CHAPTER 1

INTRODUCTION

The settlement of Australia by Europeans has served to accelerate the trend of environmental alteration begun by aboriginals on their arrival over 26,000 years ago (Merrilees, 1968). This trend takes several different forms.

Large areas of forest and woodland have been cleared for agriculture and grazing purposes with a consequent decline in suitable habitats for native faunal species. Several species of native fauna were exploited for their sporting or economic value, and numerous species of plants and animals were introduced for their commercial and aesthetic values. These introductions competed with many native species and a decline in both the distribution and abundance of the latter occurred, particularly amongst the native marsupials. Marlow (1958) assessed the present day status of marsupials in N.S.W. and concluded that 42% of all the marsupials recorded since European settlement fell into the presumed extinct or rare categories, while Calaby (1963) referred to the decline that had occurred in the geographical range of many Australian mammals since European settlement.

Despite the magnitude of these environmental alterations there have been very few studies aimed at determining the effect of these changes on species populations. Ealey (1967) discussed the relationships

between and fluctuations in the numbers of sheep and euros, *Macropus robustus*, in the Pilbara district of Western Australia, while Tyndale-Biscoe and Smith (1969a and 1969b) investigated the effect of habitat destruction on a population of greater gliders, *Schoinobates volans*, on the southern tablelands of N.S.W.

The study of Tyndale-Biscoe and Smith was the consequence of one of the more recent causes of environmental perturbation, that of clear felling large areas of native forest for plantings of introduced conifers, mainly *Pinus* spp.

1.1. History of the Study

Mammaliam damage to plantings of introduced *Pinus* spp. have occurred in nearly all states of Australia, but have been concentrated in the eastern states where the majority of these plantings occur (McNally, 1955; Baur, 1958; Kehl, pers.comm.). In New Zealand where all terrestrial mammals have been introduced, the damage to pine plantings has been severe (McKelvey, pers.comm.), particularly by the Australian brush-tailed possum, *Trichosurus vulpecula* (Kerr, 1792).

In Victoria and N.S.W. McNally and Baur made preliminary investigations to determine the species responsible for damaging pine plantings and the extent to which damage occurred, but both pointed out that there was a definite need for a thorough understanding of the biology of the offending species before suitable methods of control could be carried out.

Baur's study of N.S.W. forests showed that three major groups were responsible for severe damage in forest systems. These were the rabbit, the macropod group and the possum. Following this survey the N.S.W. Forestry Commission initiated the present research in 1966, into marsupial damage in state forests.

After a thorough examination of literature pertaining to marsupial damage, and surveys of some affected areas in north-eastern N.S.W., it was determined that possums constituted a serious threat to the establishment of pine plantings in that area, and that research should concentrate on this group of pests.

Three species of possum are responsible for attacking pine trees (Baur, 1958); they are the ring-tailed possum, *Pseudocheirus peregrinus*, (Boddaert, 1785), the brush-tailed possum, *Trichosurus vulpecula* and the mountain possum, *T.caninus* (Ogilby, 1836).

Initially the possum-pine problem involved research into the ring-tailed possum and this was reported by How (1966). During the course of this initial phase of study, it was determined that the brush-tailed and particularly the mountain possum, were far more serious agents in damaging the pine plantings in north-eastern N.S.W. than the ring-tailed possum. Consequently the orientation of the research was switched into a study of these two species.

1.2. Aims of the Study

The aim of this research was to understand the ecology of the brush-tailed possum, *T.vulpecula*, and the mountain possum, *T.caninus*

and so permit their management in pine plantations in such a way that these indigenous species were not threatened and that the pine plantings were safe from attack.

1.3. Approach

In order to achieve this aim it was necessary to have a comprehensive understanding of the population structure and function of both these closely related species in natural and modified populations. It was also necessary to have an assessment of the distribution, extent and significance of damaged pine plantations.

With this approach in mind it was decided to conduct a capture-recapture programme on these species at Clouds Creek in north-eastern N.S.W. where these species occur in both natural forest systems and a pine plantation. Cage studies of *T.caninus* were carried out to determine the reproductive biology and growth in this species and surveys of areas subject to damage by *Trichosurus* were also undertaken.

1.4. The Genus *Trichosurus*

1.4.1. DESCRIPTION AND DISTRIBUTION

There are three species (Ride, 1970) in the marsupial phalangerid genus, *Trichosurus*. These are; the brush-tailed possum *Trichosurus vulpecula*, the mountain possum *T.caninus* and the northern brush possum *T.arnhemensis*, Collett 1897. All these species are arboreally adapted herbivores although they spend some of their time travelling or

FIGURE 1.1A: The brush-tailed possum, *Trichosurus vulpecula* (Kerr, 1792).

FIGURE 1.1B: The mountain possum, *Trichosurus caninus* (Ogilby, 1836).

feeding on the ground.

The brush-tailed possum *T.vulpecula* is a well known and wide ranging species, occurring throughout most of mainland Australia and Tasmania. It is also abundant throughout New Zealand where it was introduced in 1838 (Pracy, 1962). Finlayson (1961) reported that though it had declined in Central Australia it was still found there. Troughton (1954) recorded seven races of this species which included the northern brush possum *T.arnhemensis* (recognised as a separate species by Ride) but full specific recognition was given to the Tasmanian brush-tail which is now regarded by nearly all workers as representing a race (*T.v.fuliginosus)* of the mainland form *T.v.vulpecula*.

There are numerous colour phases of this species ranging from the common grey or silver grey, to the golden and melanic phases in Tasmania and the coppery colour of the north Queensland race *T.v.johnstoni*. This variation in colour phase led most early taxonomists into classifying them as several separate species. Sexual dimosphism occurs in most phases, with adult males becoming rufous on the neck and shoulders.

The mountain possum *T.caninus* is readily distinguished from its congener by its smaller and more rounded ears which are not nearly as prominent as those of *T.vulpecula* (Figure 1.1.). It also has a more robust build, denser fur, clearer sternal gland exudate, and the tail fur tends to taper distally. No sexual dimorphism occurs in this species, but there is a melanic colour phase, *T.c.nigrans*, which occurs in north-

eastern N.S.W. and south-eastern Queensland (Troughton, 1954; Calaby, 1966).

The distribution of *T. caninus* is confined to the sub-tropical rainforests, temperate rainforests and moist hardwood forests of south-eastern Australia. Owen (1964) reported the occurrence of this species from the Bunya Mountains in south-eastern Queensland, down the eastern escarpment of the Great Dividing Range to the mountain ash forests of south-eastern Victoria. Calaby (1966) noted that very little, if any, overlap occurred in the ranges of these two *Trichosurus* species in north-eastern N.S.W.

The northern brush possum *T. arnhemensis* is much more restricted in its range, occurring only in the north and north-east of Western Australia from the Kimberley district and across the northern section of the Northern Territory. It also occurs on Barrow Island, off the Western Australian coast (Ride, 1970).

It has a more slender build than *T. vulpecula* and a more sparsely haired tail, which is naked on the sides and ventral surface. The colour varies from grizzled grey to reddish brown (Troughton, 1954).

1.4.2. PREVIOUS LITERATURE

There is a large volume of literature concerning the common brush-tailed possum *T. vulpecula*, but very little has been written on the mountain possum *T. caninus* and even less on the northern brush possum *T. arnhemensis*.

The distribution and abundance of *T. vulpecula* in Australia has

been described by Troughton (1954), Guiler (1953), Guiler and Banks (1958), Marlow (1958), Owen (1964) and Ride (1970) while in New Zealand Pracy (1962), and Pracy and Kean (1969) give a thorough history of its introductions, liberations and distribution.

The reproduction and reproductive physiology of *T.vulpecula* has received considerable attention by Bolliger and his co-workers between 1938 and 1948. Significant contributions have also been made by Tyndale-Biscoe (1955), Lyne, Pilton and Sharman (1959), Sharman (1962), Pilton and Sharman (1962), Kean, Marryatt and Carroll (1964), Clark and Sharman (1965) and Gilmore (1969) among many others.

Growth and age determination criteria were described by Lyne and Verhagen (1957), Kingsmill (1962) and Pekelharing (1970) while longevity has been discussed by MacLean (1967) and in New Zealand by Crawley (1970).

Caughley and Kean (1964), Hope (1972) and Smith, Brown and Frith (1969) considered the sex ratios of pouch young with the last named determining the breeding biology of this species in natural populations in N.S.W.

The behaviour of caged animals in New Zealand has been described by Kean (1967), while Winter (pers. comm.) has conducted a detailed study into the behaviour and social organisation of individuals in a free living population in Australia.

An analysis of the structure of the exocrine glands was reported by Green (1963). Thomson and Pears (1962) made preliminary attempts to

assess the significance of glandular secretions for both *T.vulpecula* and *T.caninus*.

The food of *T.vulpecula* has received considerable attention in New Zealand (Kean and Pracy, 1953; Mason, 1958 and Gilmore, 1965a,1965b) where considerable damage is caused by this species to native forests. Owen (1964) is the only researcher to report on the dietary preferences of this species in Australia, while McNally (1955), Mollison (1960) and Cremer (1969) have all shown that *T.vulpecula* is responsible for considerable damage to both introduced and indigenous tree species.

The study of populations of *T.vulpecula* has received little consideration. Besides the exploratory nature of the studies reported by Tyndale-Biscoe (1955), Dunnet (1956) and Owen (1964), only Dunnet (1964) has recorded the sequence of population performance for a period of greater than twelve months.

The literature relating to *T.caninus* is limited, and nearly all of it results from the work of Owen (1964). The comparative ecology of *T.vulpecula* and *T.caninus*, based on food preferences and den location, was reported by Owen and Thomson (1965). Thomson and Pears (1962) commented on the function of the anal glands in this species while Owen and Thomson (1964) reported on a varient haemoglobin in the mountain possum.

The definite lack of detailed research into the population structure and function of *T.vulpecula* is significant when it is considered that this species is the only marsupial which adapted to and has become associated with man in his urban environment in Australia.

CHAPTER 2

METHODS AND MATERIALS

2.1. Study Area

2.1.1. LOCATION

The field study area for the present research was at Clouds Creek (30°05'S, 152°37'E) in north-eastern N.S.W. (Figure 2.1.)

Clouds Creek is situated on the eastern escarpment of the New England Tableland about 137 km. (85 miles) north-west of Armidale by road, and on the northern edge of the Dorrigo Plateau, 24 km. (15 miles) north-east of Dorrigo.

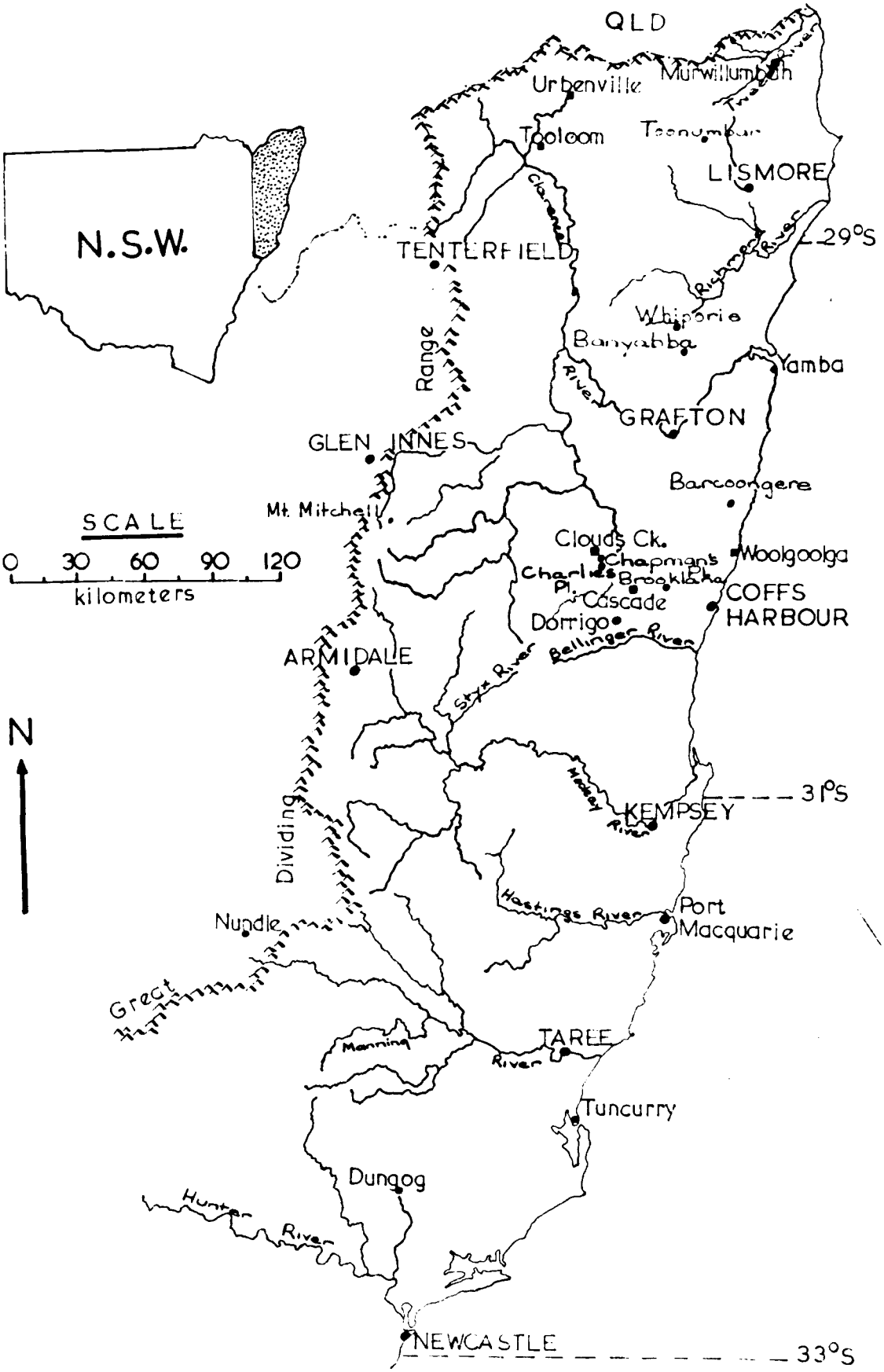
2.1.2. PHYSIOGRAPHY AND TOPOGRAPHY

The eastward flow of Clouds Creek contributes to the catchment of the Nymboida River which in turn is the major southern catchment for the Clarence River, the largest river in the east of the state.

The altitude of the former village of Clouds Creek is 595 m. (1950 ft.) above sea level (A.S.L.) but the undulating country surrounding the old village ranges from about 570 m. A.S.L. to a high of 730 m. A.S.L. at Shea's Nob, 1.5 km. west of the township.

The area covered by the trap-recapture programme varied from 595 m. altitude at Clouds Creek to 670 m. at the top of Deadmans Range about 1 km. north of the village.

FIGURE 2.1: North-eastern New South Wales showing the localities mentioned in the text.



NORTH — EASTERN N.S.W.

2.1.3. GEOLOGY AND SOILS

The geological formations of the Clouds Creek area are partially metamorphosed Palaeozoic sediments of Ordovician-Silurian age. Tertiary basaltic flows have occurred over some of the outlying areas, and the arboreta and plantings at Chapmans Plains and Charlies Plain (Figure 2.1.) are on just such basaltic outcrops.

Soils in the area are generally red or yellow podzols, while those derived from the basalt are mostly red loams (Baur, 1962).

2.1.4. CLIMATE

Weather records have been maintained at Clouds Creek Forestry Office since 1946, and the mean monthly maximum, minimum and rainfall for the 25 years to 1971 can be seen in Table 2.1.

TABLE 2.1

Mean monthly rainfall and maximum and minimum temperatures at Clouds Creek, 1946-71

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Rainfall (pts)	894	832	697	356	262	367	254	283	215	399	445	670	5684
Mean Maximum °F	78.1	76.9	75.1	70.9	65.6	61.6	60.6	62.9	66.9	71.8	76.3	79.2	
Mean Minimum °F	56.8	57.6	53.6	46.5	38.5	35.0	32.3	33.8	38.1	44.8	50.2	54.9	

The features of the climate are the cold dry winter and the hot wet summer months. The lowest minimum recorded over the 25 years was

FIGURE 2.2: Aerial photograph of Clouds Creek taken in 1964. The dark central area is the 1950-51 plantings of *P.elliottii* and *P.taeda* and to the west of it is the village of Clouds Creek .

12°F (-11.1°C) in July, 1966 and the highest maximum 103°F (39.5°C) in November, 1968.

Rainfall is concentrated in the summer months with over 55% of the average annual rainfall of 56.84 in. (1443 mm.) falling between November and March.

2.1.5. VEGETATION

Based on the classification of Beadle and Costin (1952) the three types of tree dominated communities are found in the study area at Clouds Creek. These are rainforest, sclerophyll forest and woodland.

Small areas of sub-tropical rainforest occur both to the north and south of the pine plantation (Figure 2.2). Species found commonly in this association are Coachwood, *Ceratopetalum apetalum* and Sassafras, *Doryphora sassafras* along with several others of commercial value (Figure 2.3A). The southern rainforest area was cleared in early 1970 for subsequent pine plantings.

In the transitional zone between rainforest and moist hardwood forest, the brush box, *Tristania conferta* is prominent while the wet sclerophyll forest in the area is dominated by Tallowood, *Eucalyptus microcorys*, Sydney Blue Gum, *E.saligna*, White Mahogany, *E.acmenoides*, Dunns White Gum, *E.dunnii* and Turpentine, *Syncarpia* spp. Numerous rainforest species form a dense secondary tree and shrub layer in the wet sclerophyll forest (Figure 2.3B).

There is a large area to the north-west of the plantation (Figure 2.4A) dominated by Blackbutt, *E.pilularis* while the area immediately

FIGURE 2.3A: Sub-tropical rainforest area and the type of non-collapsible wire trap used.

FIGURE 2.3B: Wet sclerophyll forest on the northern side of Clouds Creek.

FIGURE 2.4A: Dry sclerophyll forest area .

FIGURE 2.4B: The grazed woodland area to the west of the Armidale-Grafton road .

to the south of the pine was New England Blackbutt, *E.campanulata* and Camerons Stringybark, *E.cameronii*, as co-dominants prior to its clearing in 1970.

The grazed woodland (Figure 2.4B) to the west of the village is mainly Broadleafed Stringybark, *E.caliginosa* and Ribbon Gum, *E.viminalis* (Baur, 1962). Along the creek the Water Gum (*Tristania laurina*) forms a very dense association.

The central feature of the study was the pine plantation. The 1950-51 plantings of *Pinus elliottii* and *P.taeda* can be seen in Figure 2.2, but much of the natural vegetation to the south of the creek and east of the older plantings has been cleared for subsequent plantings since the 1964 aerial photograph was taken (Figure 2.5A). A further perturbation of the study area occurred with the thinning of every third row of *P.elliottii* during 1970 (Figure 2.5B).

2.2. Field Data

2.2.1. TRAPPING METHODS

2.2.1.1. Trap Type and Baits

The capture-recapture programme at Clouds Creek was carried out using wire mesh traps obtained from the Mascot Wire Works, 11 Dunlop Street, Enfield, N.S.W. 2136.

Figure 2.3A shows the type of non-collapsible trap marketed by this firm. Trap length was either 2' (61 cm.) or 2'6" (76 cm.) while the depth and width remained the same for both types at 12" x 12" (30 cm. x 30 cm.). Traps weighed between 3 and 4 kg.

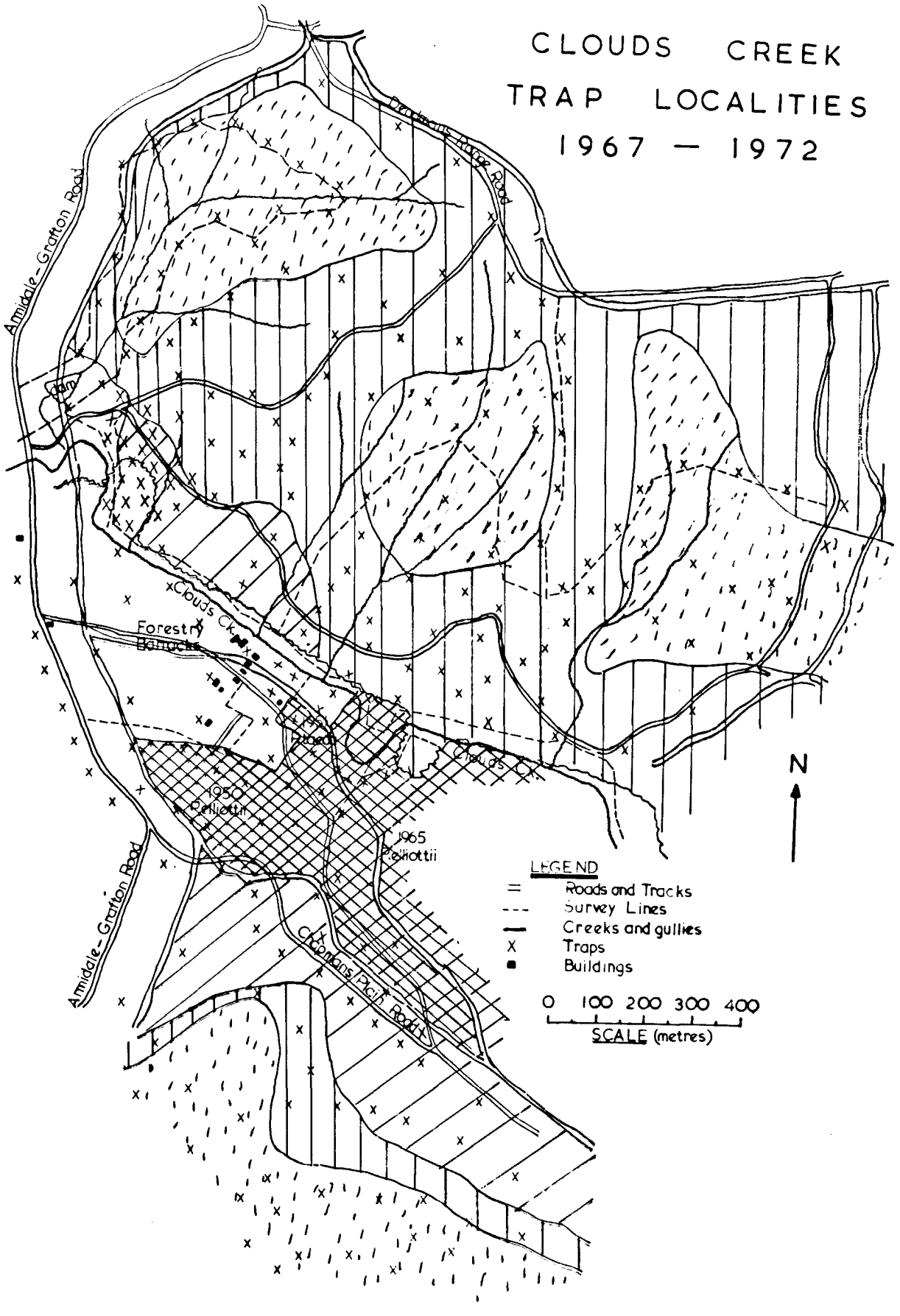
FIGURE 2.5A: The 1950-51 pine plantation and the cleared area formerly covered by the southern sclerophyll forest.

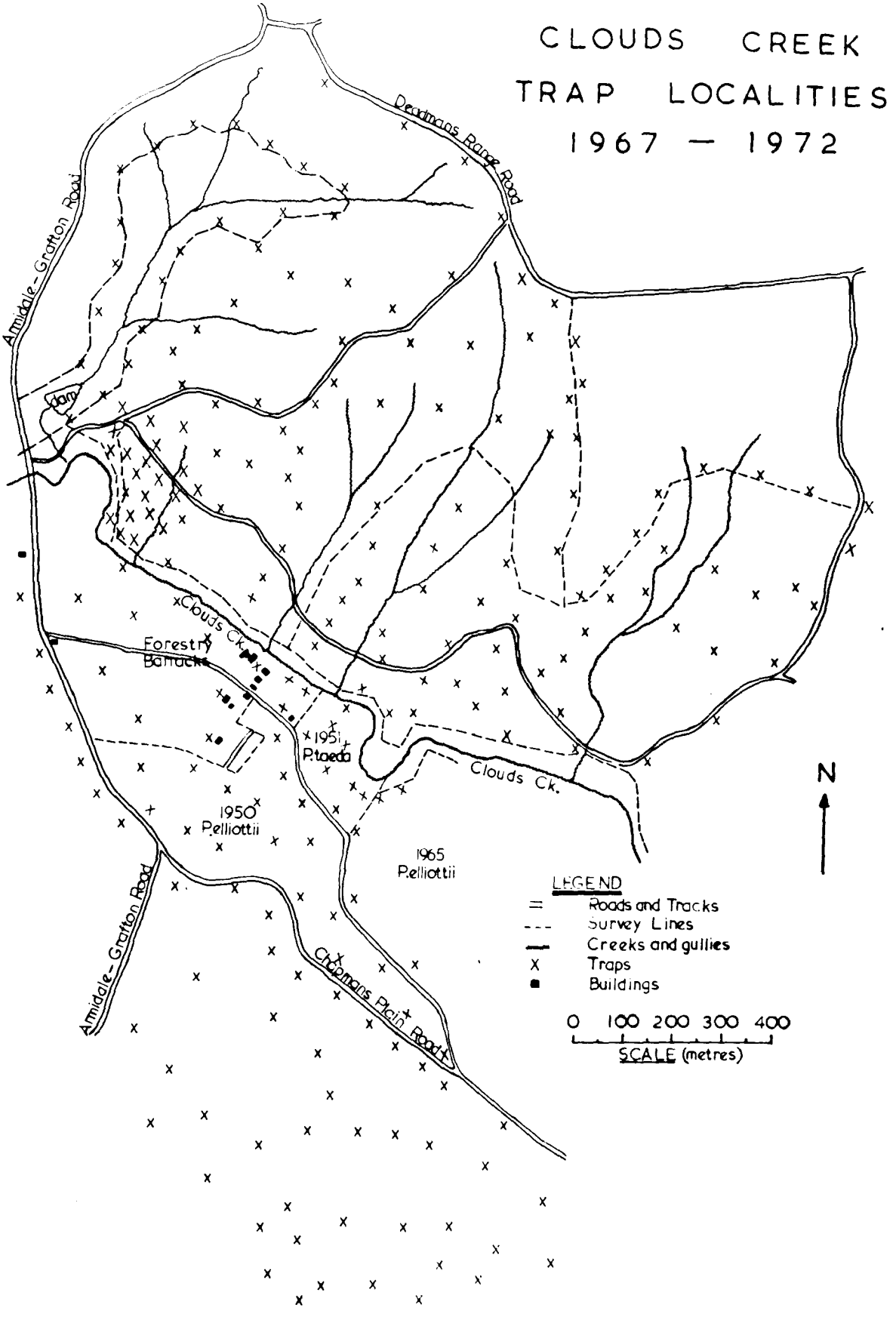
FIGURE 2.5B: Thinning within the 1950 *P.elliottii* planting.

FIGURE 2.6: Trap locations used at Clouds Creek during the entire study period, showing the area covered by traps in the northern sclerophyll forest, the 1950-51 pine plantation, the 1965 pine plantation, the southern sclerophyll (cleared in February, 1970 and planted with pine) and the woodland-old urban area (c.f. Figure 2.2).

LEGEND FOR OVERLAY

Stipple - sub-tropical rainforest
Vertical hatching - wet sclerophyll forest
Diagonal hatching - dry sclerophyll forest
Cross hatching - pine
Clear - woodland-old urban area.


CLOUDS CREEK
TRAP LOCALITIES
1967 — 1972
Amidale - Grafton Road
Dangars Ridge Road
Dam
Clouds Ck
Forestry Barracks
Road
Clouds Ck
1950 Pelliottii
1965 Pelliottii
Amidale - Grafton Road
Chandlans Pitch Road
N
LEGEND
Roads and Tracks
Survey Lines
Creeks and gullies
Traps
Buildings
0 100 200 300 400
SCALE (metres)


CLOUDS CREEK
TRAP LOCALITIES
1967 — 1972
Deadmans Range Road
Armidale-Grafton Road
dam
Clouds Ck.
Forestry Barracks
1951
P.toeda
1950
P.elliottii
1965
P.elliottii
Clouds Ck.
Armidale-Grafton Road
Chapmans Plain Road
N
LEGEND
Roads and Tracks
Survey Lines
Creeks and gullies
Traps
Buildings
0 100 200 300 400
SCALE (metres)

A possum entering the trap would pull down on the bait attached to a hook at the top of the cage which would then release a spring-loaded door. A running bar would then slide down to secure the door in position.

The traps were baited exclusively with apple. This was consistent with the procedures of Dunnet (1956), Owen (1964) and Gilmore (1969). Trials were conducted initially with peanut butter and oranges, but apple was found to be the most preferred and was easy to obtain and to handle under field conditions.

2.2.1.2. Trap Spacing

Because of the difficulties in trapping in certain vegetation types and topographical localities, traps were not set on a rigid grid system, but were spaced as uniformly as possible at suitable locations. These localities were determined subjectively.

After the first twelve months of study when the trap density was between 5/ha. and 3/ha., traps were positioned at likely successful localities, at density of about 1/ha. Figure 2.6 shows the distribution of trap localities utilised over the entire study at Clouds Creek.

2.2.1.3. Trapping Interval

Trapping was conducted for three successive nights every second week. Tyndale-Biscoe (1955) and Gilmore (1969) both trapped for three successive nights but Dunnet (1964) appears to have trapped for longer periods.

Table 2.2. records the days, month and year of all trapping periods during the study. Associated with each figure is the week of the year during which the trapping period occurred. All future references to

TABLE 2.2

Trapping periods at Clouds Creek 1967-72, expressed in days, month and week of year

1967			1968			1969			1970			1971		
Day	Month	Week	Day	Month	Week	Day	Month	Week	Day	Month	Week	Day	Month	Week
23-24	xi	47	10-11	i	2	7-9	i	2	6-8	i	2	6-8	i	2
8-10	xii	49	24-26	i	4	21-23	i	4	20-22	i	4	11-13	ii	7
19-21	xii	51	6-8	ii	6	4-6	ii	6	3-5	ii	6	23-25	ii	9
			20-22	ii	8	18-20	ii	8	17-19	ii	8	10-11	iii	11
			5-7	iii	10	4-6	iii	10	3-5	iii	10	23-25	iii	13
			18-20	iii	12	18-20	iii	12	17-19	iii	12	6-8	iv	15
			2-4	iv	14	1-3	iv	14	1-3	iv	14	20-22	iv	17
			17-19	iv	16	29-1	iv	18	14-16	iv	16	11-13	v	20
			21-23	v	21	13-15	v	20	28-30	iv	18	25-27	v	22
			4-6	vi	23	27-29	v	22	12-14	v	20	8-10	vi	24
			18-20	vi	25	10-12	vi	24	26-28	v	22	22-24	vi	26
			2-4	vii	27	24-26	vi	26	9-11	vi	24	6-8	vii	28
			16-18	viii	29	8-10	vii	28	23-25	vi	26	20-22	vii	30
			7-8	viii	32	22-24	vii	30	7-9	vii	28	3-5	viii	32
			20-22	viii	34	5-7	viii	32	23-24	vii	30	16-18	viii	34
			3-5	ix	36	19-21	viii	34	4-6	viii	32	31-2	ix	36
			24-26	ix	39	2-4	ix	36	18-20	viii	34			
			9-11	x	41	16-18	ix	38	1-3	ix	36	14-16	xii	51
			23-25	x	43	30-2	x	40	14-16	ix	38			
			5-7	xi	45	21-23	x	43	29-1	ix	40			
			19-21	xi	47	4-6	xi	45	13-15	x	42			
			3-5	xii	49	18-20	xi	47	27-29	x	44			
			17-18	xii	51	2-4	xii	49	10-12	xi	46			
									24-26	xi	48			
									15-17	xii	51			
									21-22	xii	52			

1972		
5-7	i	2
1-3	ii	6

trapping will be recorded in terms of a week and a year (e.g. any possums caught on the 8th, 9th or 10th December, 1967 will be recorded as having been captured during the 49/67).

2.2.1.4. Area Trapped

The area trapped and the density of traps was altered during the study.

The 20 ha. (50 ac.) of the 1950-51 pine planting had been trapped since early 1964, but it was not until during 20/69 that the trap-spacing assumed the positions shown in Figure 2.6. for the plantation area.

The northern sclerophyll forest was trapped for the first time during 47/67 at which time ten traps were set over 2 ha., this was extended by the increments shown in Table 2.3, until 117 traps covered the 140 ha. at the end of the study.

TABLE 2.3

Trap density in the northern sclerophyll forest

Period	Area (ha.)	Traps	Density Traps/ha.
47/67-10/68	2	10	5.00
12/68-14/69	7	24	3.43
18/69-34/69	25	43	1.72
36/69-26/70	46	67	1.46
20/70-26/70	46	49	1.06
28/70-32/70	66	67	1.02
34/70-38/70	113	97	0.86
40/70-2/72	140	117	0.83

In the woodland and old urban area trapping commenced during 39/68 when two traps were set in 4 ha. of woodland. During 26/69 this trapped area was extended to 30 ha. with 20 trap positions, but only 13 of these were used consistently due to the high turnover of traps in this area.

The southern sclerophyll forest was trapped initially during 39/68 when 7 ha. immediately to the south of, and peripheral to the pine were trapped. During 18/69 the area trapped was enlarged to 45 ha. an area which extended 800 metres south of the pine and into the rainforest area.

The 1965 pine planting was trapped briefly during 1969.

2.2.2. DATA RECORDED

2.2.2.1. Possum Data

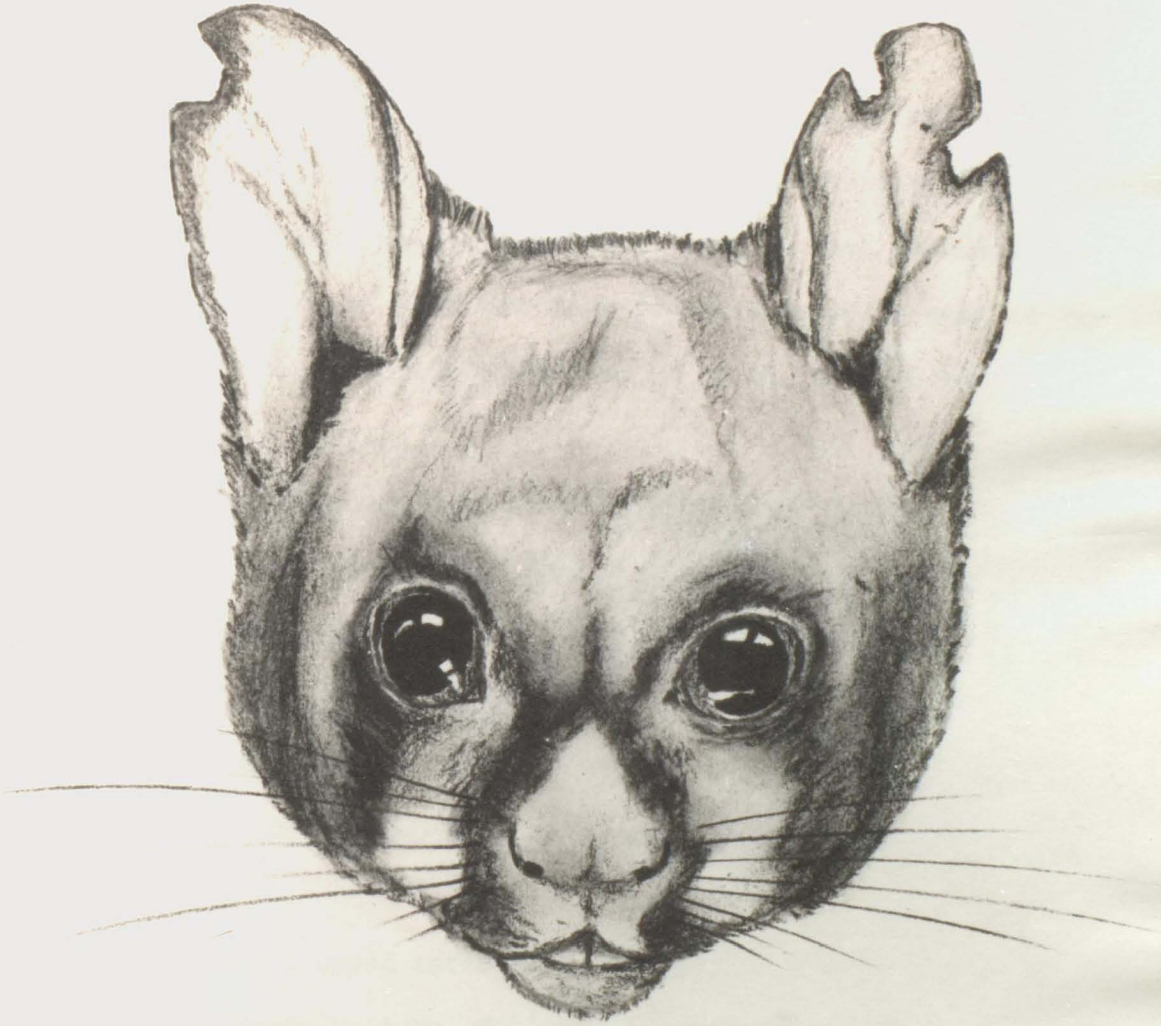
On its initial capture a possum was weighed in the trap, then moved from the trap into a hessian sack for further measurements and marking. For the first twelve months, animals were anaesthetised with ether before examination. This practice was abandoned then in favour of holding the active animal on the ground manually.

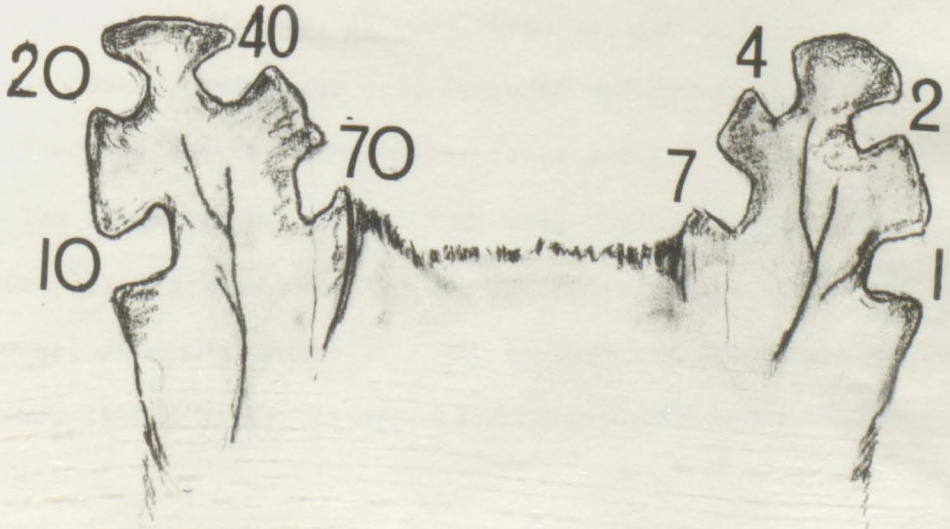
Marking

Animals were marked by ear clipping. Four positions were used on each ear as is shown in Figure 2.7. The numbers on the left ear represent one to nine and the numbers on the right ear ten to ninety.

It was only necessary therefore to remove, at a maximum, two notches from each ear to describe identities from one to ninety-nine.

FIGURE 2.7: Frontal view of *Trichosurus* showing the ear positions used for marking and their respective numerical values.




20
40
70
10
4
2
7
1

Observations

Once in the sack, head length and length of the left testis or condition of the pouch was noted. If pouch young were present, a measure of the head length was taken and the teat being suckled recorded. The condition of the sternal gland and body fur were noted as well as any other unusual criteria such a scratch marks on the nose or wounds elsewhere.

After releasing the individual from the sack it was sometimes possible to follow it to its den site. This location was then recorded. The empty trap was weighed to determine the weight of the individual.

2.2.2.2. Non Target Species

Nine species of mammals, six species of birds and two species of reptiles, other than the two species of possum,were trapped during the study.

The mammals trapped included a Ring-tailed possum, *Pseudocheirus peregrinus*, one Swamp Wallaby, *Wallabia bicolor*, three Red-necked Pademelons, *Thylogale thetis*, one Potoroo, *Potorous tridactylous*, 24 Short-nosed Bandicoots, *Isoodon obesulus*, two Long-nosed Bandicoots, *Perameles nasuta*, one Tiger Cat, *Dasyurus maculatus*, three Allied Rats, *Rattus fuscipes* and two Feral Cats, *Felis catus*.

The birds trapped were; four Grey Shrike-Thrush, *Colluricincla harmonica*, 15 Black-backed Magpies, *Gymnorhina tibicen*, 30 Pied Currawongs, *Strepera graculina*, 180 Satin Bower Birds, *Ptilonorynchus violaceus*, 24 Cat Birds, *Ailuroedus crassirostris* and a White-winged

Chough, *Corcorax melanorhamphus*.

The reptiles caught were two Carpet Snakes, *Morelia spilotes variagata* (unable to escape after entering and eating Bower Birds) and a Land Mullet, *Egernia bungana*.

2.2.3. SURVEYS

2.2.3.1. Questionnaire

During late 1967 a questionnaire was formulated in collaboration with the Forestry Commission. It was sent to all forestry officers in the state by the N.S.W. Forestry Commission in order to determine the change, if any, in species responsible for damage to forests or forestry works since the last survey conducted by Baur in 1958. This questionnaire showed that possums, especially *T. caninus*, remained a significant threat to pine plantings in north-eastern N.S.W. (How 1968).

2.2.3.2. Spotlighting

Between 6th September and 1st November 1967, four nights were spent spotlighting in natural vegetation at Clouds Creek to determine the arboreal species present in the area. These data are recorded in Table 2.4.

TABLE 2.4

Arboreal species recorded by spotlighting at Clouds Creek

DATE	TIME SPOTLIGHTING	SPECIES RECORDED			
Day/Month/Year	Hours	*Trichosurus caninus*	*Trichosurus vulpecula*	*Pseudocheirus peregrinus*	*Schoinobates volans*
6/ix/67	2½	3	1	-	3
7/ix/67	3	2	2	2	5
31/x/67	2½	-	2	-	7
1/xi/67	1½	-	2	1	4
		5	7	3	19

From this survey it was concluded that at least four arboreal marsupials including both *T.vulpecula* and *T.caninus*, were present in the natural forest. The habitat preferences of the *Trichosurus* species differed, with *T.vulpecula* occurring more frequently in the woodland and dry sclerophyll forest regions. It was also determined that both these species occurred in the pine plantation and were observed feeding on pines.

There appears to be no value in comparing the densities of the two *Trichosurus* species as determined by spotlighting due to the differences in foliage densities in the preferred habitats of the two species.

2.2.3.3. Plantings Surveyed

With the data obtained from the questionnaire and forestry records, several of the localities reporting possum damage were visited. The species of possum responsible for damage and the extent of damage was recorded for these areas and in some localities trapping was carried out. The results of these surveys are reported in Chapter 3.

2.3. Laboratory Data

Studies on caged *T.caninus* were carried out at Armidale to determine oestrous cycle length, gestation period and growth rates. The individuals were housed in cement floored wire cages, 4 m. long, 3 m. wide and 2.5 m. high. The southern sections of the cages were of asbestos and attached to the asbestos in each cage were two nest boxes, 1.2 m.

above the floor.

2.3.1. VAGINAL SMEARING

2.3.1.1. Method

Initially vaginal smears were taken by two people, but once the possums became accustomed to smearing,one person could adequately handle the procedure.

The tail of the possum was held by its base and a glass tube inserted into the urinogenital sinus. This tube was 40 mm. long and had an internal diameter of 5 mm. Cells were obtained from the posterior section of the sinus by passing a cotton-wool swabstick through the tube and rotating it slightly. The swabstick was extracted and the cells smeared on a slide, which was then fixed and stained using the method of Shorr (1941).

2.3.1.2. Interpretation

Vaginal smears were interpreted using the terminology of Pilton and Sharman (1962) for *T.vulpecula*.

Two cell types were discernible, these being the squamous epithelial cells and polymorphonuclear leucocytes. The epithelial cells were observed in three phases; cornified, partly cornified and non-cornified.

Oestrus was accompanied by a large increase in the number of epithelial cells of the three phases, with leucocytes either absent, or present in very small numbers.

The day after oestrus the number of leucocytes increased, but

the smear still consisted mainly of epithelial cells.

Two to five days after oestrus there was a very pronounced increase in leucocyte numbers, while the epithelial cells still remained in relatively high numbers.

The size of the smear decreased again after the fifth day until a day or two before the next oestrus. During this time it consisted of leucocytes, non-cornified and cornified epithelial cells in the same low density.

2.3.2. GROWTH MEASUREMENTS

Measurements and observations were made on captive *T.caninus* pouch young, in order to determine the season of births and growth rates of the young of this species. A comparison of these data was made with those reported by Lyne and Verhagen (1957) for *T.vulpecula.*

Measurements were made of head, manus, pes, left testis and ear lengths using vernier calipers.

Observations were also made on the earliest time of appearance of many external characters for a comparative study with those reported by Dunnet (1956) for *T.vulpecula.*

2.3.3. FURTHER TECHNIQUES

Two other techniques to be used in this study of the ecology of *Trichosurus* were investigated but rejected as impractical for use by one operator for one or several reasons. These techniques are described below.

2.3.3.1. Biotelemetry

With the considerable help of Mr. R. Harden of N.P.W.S. and this department, a transmitter was developed and attached to a freeliving

possum. This technique was to be used to determine the true home range of individuals, and to be compared with the trap indicated home range.

Several difficulties existed. A major problem was the inability of a single operator to locate the position of the possum by triangulating the signal on two separate aerials during the same moment in time. A further problem was the development of a suitable method of attachment of the transmitter to the neck of the possum. Only one transmitter was attached to a possum and it was found that this remained operational for only one night before the circuit was broken and the transmitter removed by the possum.

2.3.3.2. Faecal Analysis

Faeces were collected from every captured individual for the first two years of study but the analysis of this data has still to be carried out.

It is anticipated that a study of the plant remains in the faeces will provide valuable information on the preferences and seasonal variations in the food of both species in the study area. This data will provide a useful supplement to the findings of Owen (1964).