas used as fixed locations for small mammal traps gave <1% trap success. In February 1976 a trap success of 7.5% was obtained in these areas from 120 trap nights with break-back rat traps baited with peanut butter and rolled oats. The only species caught in this way were *Rattus rattus* and one juvenile *R. fuscipes*.

SPOTLIGHTING

There was a total of 38 spotlight hours both on foot and from a moving vehicle. Spot lighting from a vehicle was in general along the periphery of the pine plantation and when on foot was generally along the roads associated with Clouds Creek.

ROADKILLS

During 1975/76 regular journeys were made along the road between Clouds Creek and Billys Creek, a distance of 13 km. All roadkills were collected, decapitated and skulls subsequently prepared. Fifteen animals were collected in this way. Roadkill specimens and animals that died in traps are located at La Trobe University.

DAYLIGHT SIGHTINGS

During the time spent in the study area any mammals observed during the day were identified and recorded.

MAMMALS OF CLOUDS CREEK

TABLE 1

SYSTEMATIC LIST OF MAMMALS OF THE CLOUDS CREEK AREA INDICATING THEIR OBSERVED ABUNDANCE IN EIGHT HABITATS

1 — closed forest; 2 — tall open forest; 3 — open forest; 4 — woodland; 5 — central pines; 6 — peripheral pine; 7 — grassland; 8 — creek association

abundant (A) >50; common (C) 10-50; uncommon (U) 5-10; scarce (S) < 5 animals observed

| Common name | Scientific name | Habitat | | | | | | | |
|---------------------------|--|---------|---|---|---|---|--------|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Order Monotremata | | | | | | | | | |
| Family Tachyglossidae | | | | | | | | | |
| 1. Echidna | <i>Tachyglossus aculeatus</i> (Shaw) | | | | | | | S | |
| Family Ornithorhynchidae | | | | | | | | | |
| 2. Platypus | <i>Ornithorhynchus anatinus</i> (Shaw) | | | | | | | | S |
| Order Marsupialia | | | | | | | | | |
| Family Dasyuridae | | | | | | | | | |
| 3. Brown phascogale | <i>Antechinus stuartii</i> Macleay | A | A | U | | S | S | | S |
| 4. Tiger-cat | <i>Dasyurus maculatus</i> (Kerr) | S | S | | | | S | | |
| Family Peramelidae | | | | | | | | | |
| 5. Short-nosed bandicoot | <i>Isodon macrourus</i> (Gould) | | S | S | C | | U | C | S |
| 6. Long-nosed bandicoot | <i>Perameles nasuta</i> Geoffroy | | S | | S | | | S | |
| Family Phalangeridae | | | | | | | | | |
| 7. Brush-tailed possum | <i>Trichosurus vulpecula</i> (Kerr) | | | C | A | | C | C | U |
| 8. Mountain possum | <i>Trichosurus caninus</i> (Ogilby) | A | A | C | U | | C | S | C |
| Family Petauridae | | | | | | | | | |
| 9. Ringtail possum | <i>Pseudocheirus peregrinus</i> (Boddaert) | | S | | | | | | S |
| 10. Sugar glider | <i>Petaurus breviceps</i> Waterhouse | | S | S | | | | | |
| 11. Yellow-bellied glider | <i>Petaurus australis</i> Shaw | | S | | | | | | S |
| 12. Greater glider | <i>Schoinobates volans</i> (Kerr) | | C | C | U | | | S | U |
| Family Burramyidae | | | | | | | | | |
| 13. Feathertail glider | <i>Acrobates pygmaeus</i> (Shaw) | | S | | | | | | |
| Family Phascolarctidae | | | | | | | | | |
| 14. Koala | <i>Phascolarctos cinereus</i> (Goldfuss) | | | | S | | | | |
| Family Macropodidae | | | | | | | | | |
| 15. Grey kangaroo | <i>Macropus giganteus</i> Shaw | | | S | U | | C | A | |
| 16. Wallaroo | <i>Macropus robustus</i> Gould | | S | S | | | | | |
| 17. Red-necked wallaby | <i>Macropus rufogriseus</i> (Desmarest) | | | | C | S | A | A | |
| 18. Parma wallaby | <i>Macropus parma</i> Waterhouse | S | U | | | | | | |
| 19. Swamp wallaby | <i>Wallabia bicolor</i> (Desmarest) | U | U | U | | S | U | | U |
| 20. Red-necked pademelon | <i>Thylogale thetis</i> (Lesson) | U | C | C | | | C | | |
| 21. Red-legged pademelon | <i>Thylogale stigmatica</i> Gould | U | S | | | | | | |
| 22. Rufous rat-kangaroo | <i>Aepyprymnus rufescens</i> (Gray) | | S | | | | | | |
| 23. Potoroo | <i>Potorous tridactylus</i> (Kerr) | ? | ? | | S | | ? | ? | |
| Order Chiroptera | | | | | | | | | |
| Family Vespertilionidae | | | | | | | | | |
| 24. Bent-winged bat | <i>Miniopterus schreibersii</i> (Kuhl) | | | | | | aerial | | |
| Order Rodentia | | | | | | | | | |
| Family Muridae | | | | | | | | | |
| 25. Bush rat | <i>Rattus fuscipes</i> (Waterhouse) | C | C | C | | S | C | | U |
| 26. Swamp rat | <i>Rattus lutreolus</i> (Gray) | | | | | | U | | |
| 27. Black rat | <i>Rattus rattus</i> (L.) | | | | | U | C | U | |
| 28. Mosaic-tailed rat | <i>Melomys cervinipes</i> (Gould) | C | C | | | | | | |
| 29. House mouse | <i>Mus musculus</i> L. | | | | | | C | C | S |

| Common name | Scientific name | Habitat | | | | | | | |
|------------------|-----------------------------------|---------|---|---|---|---|---|---|---|
| | Order Lagomorpha | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Family Leporidae | | | | | | | | | |
| 30. Rabbit | <i>Oryctolagus cuniculus</i> (L.) | | | | | s | s | s | |
| | Order Carnivora | | | | | | | | |
| Family Canidae | | | | | | | | | |
| 31. Dog/dingo | <i>Canis familiaris</i> L. | s | s | s | s | s | s | s | s |
| 32. Fox | <i>Vulpes vulpes</i> (L.) | | | s | | | | | |
| Family Felidae | | | | | | | | | |
| 33. Feral cat | <i>Felis catus</i> L. | | c | s | s | s | s | s | s |
| | Order Artiodactyla | | | | | | | | |
| Family Bovidae | | | | | | | | | |
| 34. Cattle | <i>Bos taurus</i> | c | a | a | a | a | a | a | a |

RESULTS

A systematic list of the species of mammals observed in the study area is given in Table 1; Rides' (1970) classification is used. Twenty-seven indigenous and seven introduced species were recorded.

1. Echidna, *Tachyglossus aculeatus*

During the entire study period only one echidna was seen; this was in the grassland area near the Forest Commission Headquarters (F.C.H.).

2. Platypus, *Ornithorhynchus anatinus*

Platypus were sighted on three occasions in the same area although a considerable amount of time was spent along creeks at all times of the day and during all seasons. The sightings were in Clouds Creek near the F.C.H. in a region where the water was moving slowly and there were large pools. Both the monotremes must be considered uncommon.

3. Brown phascogale, *Antechinus stuartii*

A total of 131 individual *A. stuartii* were trapped, mainly in 1975/76. They were found in closed forest and tall open forest near the F.C.H. and to the east of Chapmans Plain Road in open forest, and in the pine plantation itself. Of the nine animals trapped in pine compartments, only two, both males, were trapped in the central plantation (in August at the time of mating); the others were caught in areas adjacent to native forest.

4. Tiger-cat, *Dasyurus maculatus*

Three tiger-cats were trapped during winter months, all in different vegetation types. One was in pines and another in closed forest near the F.C.H., and the other in tall open forest to the east of Chapmans Plain Road.

5. Short-nosed bandicoot, *Isodon macrourus*

Seventy-seven short-nosed bandicoots were trapped in the grazed woodland adjacent to the Armidale-Grafton Road, in the grassland, tall open forest, open forest and pines near the F.C.H. One roadkill was collected at Billys Creek and others were spotlighted in pines, in grassland around the F.C.H. and at the airport. No short-nosed bandicoots were trapped during November, December and January; 42 of the specimens were trapped between May and August.

6. Long-nosed bandicoot, *Perameles nasuta*

The long-nosed bandicoot was considerably less common than *I. macrourus*. Four specimens were trapped in grassland, tall open forest and grazed woodland, all in the vicinity of the F.C.H.

7. Brush-tailed possum, *Trichosurus vulpecula*

This was one of the target species of the ecological study. There was a total of 593 captures representing 98 individuals. None were trapped in tall open forest or closed forest and they occurred less frequently in pines than in grazed woodland, open forest and grassland.

8. Mountain possum, *Trichosurus caninus*

This species was the other major possum species. There was a total of 2,597 captures representing 193 individuals. They occurred mainly in tall open forest and closed forest. They were also found in the other vegetation types although few occurred in grazed woodland. They were widely distributed over the whole of the study area, and all individuals were of the grey colour phase.

9. Ringtail possum, *Pseudocheirus peregrinus*

This species was considered rare in the area. One specimen was trapped in tall open forest near the F.C.H. and two were spotlighted along the creek in the same area.

10. Sugar glider, *Petaurus breviceps*

Three sugar gliders were observed during the day emerging from nest holes in open and tall open forest near the F.C.H. They appeared to have been forced out by *T. caninus* and *T. vulpecula* which climbed the trees after being released from traps.

11. Yellow-bellied glider, *Petaurus australis*

This species was not sighted but its characteristic calls were heard several times in trees along the banks of the creek and in tall open forest near the F.C.H.

12. Greater glider, *Schoinobates volans*

This species was widely distributed throughout the study area; it was not observed in pines or grassland.

13. Feathertail glider, *Acrobates pygmaeus*

Only one dried skin of this species was found in tall open forest near the F.C.H.

14. Koala, *Phascolarctos cinereus*

One koala was found dead after a "control burn" in grazed woodland approximately 2 km to the west of the Armidale-Grafton Road.

15. Grey kangaroo, *Macropus giganteus*

This species was common and widely distributed in the study area and was sighted in grassland, grazed woodland, open forest and pines.

16. Wallaroo, *Macropus robustus*

This species is considerably less common than the grey kangaroo. One skull was collected opposite a transition of tall open and open forest approximately 5 km south of Clouds Creek. One live specimen was observed in a similar forest type near the F.C.H.

17. Red-necked wallaby, *Macropus rufogriseus*

This species was found extensively throughout the pines and in areas of grazed woodland and grassland.

18. Parma wallaby, *Macropus parma*

Four roadkills of this species were collected, one near closed forest and two near tall open forest ca. 3 km to the south towards Billys Creek, and one at Muck Creek. This species is probably quite common throughout the area.

19. Swamp wallaby, *Wallabia bicolor*

Two specimens were trapped in pine and along the creek in tall open forest near the F.C.H. This species was observed mainly during the day in closed forest, tall open and open forest.

20. Red-necked pademelon, *Thylogale thetis*

This small macropod was common throughout the whole study area and was sighted mainly on roads between the pines and native forest. Two roadkills were collected near grazed woodland.

21. Red-legged pademelon, *Thylogale stigmatica*

This pademelon was less common than *T. thetis* and was observed only along roads near closed forest.

22. Rufous rat-kangaroo, *Aepyprymnus rufescens*

Only one specimen was collected as a roadkill near tall open forest 10 km towards Billys Creek.

23. Potoroo, *Potorous tridactylus*

Only one specimen was trapped in grazed woodland near the F.C.H. However, spotlight sightings gave only a glimpse of many small macropods throughout the study area which were probably potoroos; this species is probably more common than indicated by the one capture and lack of positive sightings.

24. Bent-winged bat, *Miniopterus schreibersii*

The only bat collected was one specimen of this species which was brought in by a cat. Numerous bats were observed in the area but these remain unidentified.

25. Bush rat, *Rattus fuscipes*

Eighty-five individual *R. fuscipes* were trapped in closed forest, tall open forest, open forest and on the periphery of the pines. They were scattered throughout the study area, but were nowhere in high numbers; only one individual was caught in the central pine area. The nipple formula $1 + 3 = 8$ and $2 + 3 = 10$ occurred in the ratio of 3:1.

26. Swamp rat, *Rattus lutreolus*

Nine individuals were trapped in February and May 1975. They were all trapped within 35 m of the edge of the eastern pine compartments.

27. Black rat, *Rattus rattus*

A total of 16 individuals were trapped in both central and peripheral pines with live and break-back traps. None were trapped in native forest. Two colour phases, the black-backed and the brown-backed, occurred in the ratio of 7:1.

28. Mosaic-tailed rat, *Melomys cervinipes*

Twenty-six individuals were trapped in closed forest and tall open forest to the east of Chapmans Plain Road. Of these only two were trapped along the edge of a road.

29. House mouse, *Mus musculus*

Only eight individual mice were trapped, all in peripheral pines near the F.C.H. and in the eastern pines. None were trapped in native forest. Others have been brought in by cats and observed in grassland near the F.C.H.

30. Rabbit, *Oryctolagus cuniculus*

No rabbits were seen during 1975/76 and they must now be considered rare or absent from the area. However, in 1971 they were present in the one to two-year-old pine compartments.

31. Dog/dingo, *Canis familiaris*

One dog skeleton was found in grassland at Chapman Plain 11 km south-east of F.C.H., and numerous pads and faeces were observed along the pine periphery.

Three known individuals have been seen together in open forest near the airport, along Sheep Station Creek Road, and along a road through the pines near the F.C.H. Dogs probably roam throughout the area.

32. Fox, *Vulpes vulpes*

Only one roadkill fox was collected 6 km along the Armidale-Grafton Road towards Billys Creek; this species must be considered rare.

33. Feral cat, *Felis catus*

Feral cats are common and widely distributed throughout the study area except for no sightings in closed forest. Specimens have been trapped in both tall open forest and in pines.

34. Cattle, *Bos taurus*

This species is included as cattle are allowed to graze in the State Forest. They are wide-ranging and occur throughout the whole study area in all vegetation types.

DISCUSSION

The mammal fauna of Clouds Creek State Forest is very diverse. There are 27 species of native mammal and seven introduced species; this list will undoubtedly be considerably extended when more bats and some of the small macropods are collected and identified. The faunal diversity compares favourably with that of the area drained by the upper Richmond and Clarence Rivers (100 km to the north) where 45 native species (12 of which were bats) and seven introduced species were recorded (Calaby, 1966) in an area of 2,400 km² (cf. 118 km² in the Clouds Creek study area) and a smaller survey in Moonpar State Forest 15 km to the south where 17 species were recorded (Maynes, 1974).

The small mammals, however, were not particularly abundant; trap success with live small mammal traps averaged 4.4% ranging from 0.4% in the central pines to 8% in native forest to the east of Chapmans Plain Road. This latter area held three species, *A. stuartii*, *R. fuscipes* and *M. cervinipes*, the two rodents being present in relatively low numbers.

The distribution of mammals throughout the area showed that only *R. rattus*, *R. lutreolus* and *M. musculus* were trapped only in pines. This appears dependent on the age of the pines; in the older pines *R. rattus* and *M. musculus* were very strongly associated with the periphery. Although *R. lutreolus* were trapped in pines, this species was a transient in the study area and all captures were again very strongly associated with the periphery. Little is known of the biology of this species, but Braithwaite (pers. comm.) believes their distribution is closely correlated with the penetrability of the soil in which they burrow. High summer and early autumn rainfall could explain the patchy temporal distribution of this species.

Individual *R. fuscipes* and *M. rufogriseus* and possibly some *M. giganteus* and *I. macrourus* also occurred in pines and associated grasslands, but other individuals of these species occurred solely in other vegetation types. Although a few (nine out of 131) *A. stuartii* were trapped in pines, none were recaptured. Two transient male *A. stuartii* were trapped in the central pine area during the mating period, but females appeared absent from this area. Other species were observed in pines but they appeared dependent on nearby native forest areas; these included *D. maculatus*, *Trichosurus caninus*, *T. vulpecula* and *Thylogale thetis*.

The species found solely in association with native forest were *S. volans*, *Melomys cervinipes*, *Thylogale stigmatica* and probably *Perameles nasuta*, *Pseudochairus peregrinus*, *Petaurus breviceps*, *P. australis*, *Acrobates pygmaeus*, *Phascogale cinereus*, *Macropus robustus*, *M. parma*, *M. dorsalis* and *Aepyprymnus rufescens*; none of these species were observed in anything other than native forest although several occurred in grazed woodland.

None of the forest in the Clouds Creek area has been left untouched by man. Disturbance varies from selective logging in closed forest areas to complete clearfelling of native forest and subsequent planting with *Pinus* spp. The remaining closed and tall open forests are probably the least disturbed. Grazing obviously alters the vegetation association and clearing and replacing with pines is a serious perturbation.

The replacement of native forest by pines has a range of effects on the fauna depending upon the age of pines and the distance from native vegetation. *Melomys cervinipes*, *Schoinobates volans* and *Thylogale stigmatica* are always lost, while *Trichosurus caninus* and *T. vulpecula* utilize the pine margins but do not live solely in pines (How, 1972). In the central pines no native small mammals occur and are replaced by *R. rattus* and *Mus musculus*.

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ADDENDUM

Continued survey of the area since submission of the manuscript has resulted in the following additions. An individual male of each of *Mus musculus* and *Pseudocheirus peregrinus* was trapped in closed forest and one male *Rattus lutreolus* was trapped in creek-associated grassland.
