THE REINTRODUCTION OF THE WOYLIE (*BETTONGIA PENICILLATA*) INTO A FOREST AREA

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1983

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SUMMARY

The woylie (*Bettongia penicillata*) a rare and endangered species, had almost disappeared from the northern section of the Perup River Fauna Priority area. To attempt to re-establish it in part of this area, a trial release was commenced in October 1977.

A male woylie fitted with a radio collar was released, and tracked for two weeks, the results indicated that 'reseeding' was feasible. A further fifty two woylies were released, six were fitted with radio collars (3 males, 3 females) to evaluate (i) effects of release and (ii) release movements. The remaining animals were monitored by the trap, mark and release methods. Digging activity was also used to confirm any increase in population and movements, and molar eruption was used for aging animals.

Predation by the fox (*Vulpes vulpes*) could be a major factor in preventing successful re-colonisation of the woylie, therefore the use of 1080 poison was implemented as a possible means of control. Both fox prints, and the baits taken were monitored by the use of sand tracks, which had the baits placed by them. Every seven days the remaining baits were counted and re-covered, prints counted and sand raked smooth, and the results correlated.

1. INTRODUCTION

From 1971-1972 when the first trapping and spotlight surveys were carried out, in what is now known as the Perup River Fuana Priority area, woylies were recorded frequently, and percentage capture was high (24%-30%). Also the characteristic diggings which are made by the woylie whilst searching for their food (Hypogean fungi) were seen everywhere.

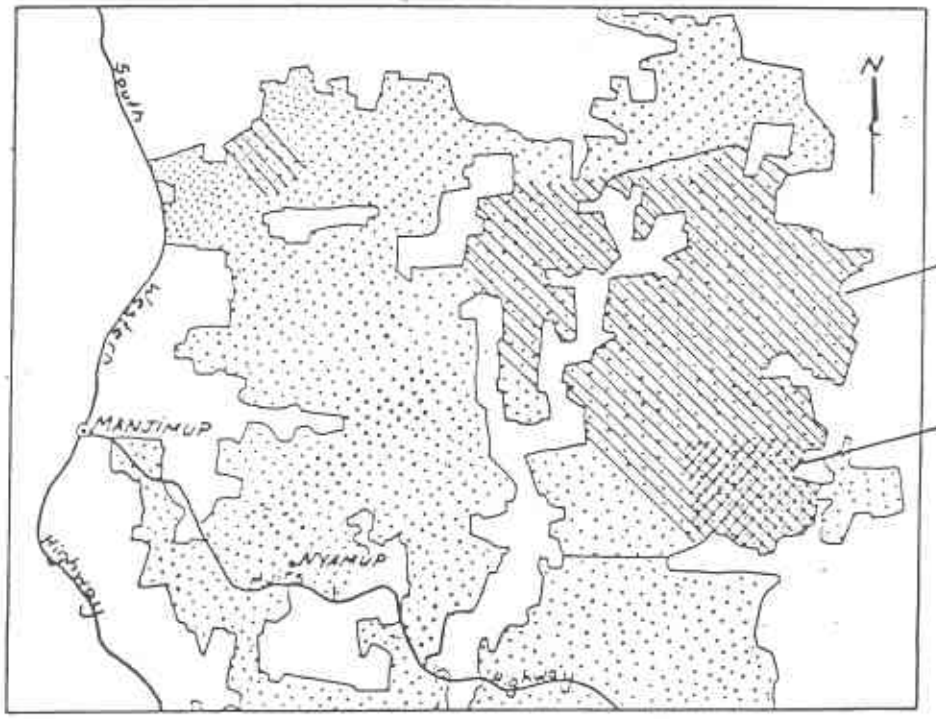
A major study started in 1974 (Christensen PhD thesis, 1980) found that the southern area (Boyicup Block) of the Perup still had a high population of woylies (average capture 8%). Numbers in the northern area however had declined, along with fauna populations in general. This was confirmed when in 1976 not a single woylie was captured in a total of 260 trap nights. When a further 400 unsuccessful trap nights were carried out in surrounding areas, previously known to have contained a stable woylie population, it appeared that a drastic depletion of woylies had occurred.

It was decided in 1977 to attempt to re-establish part of the northern area by 're-seeding' with woylies from the south (Map 1). This was considered feasible from data already available, which established that woylies released in areas outside their 'home range' do not stray far from the point of release (Christensen, 1980). On the basis of this data, and with permission obtained from Fisheries and Wildlife Department, a trial release was carried out to test the feasibility of radio tracking some of the woylies that would be released.

A young male woylie fitted with a radio transmitter collar was released in Balbanup Road, (most of the woylies were here in 1971-1972) and for two weeks its locations were found and mapped (Map 2). When it showed no signs of travelling large distances, and quickly settled into an area, the results indicated this method was feasible.

MAP 1

Map showing former and present Woylie distribution in the forest areas to the east of Manjimup.



Perup Fauna Priority Area.

Study Area.

State Forest.

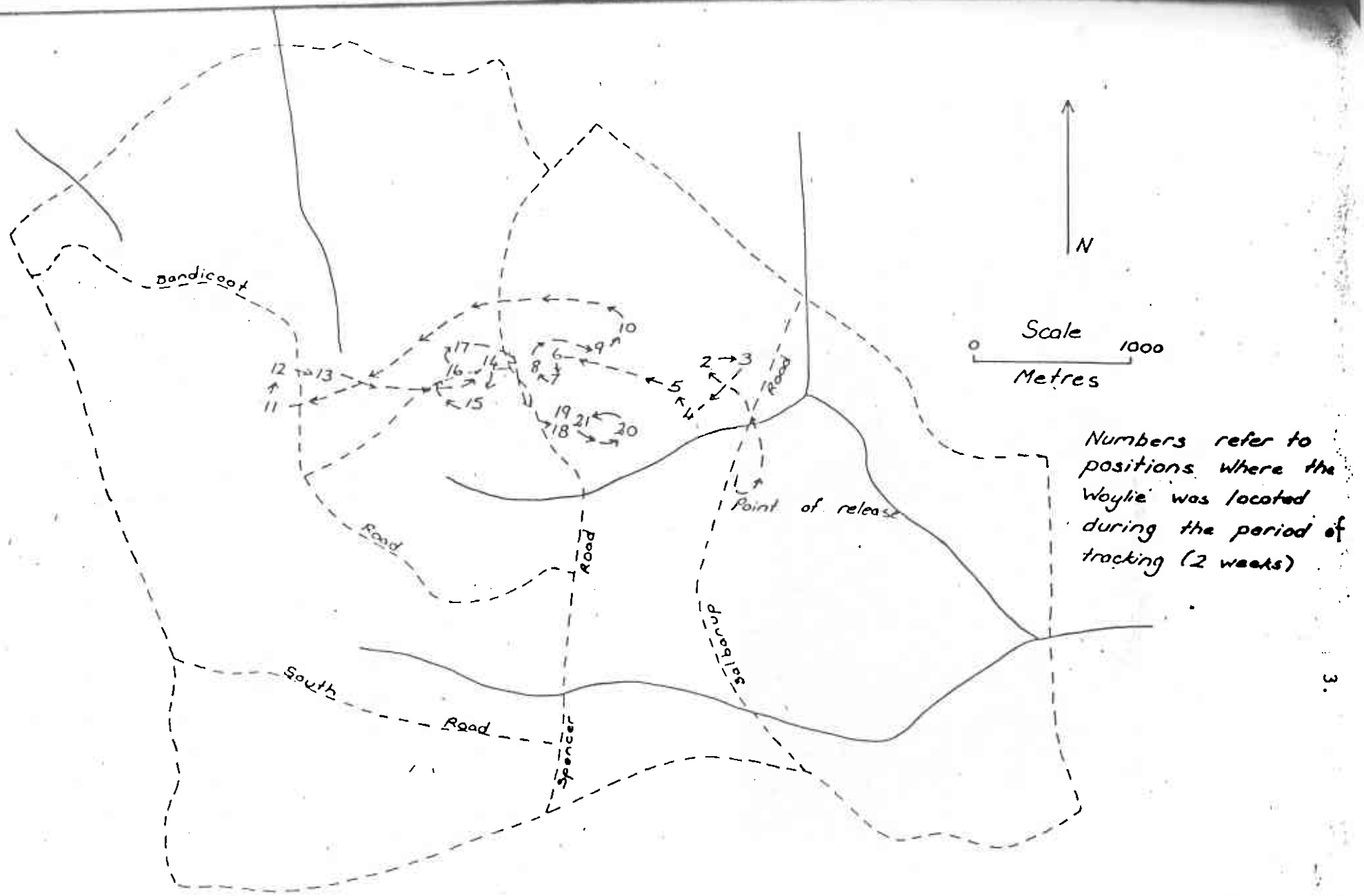
Former extent of population (pre 1973/74.

Present extent of population.

Scale

0 20 40 Km

(CHRISTENSEN, 197



MAP 2

Detailed movements of initial trial release, Woylie fitted with radio transmitter

(CHRISTENSEN, 1978)

2. DESCRIPTION OF THE AREA

2.1 STUDY AREA

Yendicup Block and surrounding area, located 50 km east of Manjimup, an area comprising approximately 5000 ha within the Perup River Fauna Priority area. Topography is dominated by the drainage systems of the Perup and Tone Rivers. Ridges are well defined, with open jarrah (*Eucalyptus marginata*), marri (*Eucalyptus calophylla*) forest, and the understorey consists mainly of *Bossiaea ornata* and *Hakea lissocarpa*. In the more clay soils, wandoo (*Eucalyptus wandoo*) woodland with an understorey of *Acacia pulchella* occurs in the majority of the valleys. Heartleaf poison (*Gastrolobium bilobum*) thickets are found in the more sandy soils. *Melaleuca viminea* and Flooded Gum (*Eucalyptus rudis*) occupy the seasonal swampy areas.

The whole of the Perup reserve was burnt in 1950 when a wildfire swept through. As part of the State Forest the area has been subject to regular prescribed burning (Peet, 1967) on a five to seven year cycle. This broadscale design is primarily to provide protection to timber resources, and private property within State Forest, but it is not necessarily the best for M.P.A.'s. For this reason a burning plan was conceived, and in conjunction with divisional personnel, decisions for protection and conservation were decided, and formed the basis of the current burning programme (Map 3). Since its conception this plan has been modified. Scientific investigations are never complete, therefore changes must be made as more is learnt with long term vegetation - animal studies (Photo 1&2).

2.2 STUDY SITE

The study site comprises the western portion, which is the unburnt control block and its surrounds (Map 4). Access tracks constructed, and 37 km of roads and tracks were surveyed. These were marked at 100 m intervals with numbered tags, to form the basis of a trapping grid system from which accurate radio tracking movements could be plotted, and spotlight survey sightings and traps located. (Tracks were upgraded to conform with dieback regulations.)

PHOTO 1: Dense understorey of the central area where woylies are surviving in medium to high density.

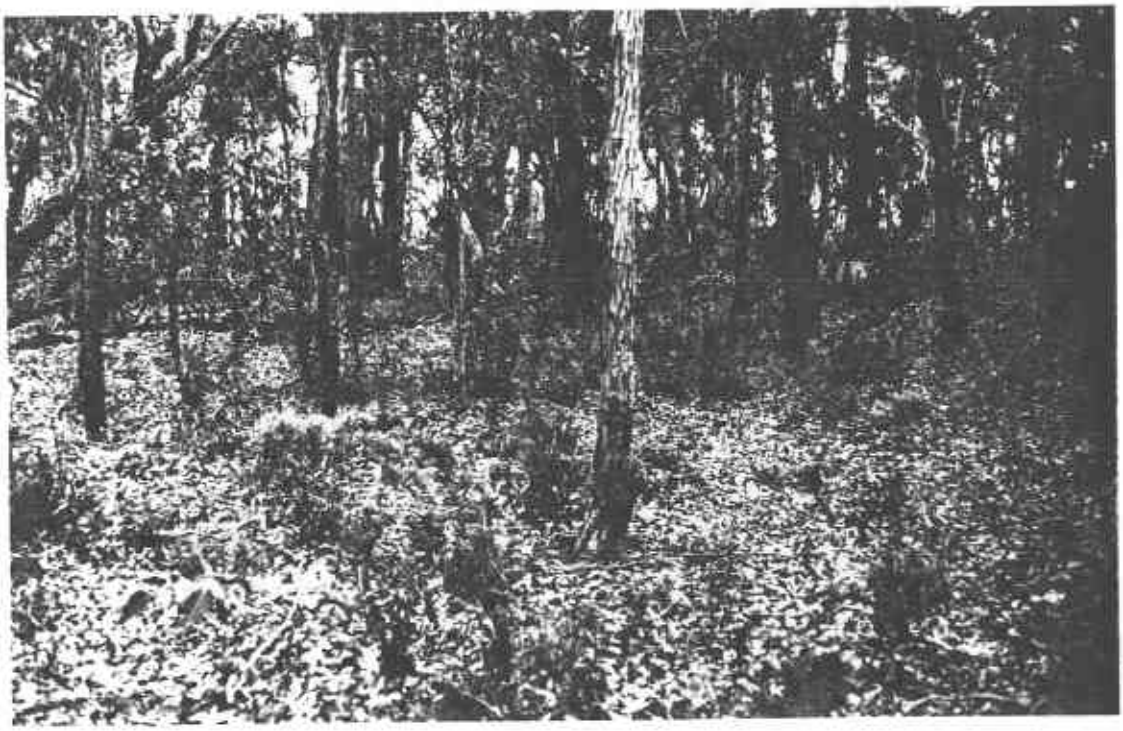


PHOTO 2: Typical of most ridges in the North Perup. Sparse open understorey, unsuitable for the woylie or nesting sites.

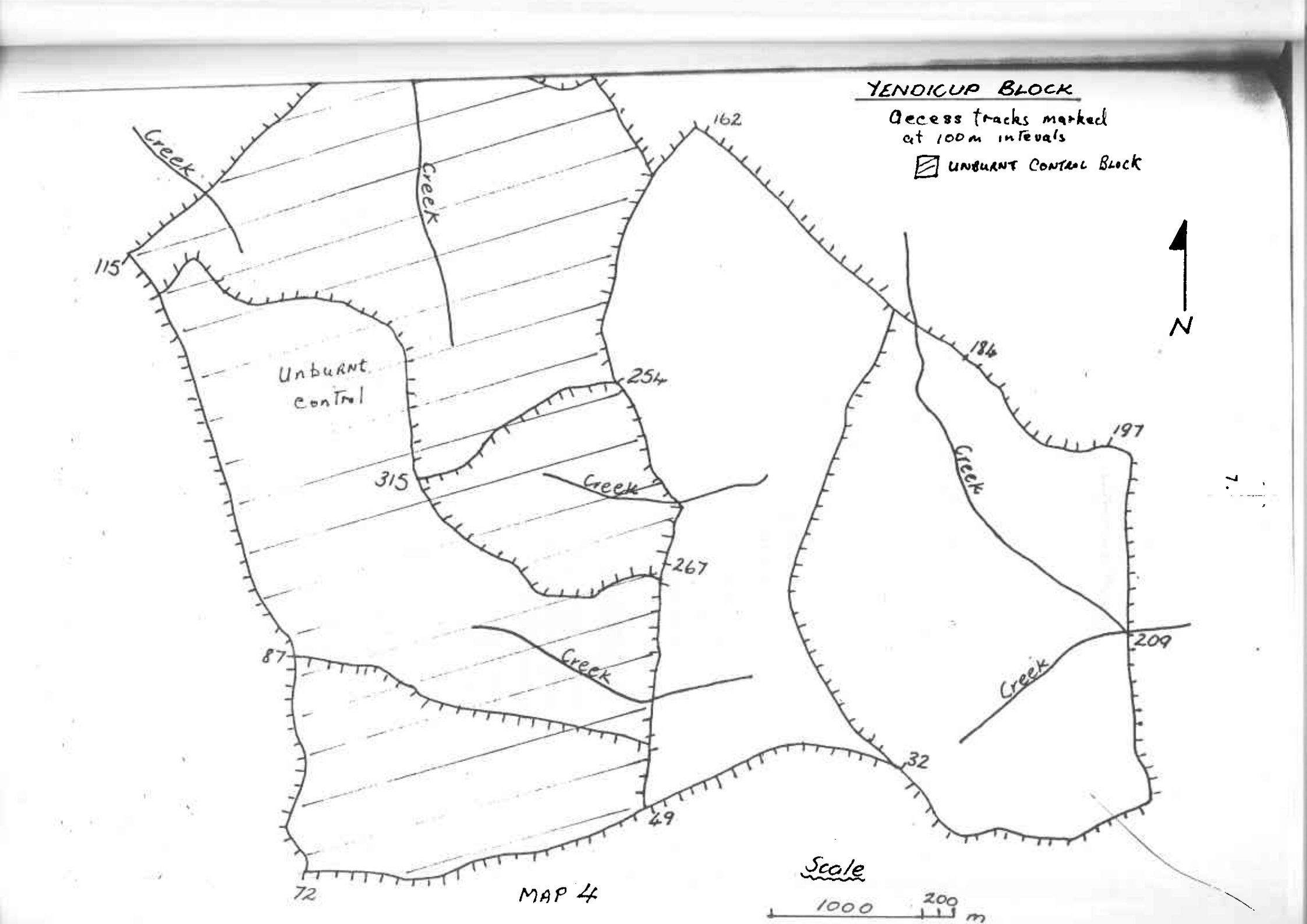
PERUP RIVER FAUNA PRIORITY AREA

BURNING PLAN

A = Autumn S = Spring

P.P. = Private property

Map. 3.


YENDICUP BLOCK
Access tracks marked at 100m intervals
UNBURNT CONTROL BLOCK
N
Creek
Creek
Unburnt control
Creek
Creek
Creek
Creek
115
162
254
315
267
87
72
49
184
197
209
32
Scale
1000
200
m
MAP 4

3. METHODS

From 27th September to 6th October 1977, 52 animals, both male and female, were released at a central point. These animals were monitored using five separate techniques; radio tracking, capture-mark and release method, molar eruption digging activity and sand tracks.

3.1 RADIO TRACKING

Six woylies, three males and three females, were fitted with radio transmitters and movements recorded using a triangulation technique (Christensen, 1980) (Map 5).

3.2 TRAPPING

Standard "possum" traps were used over a four night period at intervals of one - two months. The initial trap lines were centred around the release area, and relocated as expansion took place (Map 6). All animals released were tagged, weighed to the nearest gram. Movement, condition and breeding were monitored by trapping and weighing.

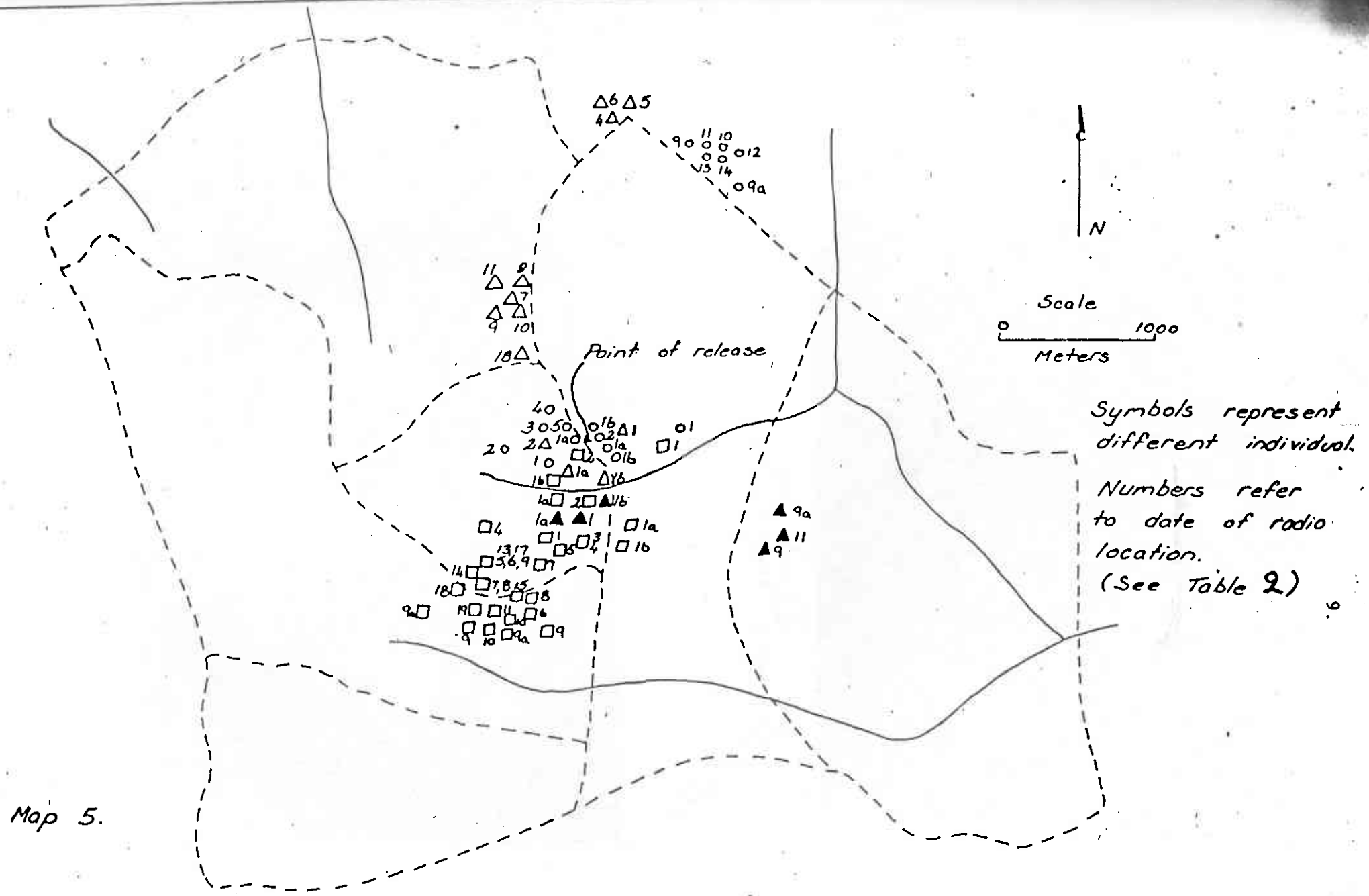
3.3 MOLAR ERUPTION

The method used to age woylies in this study is that of molar eruption. Sampson (1971) published various body measurements, but not until September 1974 was a method based on molar eruption developed, similar to that used by Shield (1958). This uses sectorial premolar p^4 which is larger than p^3 and has a different appearance, and therefore easy to distinguish.

The sequence of molar eruption is as follows; sectorial premolar p^3 molarform dp^4 and then first molar m^1. After a time $p^3 dp^4$ are shed, this occurs when molars 3 to 3.2 have erupted, when they are replaced with permanent premolar p^4. Therefore by using molar eruption, a woylie can be aged to within a few months (Christensen, 1980) also Kirkpatrick (1964) and Frith and Calaby Red Kangaroo (1961) (Photo 3&4).

3.4 DIGGING ACTIVITY

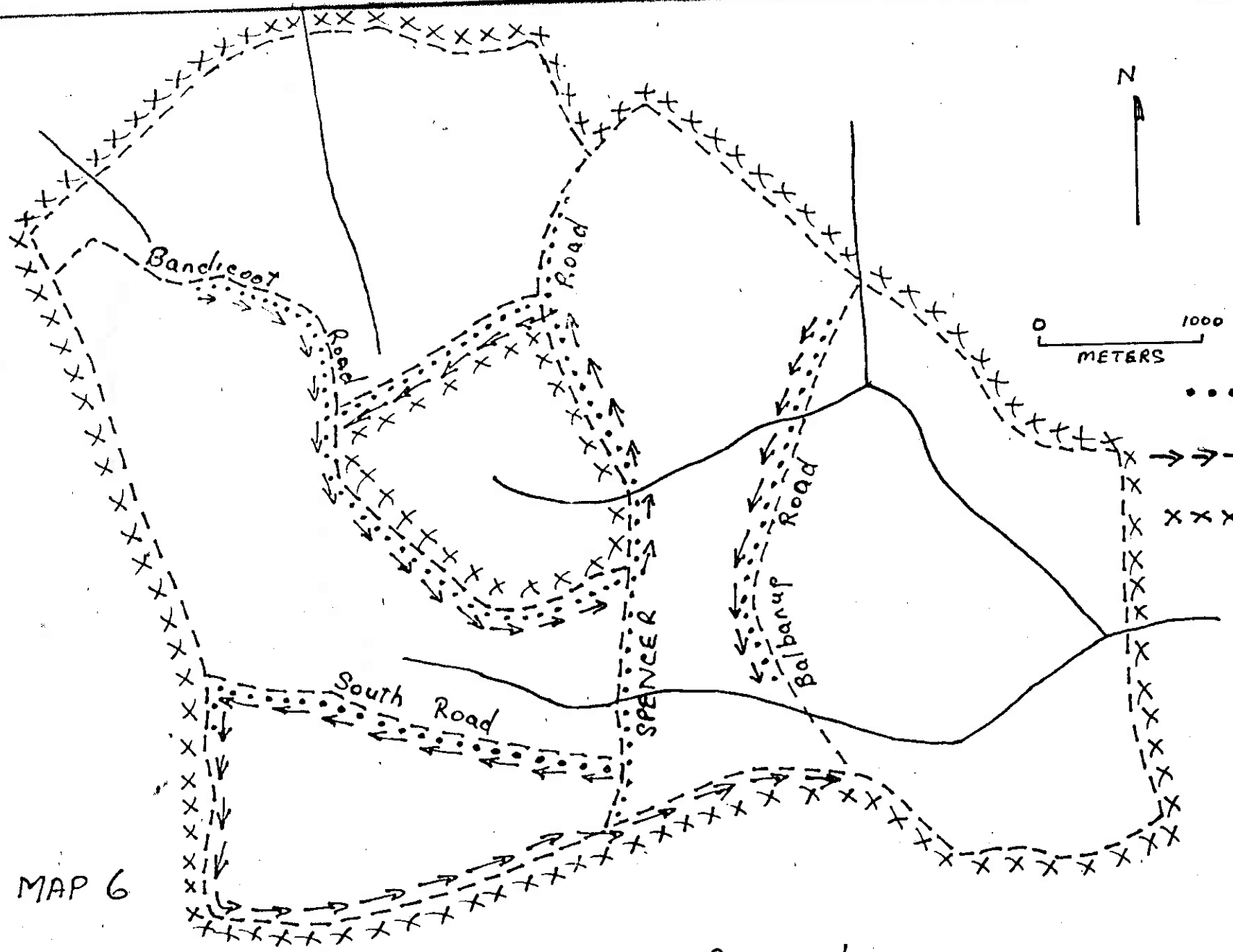
Presence and distribution of woylies was also recorded from digging activity. On eighteen 15 m x 15 m plots and 6 different sites, diggings were recorded on a monthly basis and each one filled in as it was recorded (Map 7).



Map 5.

Recorded locations of 6 Woylies fitted with radio transmitters

(CHRISTENSEN, 1978)



MAP 6

Location of trap lines

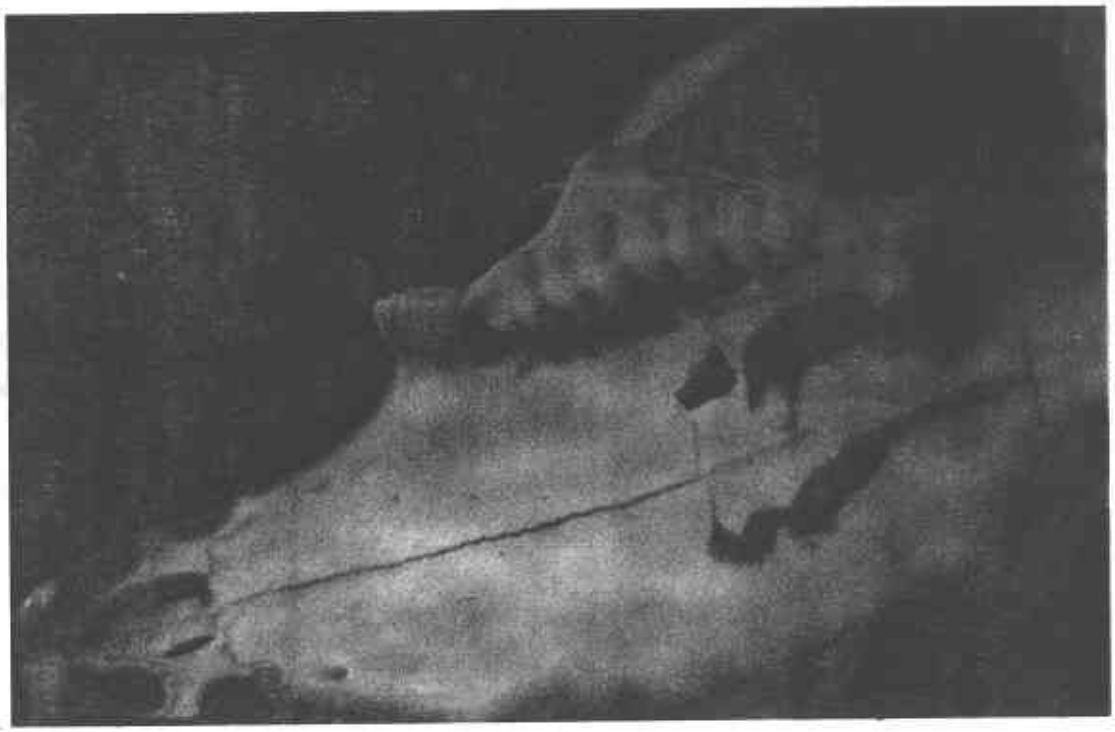


PHOTO 3: Sub adult - from approximately 200 days to 10 or 12 months. Tooth eruption: $p_3^4 dp_4^4$ M3.0.

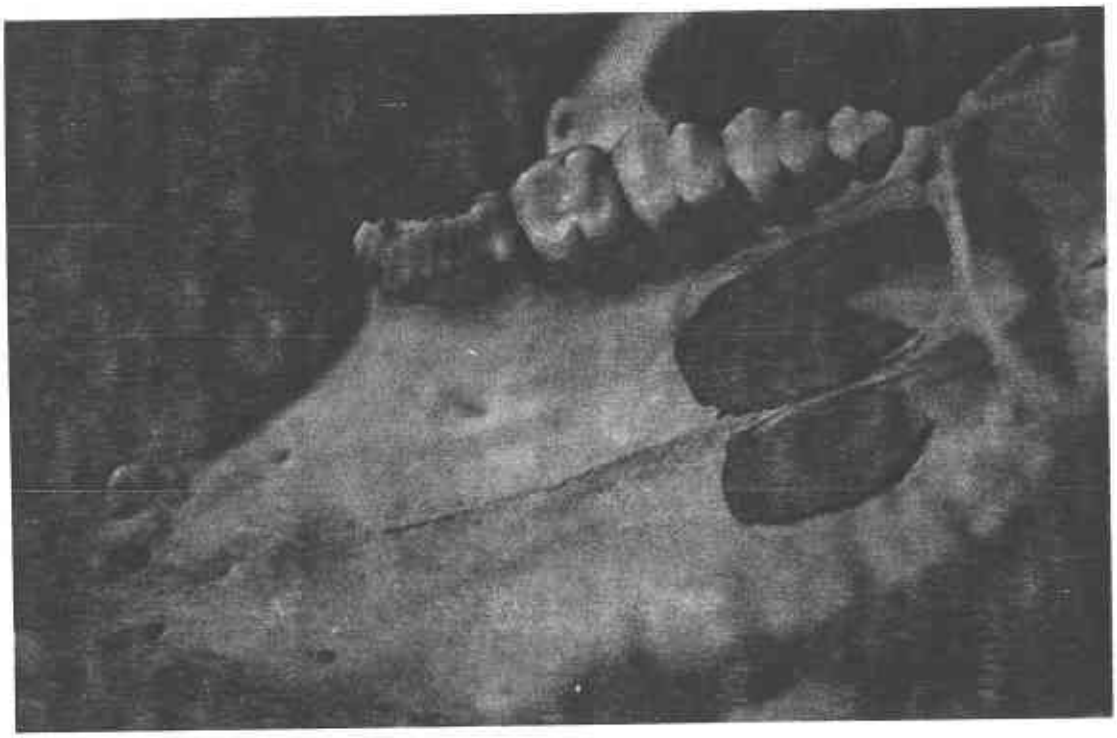
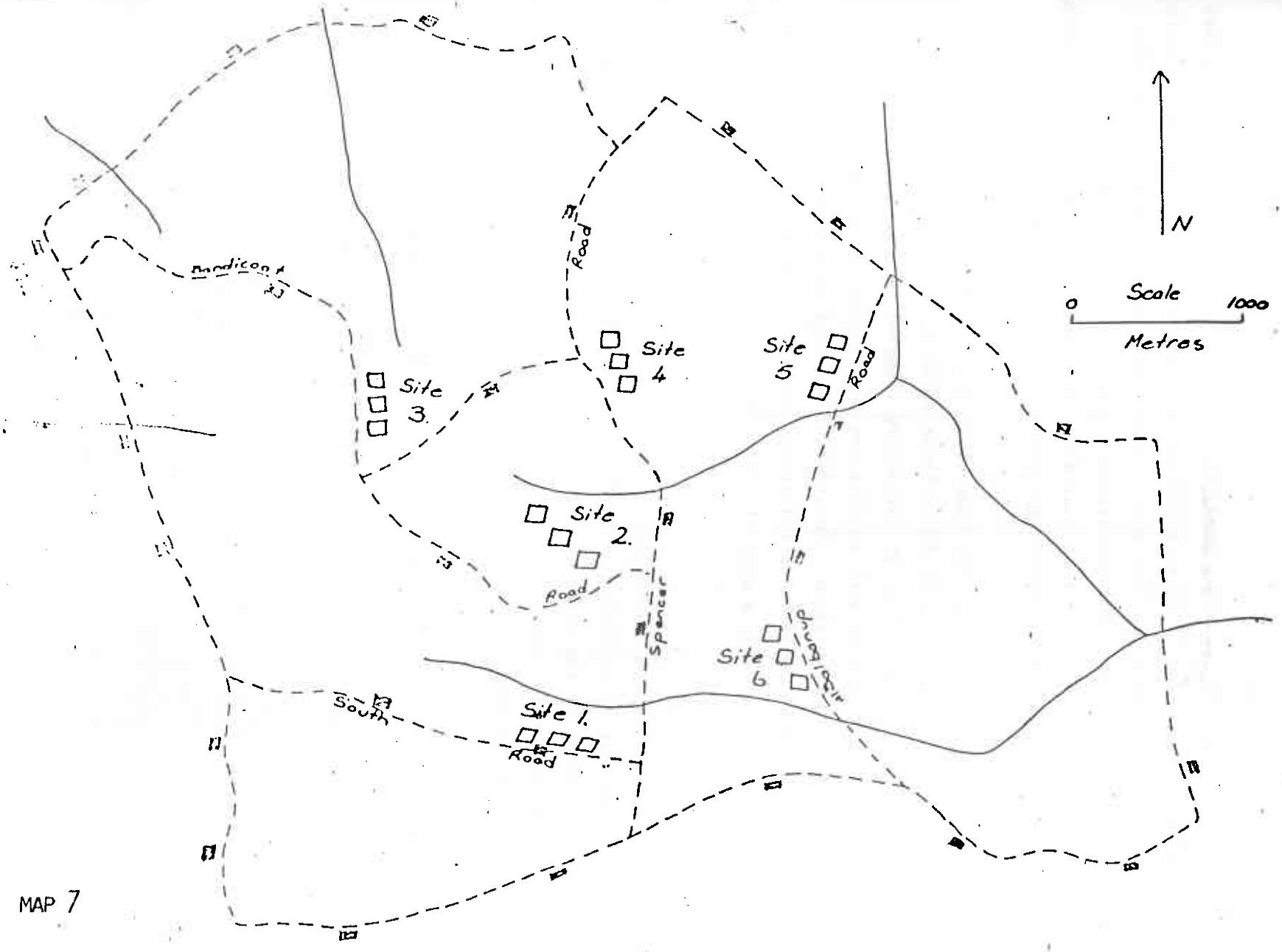


PHOTO 4: Adult - from approximately 10 to 12 months and older. Tooth eruption: p_4^4 M4.

3.5 SAND TRACKS/1080 POISON BAITS

The use of sand as a method for counting the number of foxes within an area has been used in many studies. Fox prints can be found on most sandy areas along tracks, and in the Perup this was found to occur.

Over the northern area 28 small (2 x 1 m) areas of white sand were spread, and next to these, six 1080 baits were laid by A.P.B. officers (Map 7). Every seven days both the number of fox prints, and the number of baits left, were counted. As a control, 14 sand tracks were located in the southern area, no baits were laid, but the number of prints was recorded the same day as the northern area.



MAP 7

Location of digging plots □

Location of Sand tracks

4. RESULTS

4.1 MOVEMENTS

Corresponding with the findings of Christensen (1980), once the animal had selected a site that was suitable, it settles down after a few weeks to a typical home range/nesting site. Home ranges were calculated from trap data, using the exclusive boundary strip method (Stickel, 1954) (Table 1). Animals that were caught more than four times and less than ten (Christensen, 1980) were used, this resulted in only ten woylies that were suitable.

Using trapping data, the home range mean of 33.04 ha (range 12.25 - 62.70) was less than the 41.88 ha (Post burn) found by Christensen (1980) and also that of the 45 ha at Tuttanning (Sampson, 1971). Radio tracking movements could not be used as data was insufficient-to allow for accurate measurements of area sizes. In addition the woylies did not have time to settle into what could be called their home range. It has been found that the home range area is a gradual extension by limited exploration (Christensen, 1980).

In examination of captures, resident woylies (those captured four or more times) were concentrated initially in a relatively small area close to the centre of the study area. But with 18 months successful survival and breeding rate, animals spread throughout the area, and woylies are now caught to the limit of the trap lines (Appendix 3).

TABLE 1. HOME RANGE SIZES CALCULATED FROM TRAPPING DATA.

TAG NUMBER	SEX	YOUNG / ADULT	AREA IN HA
524-525	♀	ADULT	15.42
1417-1418	♂	ADULT	12.25
1839-1840	♂	ADULT	48.18
2214-2215	♂	ADULT	12.98
1122-1123	♂	ADULT	27.92
1421-1422	♂	ADULT	47.43
2237-2238	♂	ADULT	62.70
518-519	♂	ADULT	32.55
1807-1808	♂	ADULT	57.48
526-527	♂	ADULT	13.50
		N =	10
		$\bar{x}$	33.04
		S.D.	18.61

TABLE 2. FATE OF THE SIX WOYLIES FITTED WITH RADIO COLLARS.

DATE 1977	WOYLIE IDENTIFICATION CHANNEL NO.					
	CH 1 ♂	CH 2 ♂	CH 4/4 ♀	CH 11/2 ♀	CH 11/4 ♀	CH 12 ♂
4.10	+	+	+	+	+	+
5.10	+	+	+	+	+	+
7.10	+	+	+			
11.10	+	+			+	+
13.10	+	+			+	+
16.10		+			+	+
21.10		+			+	+
24.10		+			+	+
25.10		+	+	+	+	+
28.10		+		+	+	+
31.10				+	+	+
7.11				+		
15.11	DISAPPEARED			+	TRANSMITTER CUT OUT REMOVED	+
17.11	PREDATED			+		+
22.11	FOX?		+	DEAD		+
23.11			DEAD	FOX		+
24.11			FOX			+
25.11						+
28.11						STILL ALIVE 3/79

(AMENDED CHRISTENSEN 1978)

4.2 RADIO TRACKING

After the initial trial was found to be successful, a further six woylies, three males and three females, were fitted with radio transmitters and released. The movements of all animals were recorded, and results plotted on a map, and it was found that no woylie was recorded more than 2.5 km from the point of release (Map 5).

Three females left the general area of release. When one returned at a later date, it was discovered that its transmitter had recently cut out, which was then removed. Two remaining females were predated by foxes, one of which was located in an old fox den (Table 2). Of the three remaining

woylies, one stayed within the release area, and was still alive on 3/79, the fate of the other two male woylies is unknown, but most probably they were taken by the fox. When after a total of twenty four days no signals were received, an aircraft fitted with receiving equipment was used, which failed to locate them. Since the mean life of a transmitter is 192 days (Christensen, 1978) the most likely explanation is predation.

4.3 TRAPPING

From the start both capture and recapture are low, data from the first 8 trap sessions show a 1.5% capture rate, with recaptures of 1.9%. This improved steadily until between November 1981 and September 1982, the percentage capture reached a high of 11.7%, with 14% recapture (Table 3). Correspondingly in the southern area (Boyicup Block) the recapture percentage increased, in 1978, 1140 trap nights resulted in 8.4%, which further increased until in 1982-1983 the recapture has reached a high of 50% (Table 4). It would appear that sometime towards the middle of 1979, there was a viable increase in the number of woylies in Yendicup and Boyicup Block

To verify this assumption capture/recapture data from Yendicup Block was tested for correlation with a linear regression. This resulted in a good correlation of $r = 0.86$ r^2 0.747, a line accounts for 75% of variance (Graph 1). When percentage capture data was graphed a linear correlation of $r = 0.87$ was produced, but more natural would be an exponential curve, which tested gave $r = 0.89$ (Graph 2).

Results between male and female adults show a larger proportion of males, about 2:1 which would be a normal ratio when an increase in population occurs (Graph 4). Sub adult male and female show no significant variation (Graph 3).

Both Sampson and Christensen found no seasonal effect on trapping results. But when examining adult capture/recapture (Graph 1) 25% of the remaining variance could be accounted for by seasonal fluctuation, although periodically, numbers tend to be lower in May/July.

TABLE 3. YENDICUP BLOCK.
DATA FROM TRAP SESSION SHOWING THE PERCENTAGE INCREASE OVER 5 YEARS.

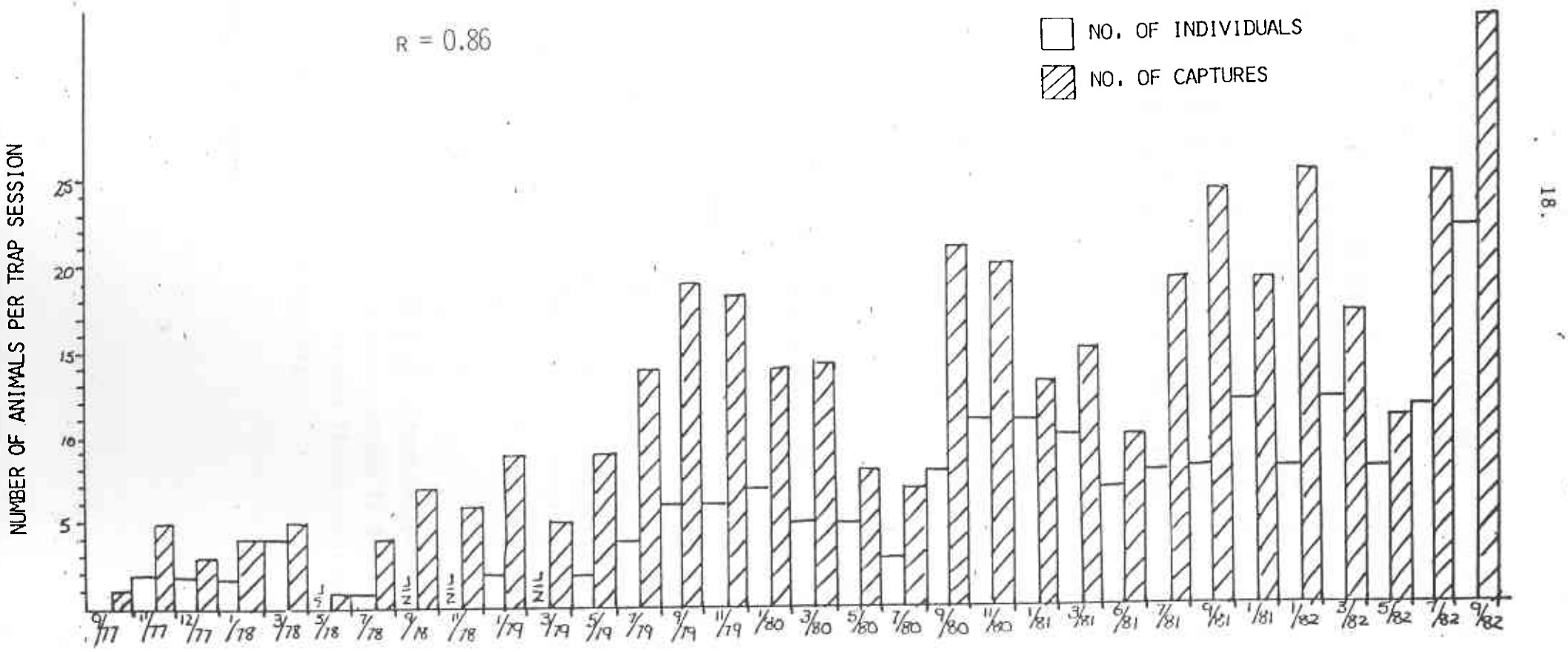
DATE	CAPTURE	%	RECAPTURE	%
9/71 - 9/78	43	1.5	54	1.93
11/78 - 9/79	60	2.6	87	3.77
11/79 - 9/80	118	5.12	162	7.03
11/80 - 9/81	147	6.29	193	8.26
11/81 - 9/82	259	11.73	310	14.00

TABLE 4. BOYICUP BLOCK.
INCREASE IN PERCENTAGE RECAPTURE WHICH SHOWS THE RELATIONSHIP WITH YENDICUP BLOCK.

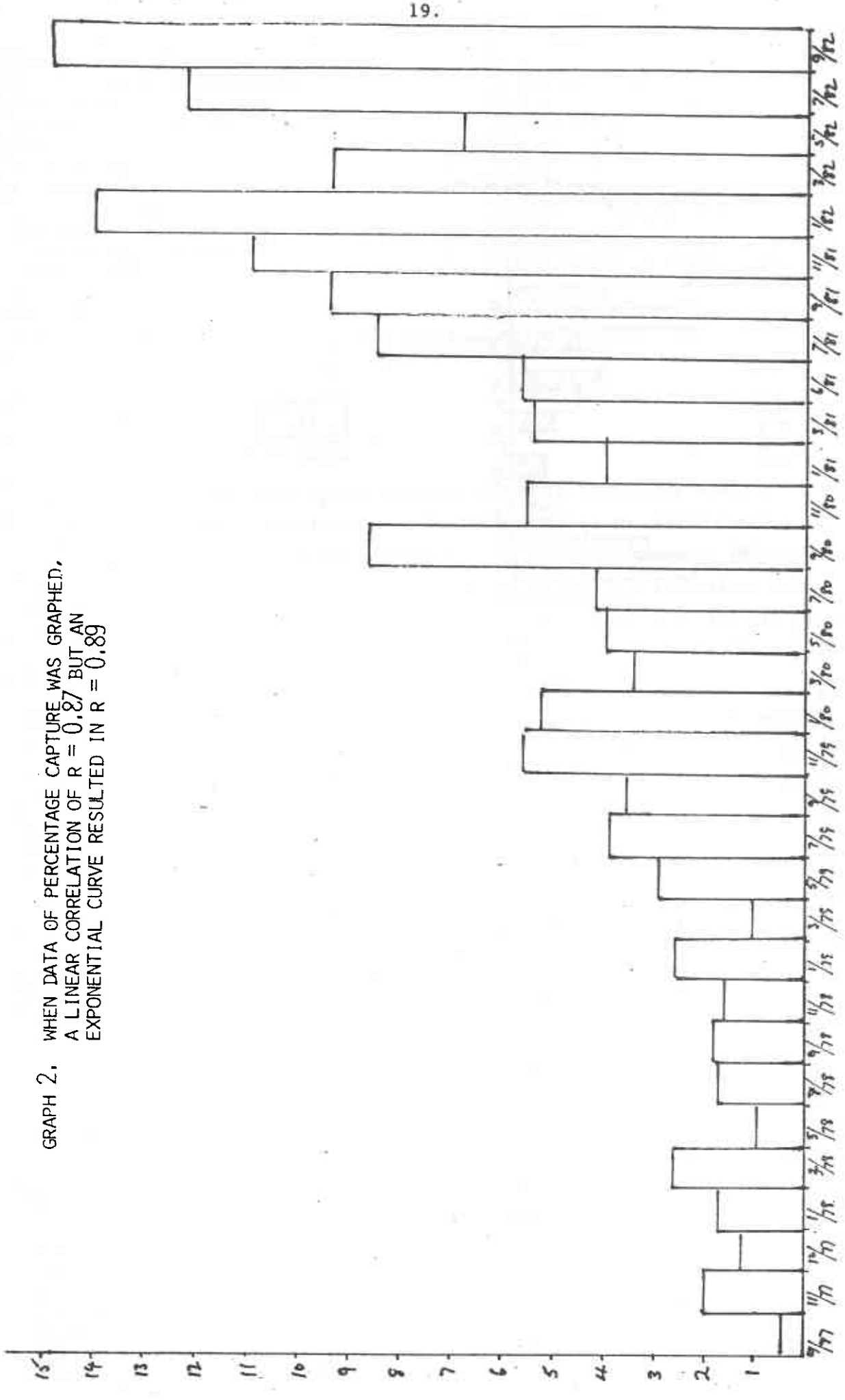
DATE	RECAPTURE	%
1976	33	7.2
1977	37	8.1
1978	96	8.4
1979	146	16.0
1980	270	26.0
1981	507	29.9
1982	111	52.8
5/1983	90	50.0

YENDICUP BLOCK

GRAPH 1. THIS DATA WAS TESTED FOR LINEAR CORRELATION, AND THE RESULT WAS EXCELLENT. A LINE ACCOUNTS FOR 75% OF THE VARIANCE.

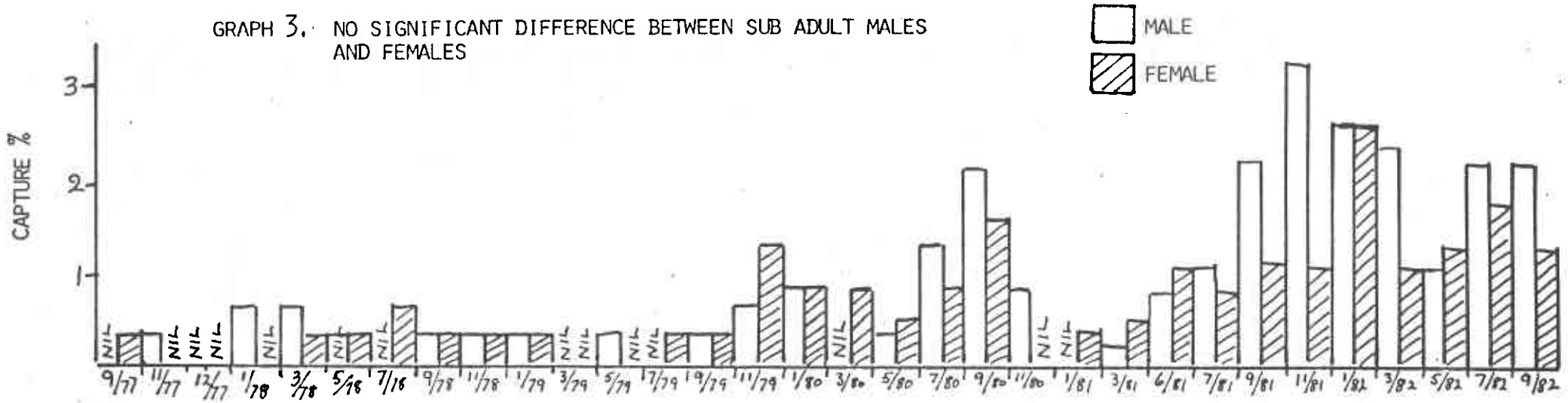


GRAPH 2. WHEN DATA OF PERCENTAGE CAPTURE WAS GRAPHED, A LINEAR CORRELATION OF R = 0.87 BUT AN EXPONENTIAL CURVE RESULTED IN R = 0.89



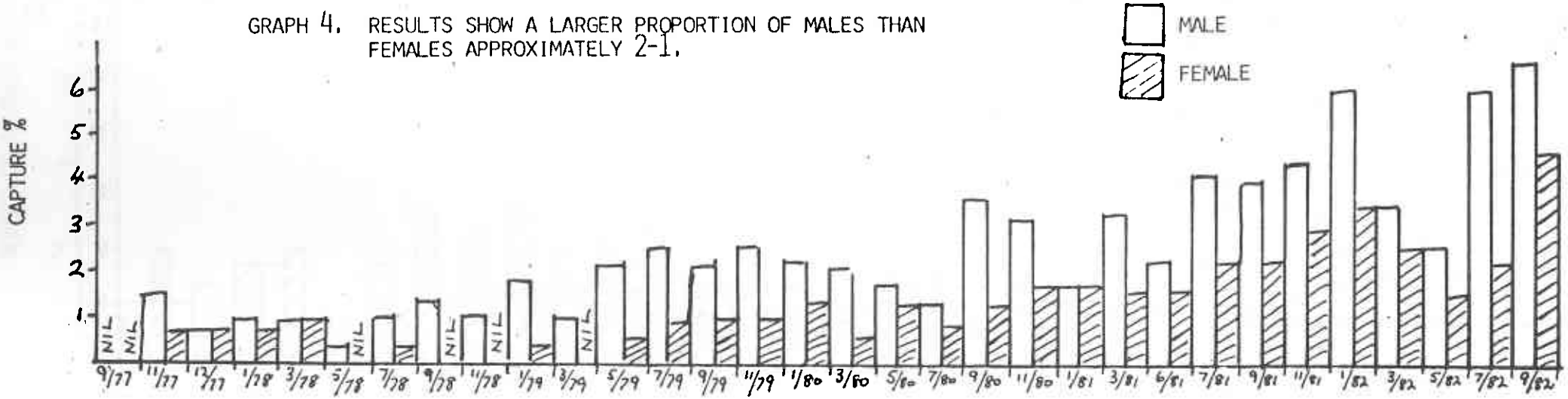
SUB ADULT WOYLIE

GRAPH 3. NO SIGNIFICANT DIFFERENCE BETWEEN SUB ADULT MALES AND FEMALES



ADULT WOYLIE

GRAPH 4. RESULTS SHOW A LARGER PROPORTION OF MALES THAN FEMALES APPROXIMATELY 2-1.



5. POPULATION ANALYSIS

5.1 SURVIVAL

POUCH YOUNG - Those joeys still in pouch.

SUB ADULT - From approximately 200 days to 10/12 months. Tooth eruption M2.0 to M3.2 before p^4 has replaced p^3 and dp^4.

ADULTS - From approximately 10/12 months and older. Tooth eruption P^4 fully erupted.

5.2 FEMALES WITH JOEYS

Table 5 shows that normal breeding cycle is continuing again with no noticeable seasonal variation. In Tuttanning (Sampson, 1971) breeding was continuous, as in Christensen (1980) and also the Red Kangaroo (*Megaleia rufa*) study (Frith and Calaby, 1969), but with possible variations caused through severe drought. Also of 2,225 female red kangaroos, 78% had pouched young. Of these 22% had young at foot also.

The woylie figure of 78% may be coincidental, because of the much smaller sample (232) but it must reflect the trend. Unfortunately woylie at foot (sitting outside the trap) have been seen, but no count has been made.

5.3 SURVIVAL OF POUCH YOUNG

Table 6 shows the survival of pouch young over the period of the study. Joeys that reach the age of eighty five days are old enough to leave the pouch (Christensen, 1980) and are judged to have survived the pouched life.

5.4 KNOWN SURVIVORS

Are animals captured that are over eighty five days old.

5.5 PROBABLE SURVIVORS

Are joeys whose mothers were recaptured after the pouch had been abandoned but were judged to have survived, since the period between successive joeys had not been shortened significantly below the mean of 101.7 days.

5.6 UNKNOWN FATE

Joeys on which no definite judgement could be made.

5.7 MORTALITIES

Deaths, not obviously a result of handling, but including cases where the interval between successive joeys was reduced significantly below the mean of 101.7 days.

Therefore pouched mortalities are judged to be 12.9% minimum to a maximum 20.5%. These figures would be a favourable comparison with the woylie in the Southern area (Boyicup Block) with figures of 8.8% - 18.5% (Christensen, 1980) and the mortality rate of 16% in the Red Kangaroo (*Megaleia rufa*) (Frith and Calaby, 1969).

TABLE 5. PERCENTAGE OF FEMALES WITH JOEYS DURING EACH TRAP SESSION.

TRAP SESSION	NUMBER OF FEMALES CAUGHT	NUMBER OF FEMALES WITH JOEYS	%
9/77	1	1	100.0
11/77	2	1	50.0
12/77	1	1	100.0
1/78	2	2	100.0
3/78	4	4	100.0
5/78	1	1	100.0
7/78	3	2	66.66
9/78	1	-	0
11/78	1	1	100.0
1/79	2	2	100.0
3/79	-	-	-
5/79	2	1	50.0
7/79	4	3	75.0
9/79	5	5	100.0
11/79	9	6	66.66
1/80	8	6	75.0
3/80	5	3	60.0
5/80	7	6	85.71
7/80	6	6	100.0
9/80	11	10	91.0
11/80	7	7	100.0
1/81	10	8	80.0
3/81	9	6	66.66
6/81	10	3	30.0
7/81	11	8	72.72
9/81	11	10	91.0
11/81	15	14	93.33
1/82	23	15	65.21
3/82	12	11	84.61
5/82	11	8	72.72
7/82	15	14	93.33
9/82	22	16	72.72
	232	181	78.0

TABLE 6. SURVIVAL OF POUCH YOUNG.

	KNOWN SURVIVALS	PROBABLE SURVIVAL	UNKNOWN FATE	MORTALITIES
NUMBER OF JOEYS	20	46	48	17
PERCENTAGE OF TOTAL	15.3	35.1	36.6	12.9
PERCENTAGE OF TOTAL MINUS ANIMALS OF UNKNOWN FATE	24.0	55.4		20.5

TABLE 7. THE NUMBER OF DIGGINGS FROM SIX PAIRED PLOTS TOTAL AREA 1350 SQ.M.

DATE	BOYICUP	YENDICUP
DECEMBER 1979	55	35
JANUARY 1980	122	39
FEBRUARY 1980	178	71
MARCH 1980	193	80
APRIL 1980	93	103
MAY 1980	131	104
JUNE 1980	95	117
JULY 1980	133	100
AUGUST 1980	102	57
SEPTEMBER 1980	88	159
OCTOBER 1980	97	104
NOVEMBER 1980	52	38
η 12		
$\bar{x}$	111.58	83.91
S.D.	41.04	36.0
V	1684.7	1298.9

t value 1.94
not significant at the 5% level

6. DIGGING ACTIVITY

Over a three year period a total of 20,785 diggings were recorded on six paired plots (Appendix 1). This results in 2309 diggings per ha per year. Christensen (1980) suggests that it's reasonable to assume that the diggings are made to acquire fungi, (which is) the woylies food source (Photo 5&6). A mean of one sporocarp with a dry weight of 1.0 to 1.5 g per digging gives 2.3 to 3.4 kg of sporocarp per hectare per year. Christensen (1980) found in Boyicup Block figures of 4.6 to 6.9 kg but in a Douglas fir stand in Western Oregon figures of 2.3 to 5.4 kg ha^{-1} were recorded (Fogel, 1976).

Sites 1 and 2 (South and Bandicoot Road) produced the highest number of diggings, however, most of these were bandicoot (*Isoodon obesulus*) easily identified by the characterisitc "V" notch shape and steep sides.

Sites 3-4 (Spencer and Bandicoot Roads) where most of the early captures were recorded, a higher proportion of woylie diggings occurred, as could be expected for these were within the better woylie habitat.

Sites 5-6 (Balbanup Road). Diggings from the start were very low, but appear to have increased around August - September 1979, which coincides with an increase in captures.

To confirm if this apparent increase was confined to Yendicup Block only, data recorded from six plots in the southern area (Boyicup Block) were compared to Yendicup. Both had the same total area of 1350 sq.m., and also the same period of time (Table 7). Using a Student "t" test the figures were found to be not significant at the 5% level (t value 1.94).

In theory, with an increase in the number of woylies captured, there should also be an increase in the number of diggings. To test this hypothesis, 14 monthly pairs of diggings/captures figures were tested to find a mathematical relationship by the use of a linear regression, but none was proved (Graph 5).

Although there was no statistical significant increase, the results shown in Table 8 indicate a change in digging activity in sites 5-6, around June/July 1979.

PHOTO 5: Hypogeon fungi eaten by the woylie, a species of *Mosophellia*.
a = outer covering or peridium
b = spore layer
c = central collamella eaten by the woylie.

PHOTO 6: Digging on recently burnt ground. The remaining hymenium, and outer casing can be seen on the freshly dug soil.

GRAPH 5. RELATIONSHIP BETWEEN THE NUMBER OF DIGGINGS AND THE NUMBER OF CAPTURES FROM YENDICUP BLOCK.

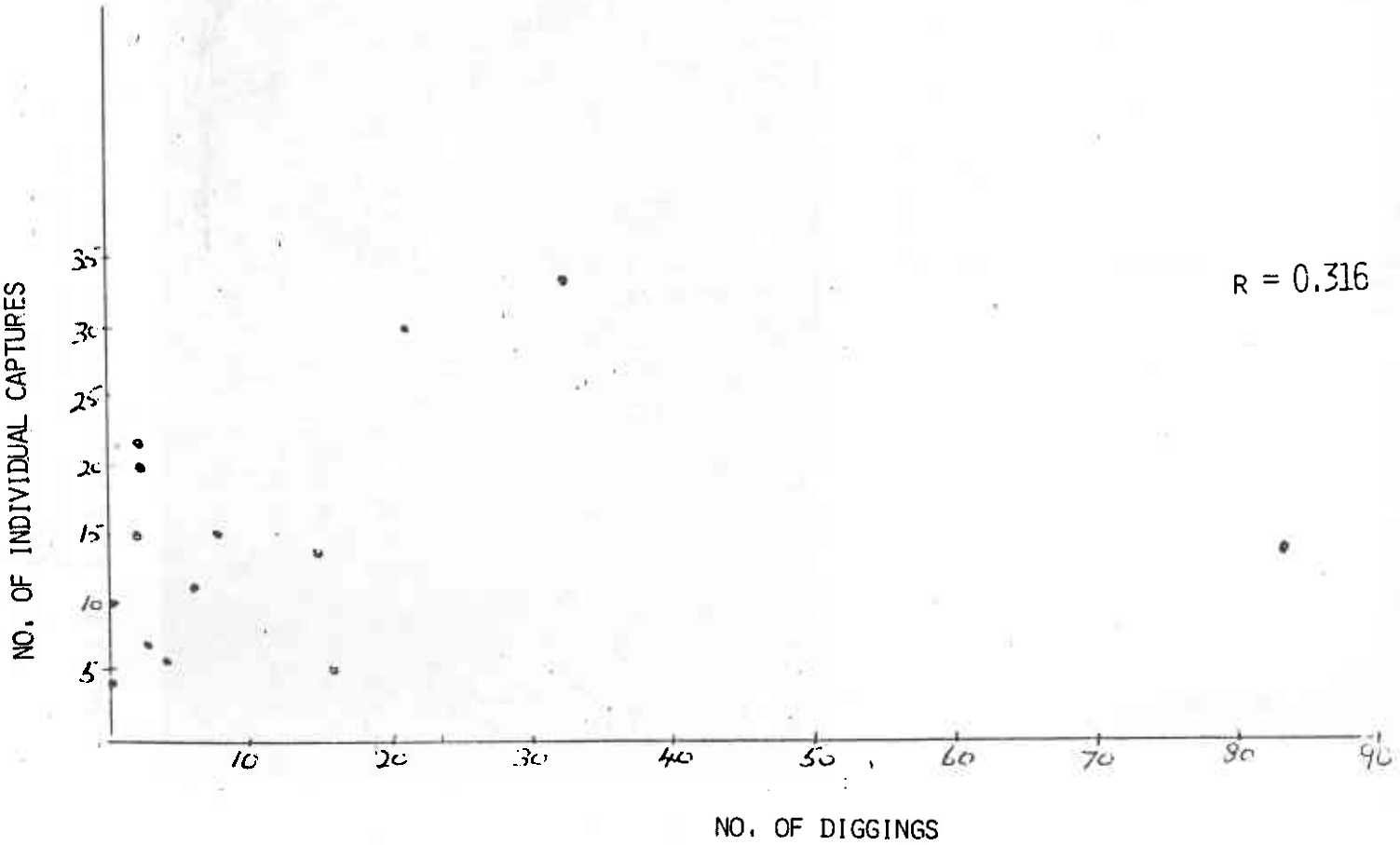


TABLE 8. ALTHOUGH THERE WAS NO STATISTICAL SIGNIFICANT INCREASE, THE RESULTS SHOW A CHANGE IN DIGGING ACTIVITY IN SITES 5-6 AROUND JUNE/JULY 1979.

DATE	SOUTH/ BANDICOOT ROADS SITES 1-2	BANDICOOT/ SPENCER ROADS SITES 3-4	BALBANUP ROAD SITES 5-6
12/77	41	14	7
1/78	26	2	3
3/78	35	29	2
4/78	21	14	3
5/78	12	24	3
6/78	49	73	NIL
7/78	21	30	1
8/78	123	6	1
9/78	99	15	3
10/78	40	2	4
11/78	30	13	4
12/78	40	8	1
1/79	41	16	NIL
2/79	44	17	3
3/79	49	7	NIL
4/79	9	28	3
5/79	10	9	6
6/79	10	9	NIL
7/79	41	26	2
8/79	55	30	38
9/79	64	18	83
10/79	23	5	61
11/79	33	3	30
12/79	24	1	10
1/80	31	6	2
2/80	29	21	21
3/80	59	6	15
4/80	65	30	8
5/80	75	21	8
6/80	80	15	22
7/80	73	22	5
8/80	50	6	1
9/80	109	17	32
10/80	83	14	7
11/80	28	8	2
12/80	99	9	31

7. SAND TRACKS/1080 POISON

It is well documented that an increase in fox (*Vulpes vulpes*) population has taken place over the years. Christensen (1980) recorded this from data supplied by the A.P.B. (Table 9) where it is shown that in 1973 a big increase in the fox population, coincided with a decrease in 1080 rabbit poisoning.

The decline of native fauna was noticed during the early years, when Wood-Jones (1924) considered the fox to be a major predator of *Bettongia leseur*, and assumed that the woylie also would share the same fate of predation. In later years Finlayson (1958) and Perry (1973) have also suggested that the fox was a major predator of native fauna (Photo 7).

Burbidge (1977) notes that the remaining areas in which the woylie still exist, Tuttanning Reserve, Dryandra Forest, and Perup, all have shrubs of the genus *Gastrolobium*, which contain the toxic monofluora-acetic acid, a constituent of 1080. King (1982) states "that one species known as Heartleaf poison (*Gastrolobium bilobum*) has been shown to contain up to 2,650 ppm of 1080 equivalent in its young leaves. This level is so high that less than 50 grams of the leaves will kill an adult sheep". In the South-west of Australia the native fauna have a high tolerance to poison, which can be used directly to benefit a monitoring programme.

The use of sand as a method of estimating the abundance of the fox, has been used in many studies, also many sandy areas within the Perup have fox prints on them, which would illustrate that a method similar, if modified, would be feasible to use.

To monitor both fox prints, and the number of baits taken, twenty eight tracks of sand (2 x 1m) were placed throughout the northern area close to the side of the road. When the area was baited by the A.P.B. six baits were placed at each sand track. Every seven days fox prints on the tracks were counted, and then sand was wiped clean. When baits had been used these were counted also, then re-covered with leaves (baits were not touched by hand). A control of 14 sand tracks was located in the southern area (Boyicup Block), they were not baited with 1080 poison (Graph 6).

Data correlated from the number of baits/time suggest that 50% of the baits are taken within 8 days, 30/50% 12 to 20 days, and the remainder 20 plus days. Sodium fluoroacetate is highly soluable in water, 34% can be

PHOTO 7: Woylie predated by fox, during Christensen study (1980) in Boyicup Block. Notice the radio collar still intact.

lost within two days from the effect of dew and damp soil, and over 5 days 42% is lost (A.P.B.). Therefore 1080 one shot baits are only effective for a maximum of eight days, any rainfall of 5 mm would remove the toxicity completely.

No correlation was found in the number of fox prints counted, for seasonal variation, nor was it proved whether 1080 poison was effectively reducing the fox population, although, one fox was found to have died from "secondary" poison! A major problem with the use of sand plots was rain, this had an extremely adverse effect on the clarity of prints, and therefore their effectiveness is reduced during wet periods.

TABLE 9. DATA SHOWING THE DRAMATIC INCREASE IN SPOTLIGHT SIGHTINGS OF FOXES IN TWO AREAS FOLLOWING THE REDUCTION OF BROADSCALE 1080 RABBIT POISONING.

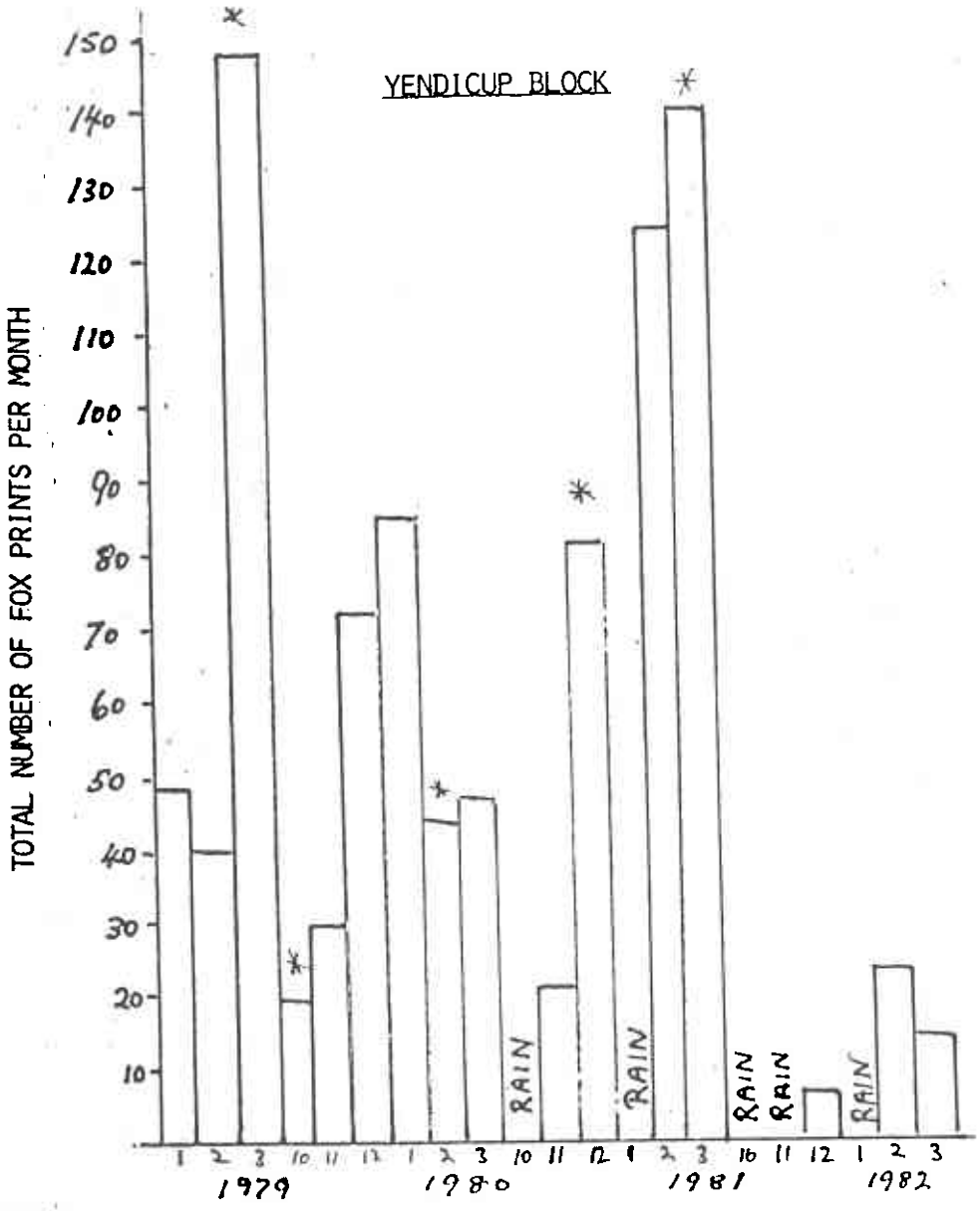
YEAR	POISONING*	CAPE NATURALISTE DATA	SPOTLIGHT FOXES/100 KM CHIDLOW AREA
1968	8066	NIL	-
1969	6800	NIL	-
1970	4900	NIL	-
1971	5500	-	-
1972	4600	-	-
1973	2600	-	2.4
1974	700	4.9	17.2
1975	50	5.1	19.2
1976	93	5.7	31.1
1977		3.8	37.1
1978		8.2	34.9

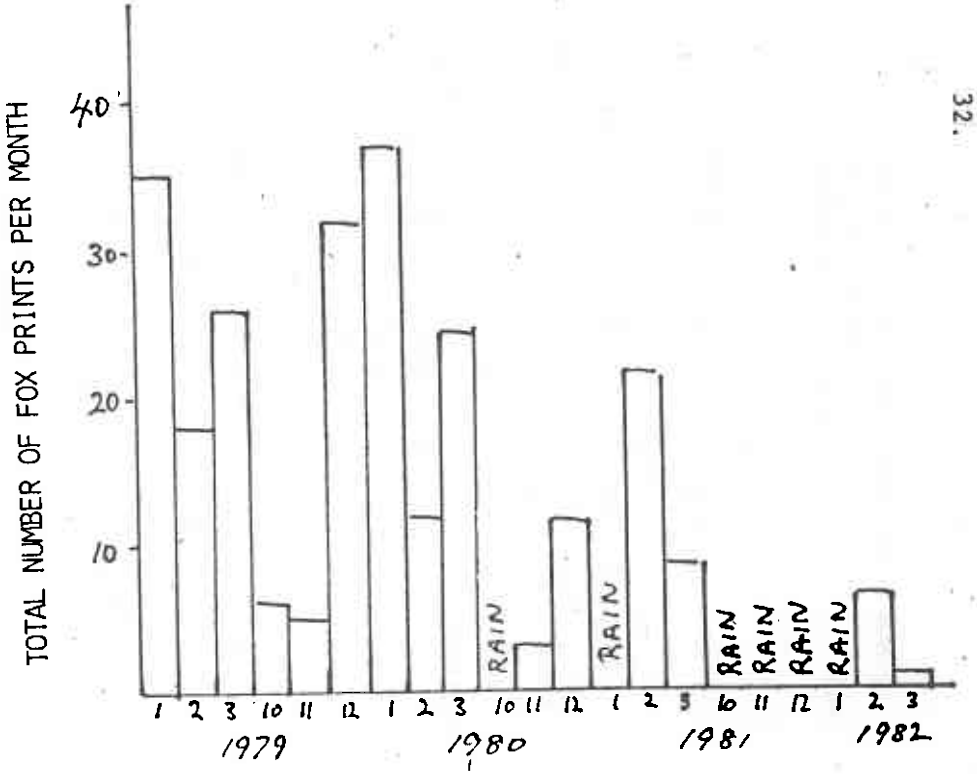
* PACKS OF 1 SHOT 1080 POISON LAID IN THE SHIRES OF MARGARET RIVER, BUSSELTON AND CAPEL. SIMILAR REDUCTIONS HAVE TAKEN PLACE IN OTHER SOUTH-WEST SHIRES.

DATA SUPPLIED BY A.P.B.

(CHRISTENSEN, 1980)

GRAPH 6. THE NUMBER OF FOX PRINTS COUNTED EVERY SEVEN DAYS, COLLATED INTO A MONTHLY TOTAL.





* 1080 BAITING CARRIED OUT

8. CONCLUSIONS

The results indicate that a management programme to reintroduce the woylie into forest areas, can be achieved. More males than females should be released in a single transplant, as found during this study a ratio of 2:1 should suffice. Where possible, females with implantation of the blastocyst should be used in the reintroduction, and at least a total of 60 animals released within an area.

Sites selected for this programme should have a poison species *Gastrolobium* or some equivalent, this will provide the source of 'secondary' poisoning for the fox. Also, areas should be baited with 1 shot 1080 rabbit poison, which can now be carried out by a trained officer of this department. The site should not have been burnt for four years, this allows adequate vegetation density for woylie survival chances. A burning programme should also be prepared, and be flexible enough to allow for future change.

Monitoring can be carried out by officers from the area selected. Techniques required have been shown, and successfully carried out by the Collie division. When in March 1982, 30 woylies were released in Batalling Block and Forest Officer T. Mitchell (under guidance) has monitored the first year.

Data obtained from this report, and the Perup study, would suggest that more woylies are needed to continue a successful 'transplant'. And it is therefore proposed to reintroduce a further thirty woylies into Batalling Block in the spring of this year (1983).

An additional release programme was initiated in March of this year. Thirty woylies were transported from the Perup to St. John's Block, an area previously inhabited by woylies (D.H. Perry, 1919, pers. comm.). As yet no data is available from this study.

9. ACKNOWLEDGEMENTS

I would like to thank Per Christensen for his comments and guidance throughout this study, also his help, and that of Chris Vellios in trapping and radio tracking. Peter Skinner, Elizabeth Bartuccio for their time in compiling data sheets to use in the analysis. Julie O'Connor for the statistical methods used, and Fiona Styles for typing this report.

10. REFERENCES

BURBIDGE, A.A. (1977).

The management of Dryandra forest for wildlife conservation. Department report, Dept. of Fisheries and Wildlife.

CHRISTENSEN, P.E. (1978)

The introduced european Red Fox (*Vulpes vulpes*). A serious threat to native mammals of the South-west.

CHRISTENSEN, P.E. (1980)

The biology of *Bettongia penicillata* Grey, 1837, and *Macropus eugenii* (Desmarest 1817) in relation to fire.

FINLAYSON, H.H. (1958)

On central Australian mammals (with notice of related species from adjacent tracts). 3 - The Potoroinae. Records of the South Australian Museum, 13, 235-302.

FOGEL, R. (1976)

Ecological studies of hypogeous fungi. 11 - Sporocarp phenology in Western Oregon Douglas fir stand. Canadian Jour. of Bot. 54, 1152-62.

FRITH, H.J. & CALABY, J.H. (1969)

Kangaroos (Hurst London).

KING, D. (1982)

How toxic 1080 selects its targets. Aust. Nat. Hist. Vol. 20, No. 10.

KIRKPARTRICK, T.H. (1964)

Molar progression and macropod age. Queensland Jour. of Ag. Sci., 21, 163-5.

PEET, G.B. (1967)

Controlled burning in the forests of Western Australia. (Forests Dept. of Western Australia.)

PERRY, D.H. (1971)

Observations of a young naturalist in the lower Blackwood Valley in the year 1919. West. Aust. Nat. 12, 46-7.

REFERENCES (cont)

REES, D. (1983)

Fox control with 1080 poison. Instruction Booklet, A.P.B.

SAMPSON, J.C. (1971)

The biology of *Bettongia penicillata* Grey, 1837. PhD thesis. University of Western Australia.

SHIELD, J.W. (1958)

Aspects of field ecology of the Quokka (*Setonix brachyurus*) Quoy and Gairnard. PhD thesis. University of Western Australia.

STICKEL, L.F. (1954)

A comparison of certain methods of measuring ranges of small mammals. Jour. of Mamm. 35, 1-15.

TROUGHTON, E. (1967)

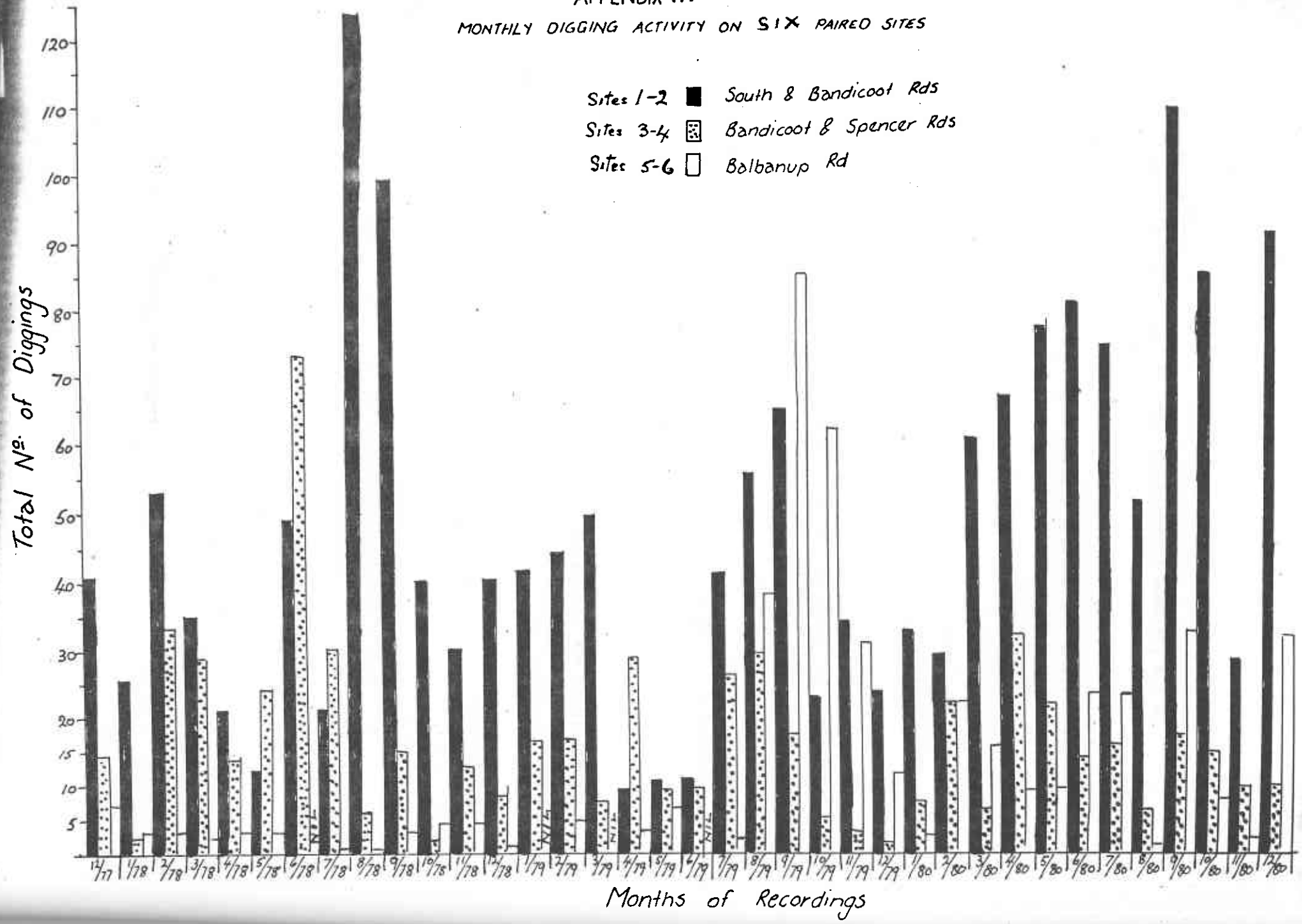
Furred animals of Australia. 9th Edition. (Angus and Robertson, Sydney).

WOOD-JONES, F. (1924)

The mammals of South Australia. 11 - Bandicoots and herbivorous marsupials. (Govt. Printer, Adelaide).

APPENDIX .1.

MONTHLY DIGGING ACTIVITY ON SIX PAIREO SITES

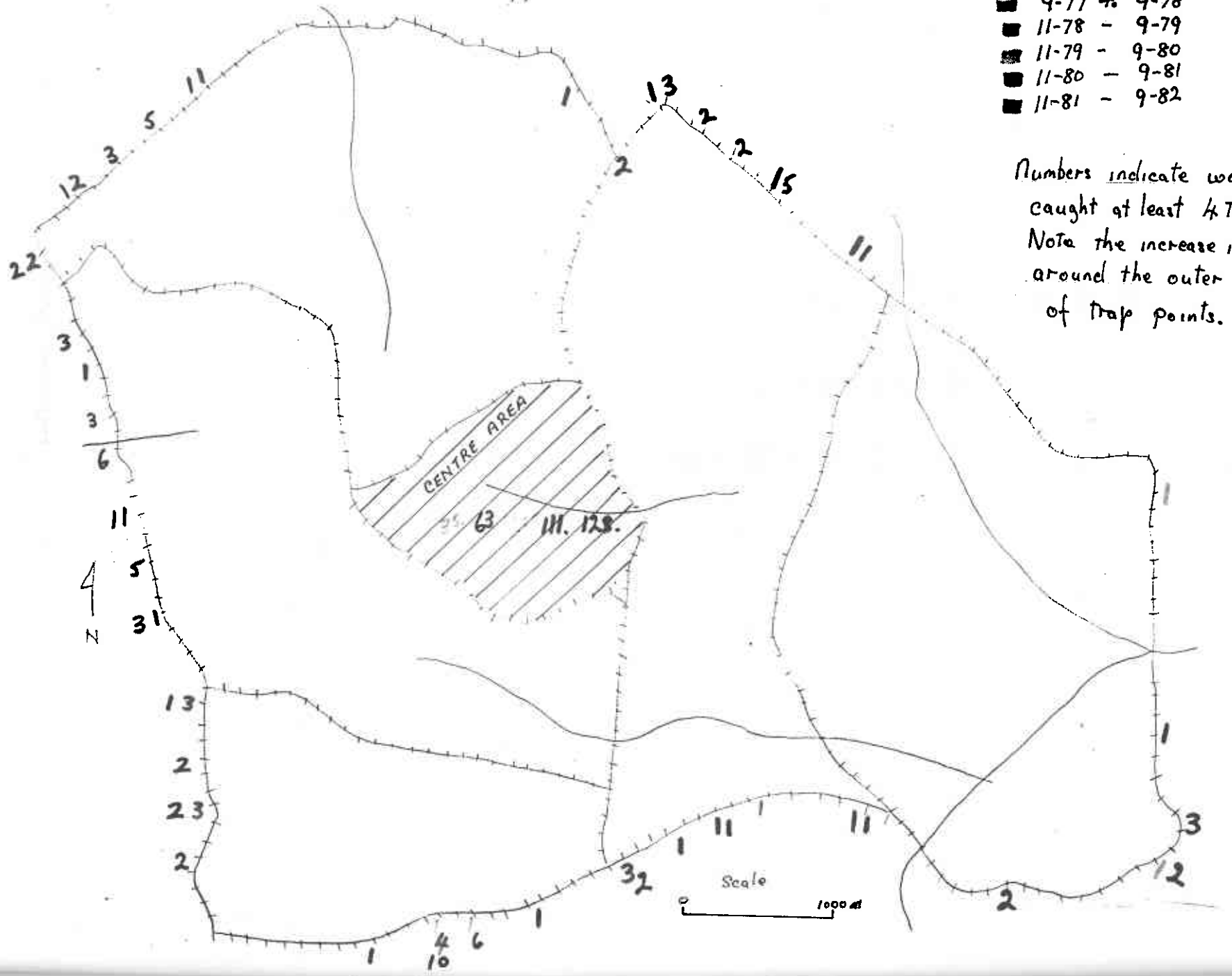


APPENDIX 2. A MAJOR PROBLEM WITH THE USE OF SAND PLOTS WAS RAIN, THIS HAD AN ADVERSE EFFECT ON THE IDENTIFICATION OF PRINTS.

RAIN	YENDICUP 1080				BOYICUP NO/1080			
	BAD	SLIGHT	NIL	TOTAL	BAD	SLIGHT	NIL	TOTAL
1/79		19	29	48		12	23	35
2/79		18	22	40		9	9	18
* 3/79		113	55	168		12	14	26
		150	106	256		33	46	79
*10/79	7	NIL	12	19	1	NIL	6	7
11/79		8	21	29	-	4	1	5
12/79			72	72			32	32
1/80			85	85			37	37
* 2/80	21	NIL	23	44	4	NIL	8	12
3/80	7	9	30	46	1	5	18	24
	35	17	243	295	6	9	102	117
11/80			21	21			3	3
*12/80			88	88			12	12
2/81		19	105	124		4	18	22
* 3/81	5	NIL	135	140			9	9
	5	19	349	373		4	42	46
11/81		RAIN				RAIN		
12/81	3	3		6		------ NIL ------		
1/81		RAIN				- RAIN		
2/81	9	NIL	14	23			7	7
3/81		14		14		1		1
	12	17	14	43		1	7	8

* 1080 BAITING CARRIED OUT

Appendix 3.


DATE of TRAPPING
9-77 to 9-78
11-78 - 9-79
11-79 - 9-80
11-80 - 9-81
11-81 - 9-82
Numbers indicate woylies caught at least 4 Times.
Note the increase in captures around the outer perimeter of trap points.
CENTRE AREA
63
111. 128.
N
Scale
1000 m