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STUDIES OF MACROPODIDAE IN QUEENSLAND

3. REPRODUCTION IN THE GREY KANGAROO (MACROPUS MAJOR) IN SOUTHERN QUEENSLAND

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SUMMARY

Reproduction in the grey kangaroo has been studied in captivity and in two field populations.

In captive animals, the oestrous cycle ranged from 41 to 43 days and the gestation period from 35 to 38 days. Pouch life of the young averaged 297 days; the interval between successive births, in the absence of a delayed embryo, averaged 356 days. Delayed embryos in captive females were produced at an oestrus occurring between 112 and 243 days after a birth; the delayed birth normally occurred when the first pouch young was between 291 and 312 days old.

Female kangaroos in the field commenced reproductive activity at ages ranging from 17 to 28 months, with reduced fertility in old age (over 16 years). Delayed embryos were seldom found in field-collected kangaroos and only in those with pouch young older than 174 days. No defined breeding season was apparent, though more young were conceived during October-December than at other times. Approximately 50% of young failed to reach independence.

Young suckled until 18 months of age both in captivity and in the field.

Males were observed to be reproductively effective between the ages of 3 and 15 years.

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I. INTRODUCTION

Until recently, few observations on reproduction in the grey kangaroo (*Macropus major* Shaw) had been published; most related to captive animals of uncertain geographical origin. Sharman (1959) and Poole and Pilton (1964) have summarized most of the older literature.

Recent studies are by Pilton (1961), who suggested a breeding season in South Australia during the summer months from a small collection of pouch young, and noted the apparent absence of the post-partum oestrus and delayed embryo found in many other Macropodidae (Sharman 1963); and Poole and Pilton (1964), who in a study of grey kangaroos from New South Wales and South Australia noted considerable variation in the duration of the oestrous cycle and gestation period, and recorded that breeding occurred throughout the year in a wild population, with a peak of reproductive activity during the warmer months. These authors also recorded apparently delayed embryos in field-collected females but did not find them in captive specimens.

In this paper, observations made on two populations of grey kangaroos, supplemented by studies of captive animals taken from the study areas, are presented. Field work commenced in 1959 and studies of captive animals in 1961. Work has continued to the present.

II. MATERIALS AND METHODS

(a) Field Studies

Study areas.—Two study areas were used, in the St. George and Warwick districts of southern Queensland. The St. George area included some hundreds of square miles of level forested country in central southern Queensland between latitudes 147°E. and 150°E., longitudes 27°30′S. and 28°30′S. Soils of the area ranged from a red sand to a lateritic grey clay. Forest cover was provided mainly by a box (*Eucalyptus populnea* F. Muell.) and several *Acacia* species. During the period of study, annual rainfall averaged about 16 in. and mean monthly temperatures ranged from 10° to 34°C. The Warwick area included some 30 square miles of undulating forested country near Warwick, south-eastern Queensland, between latitudes 151°35′E. and 151°50′E., longitudes 28°10′S. and 28°20′S. Soil was a grey to grey-brown stony clay loam. Forest cover was provided mainly by yellow box (*E. melliodora* A. Cunn. ex Schau) and an ironbark (*E. crebra* F. Muell.). Mean annual rainfall was in the vicinity of 25 in.; mean monthly temperatures ranged from 7° to 26°C.

Both areas were grazed by domestic stock, principally sheep, and had been improved for this purpose by the provision of permanent watering facilities, erection of fences and some clearing of forest.

Collecting.—Random collections, by shooting from a vehicle, were attempted by taking from any group the nearest animal offering the most suitable target. Reproductive systems of females were removed for laboratory examination;

ovaries were inspected for follicles and corpora lutea, and saline flushings of uteri were examined for small embryos. Testes were removed and the three linear dimensions measured; epididymal smears of selected animals were examined for spermatozoa.

Pouch young were removed and ages estimated from tail and hind feet measurements (Kirkpatrick 1965) and dates of conception calculated. Condition of teats was recorded.

Heads of all animals were removed and cleaned for estimation of age (Kirkpatrick 1964, 1965).

(b) Studies of Captive Animals

Captive animals, originally secured as pouch young from both areas of study, were maintained in yards at the Department of Primary Industries Research Station, Hermitage. Food supplied included lucerne hay, grain and freshly cut grass. Daily observations were made of reproductive activity, and dates of oestrus and parturition recorded. Pouch young were removed from several females known to be carrying a delayed embryo, and the interval between loss of the pouch young and birth noted.

III. RESULTS

Oestrous cycle.—Duration of the oestrous cycle, as indicated by the interval between successive oestrous periods, in four captive females ranged from 41 to 43 days. Females not carrying a delayed embryo which lost immature young came into oestrus between 5 and 39 days after loss of young.

Gestation period.—Parturition in captive animals occurred from 35 to 38 days after mating; the mean of 14 observations was 36·7 days. Duration of several gestations varied from 35 to 38 days in one animal (W64A); in others (W1047, W1048, W272A) successive gestations lasted 36 and 38 days.

Duration of pouch life.—Pouch young of captive animals first left the pouch for short periods at about 250 days from birth, and were kept permanently out of the pouch at ages ranging from 277 to 308 days; the mean of 12 observations was 297 days.

Interval between successive births.—Captive females without delayed embryos normally came into oestrus between 2 and 4 weeks after permanent eviction of a young from the pouch, and gave birth at intervals ranging from 338 to 368 days after birth of the first young; mean of five observations was 356 days. Those carrying a delayed embryo gave birth from 299 to 312 days after the first birth; mean of four observations was 306 days. Further details are given in Table 1.

TABLE 1

DELAYED EMBRYOS PRODUCED BY CAPTIVE GREY KANGAROOS, HERMITAGE, 1961–64

Kangaroo No.	Month of Oestrus Producing Delayed Embryo	Days After Birth of First Pouch Young at:—		
		Oestrus Producing Delayed Embryo	Loss of First Pouch Young*	Birth from Delayed Embryo
W64A	March	243	..	305
W272A	December–January	between 175 and 201	..	299
W272A	October	181	224	254
W362	June	124	124	162
W362	November	112	180	209
W1048	August–October ..	between 162 and 238	..	312
W1147	December	188	..	310

* If this occurred.

Lactation.—Young of captive animals continued to suckle for 18 months from birth; for the last 6-8 months a second young normally occupied the pouch. Of the four teats and associated mammary glands available, the same one was used throughout the suckling period by any one young. Field-collected juveniles less than 18 months of age collected at the same time as their mothers were usually suckling, as indicated by a lactating teat in the mother's pouch; lactation had invariably ceased in females with an accompanying juvenile older than 18 months.

Delayed implantation.—Delayed embryos were produced in several captive females; they were found rarely in the field. Details are given in Tables 1 and 2.

TABLE 2

DELAYED EMBRYOS FOUND IN WILD-COLLECTED GREY KANGAROOS,* WARWICK AND ST. GEORGE, 1959–64

Month Collected	Study Area	Age of Young in Pouch (days)	Diameter of Blastocyst (mm)
December ..	Warwick ..	174	In oestrus
June	Warwick ..	206	·29
May	Warwick ..	236	·25
November ..	Warwick ..	239	·22
February ..	Warwick ..	241	·27
July	St. George ..	256	·31
April	Warwick ..	261	·30
November ..	St. George ..	Escaped >250	·31
August	Warwick ..	Escaped >250	·30
July	Warwick ..	Escaped >250	·29

* Numbers of eligible does (i.e. with pouch young over 160 days old)—St. George 50, Warwick 68.

Breeding season.—Estimated month of conception of all field-collected embryos and young less than 18 months old is indicated in Figure 1. Data were not separated on a yearly basis as no obvious differences occurred. The possible influence of delayed embryos on the detected pattern, which must in any case have been slight, could not be excluded.

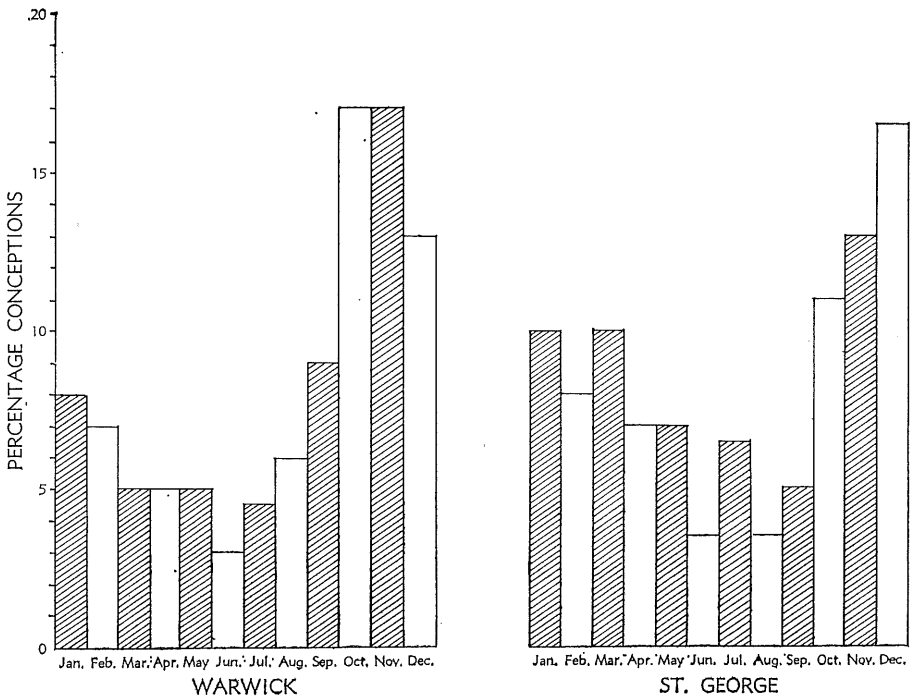

Fig. 1.—Grey kangaroo: monthly breeding in the Warwick and St. George study areas, 1959-1964.

Adult males were found with epididymal spermatozoa at all seasons in both areas.

Reproductive success.—As the normal interval between successive births was found to be about one year, and the evicted pouch young normally accompanied its mother until at least one year 100 days old (no juvenile this age or younger was ever collected independent of its mother), it was assumed that any female old enough to have produced two young and carrying a pouch young less than 100 days old (including pregnant animals) would be accompanied by a juvenile unless death of either a pouch young or a juvenile had occurred. Numbers of such females with and without juveniles collected from both areas are given in Table 3. An accompanying juvenile was deemed present if a lactating teat additional to that nursing the pouch young was present; usually, however, the juvenile was actually seen and often collected.

TABLE 3

REPRODUCTIVE SUCCESS IN GREY KANGAROOS, ST. GEORGE AND WARWICK, 1959–1964

Study Area	Number of Females Collected—		
	With Pouch Young, Age not more than 100 days	With Accompanying Juvenile (Lactating Teat)	Without Accompany-Juvenile (No Lactating Teat)
Warwick	73	38	35
St. George ..	37	22	15

Minimum and maximum breeding ages in the field.—Results from both study areas were similar and have been grouped for presentation.

Age at first conception was calculated for 62 primiparous females from estimated ages of female and pouch young. The distribution of ages is indicated in Table 4. A maximum breeding age was not found in the field; percentages of reproductively active females at 2-year intervals are illustrated in Figure 2.

TABLE 4

AGE AT FIRST CONCEPTION OF 62 PRIMIPAROUS GREY KANGAROOS, ST. GEORGE AND WARWICK, 1959–64

Age (months)	Number	Percentage
17	2	3·2
18	2	3·2
19	8	12·9
20	8	12·9
21	13	20·9
22	6	9·8
23	6	9·8
24	7	11·3
25	3	4·8
26	4	6·4
27	2	3·2
28	1	1·6

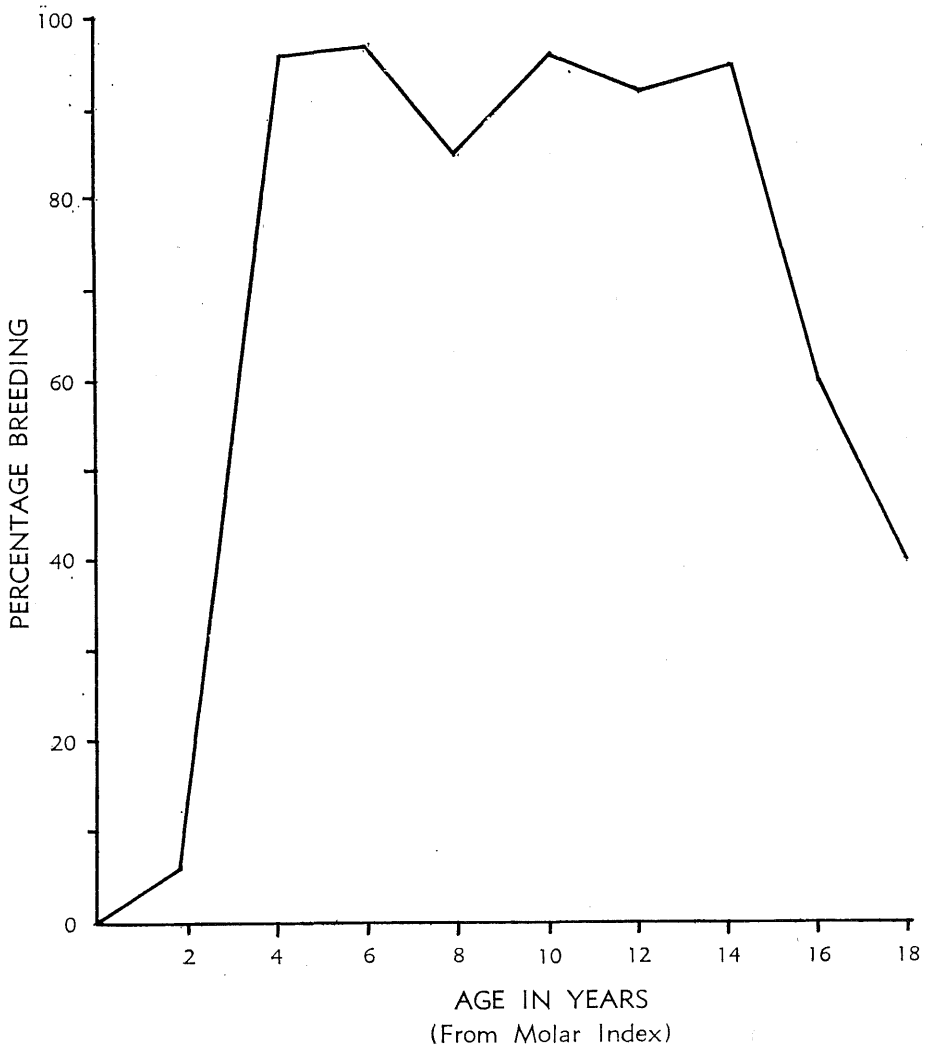

Fig. 2.—Grey kangaroo: female age and breeding, Warwick and St. George study areas, 1959-1964.

Sexual development of males is indicated in Figure 3, where major testis diameter is plotted against estimated age. Epididymal spermatozoa were not found in animals of estimated age less than 20 months, and were present in all older than 30 months. Males between the ages of 2 and 3 years were never found accompanying adult females except in feeding groups, and males older than an estimated age of 15 years were invariably found alone or with other males.

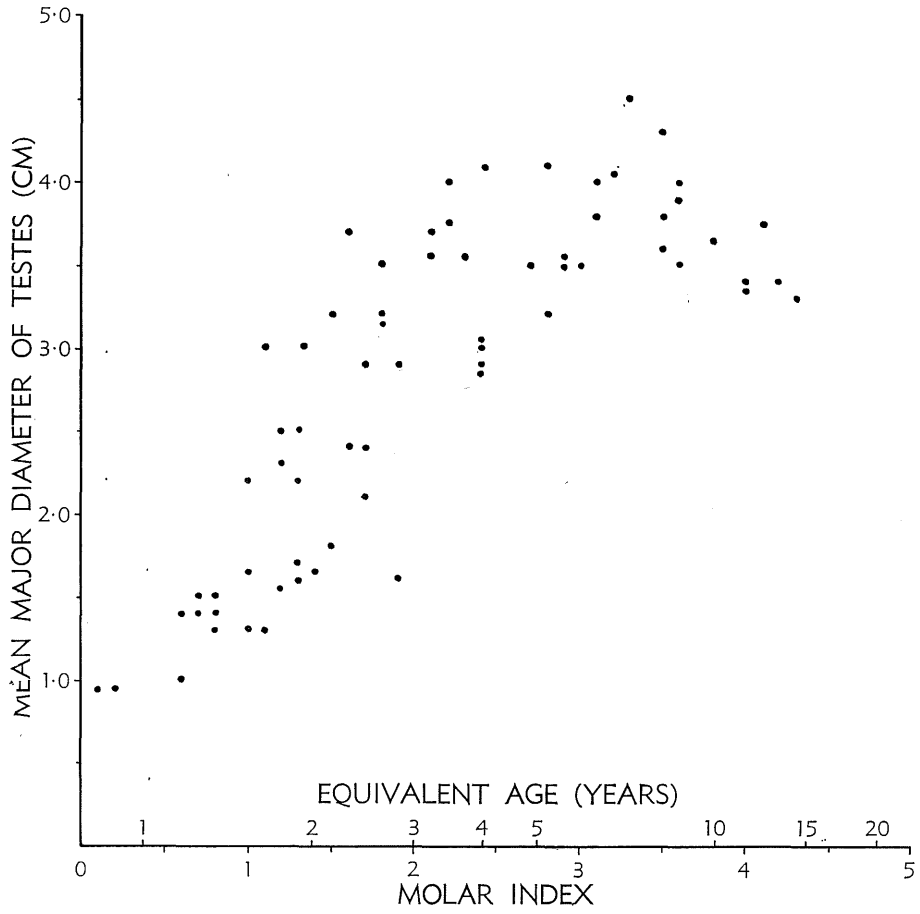

Fig. 3.—Grey kangaroo: age, and size of testes as an indication of sexual development, Warwick and St. George study areas, 1959-1964.

Sex ratio of pouch young.—The sex of 117 pouch young between 20 and 250 days old collected from the St. George area, and of 153 from the Warwick area, is given in Table 5.

TABLE 5

SEX OF GREY KANGAROO POUCH YOUNG, COLLECTED ST. GEORGE AND WARWICK, 1959–1964

Study Area	Males	Females
St. George	57	60
Warwick	70	83
Total	127	143

IV. DISCUSSION

The normal pattern of reproduction in the grey kangaroo, as indicated by observations on captive animals, involved the production of a single young each year. No defined breeding season occurred in either study area, but a peak of reproductive activity was recorded during the summer months, particularly October to December, which are within the period of higher rainfall and temperature in both areas. Young leaving the pouch at the normal age of 10 months would thus generally encounter favourable weather and pasture conditions. Jones (1924), Pilton (1961) and Poole and Pilton (1964) indicated a similar breeding season at about the same time of the year for grey kangaroos in southern areas of Australia.

The unusually variable gestation period has been discussed by Poole and Pilton (1964), who found a wider variation (29-38 days) with some differences related to the geographic origin of the animals. The smaller variation (35-38 days) recorded in this study could not be related either to geographic origin or to the incidence of lactation, a possibility also suggested by those authors.

The presence of a delayed embryo was unusual in the field and should perhaps be regarded as atypical. In captivity, however, delayed embryos occurred regularly. The late initiation (4-8 months after a birth), the short period of development (29-30 days) following loss of a pouch young compared with the normal gestation period (35-38 days), together with the comparative rarity, are features unique among Macropodidae so far studied. It may be that delayed embryos are produced only by animals on a high nutritional level which are thus physiologically capable of bearing the extra stress involved in rearing pouch young at 10-month intervals rather than the more usual 12 months. On this basis, delayed embryos would be expected more commonly in wild populations in good years, or in more productive areas. This may be involved in the apparent difference in frequency with which delayed embryos were found between the two study areas (Table 2), as the Warwick area, on the whole, provided better overall conditions than the St. George area.

A minimum breeding age of 17 months was indicated for females, with all breeding by 28 months old in both areas. The mean age at which reproduction commenced was 22 months (Table 4). Once reproduction commenced, females bred throughout life, and although some decline in fertility was indicated in the oldest animals (Figure 2) no age was encountered in the field at which breeding was not possible. In males, sexual development followed a similar pattern (Figure 3), with production of spermatozoa commencing at ages ranging from 20 to 30 months. The period of reproductive effectiveness of males was between the ages of 3 and 15 years.

A high rate of failure to rear young to independence was indicated in both areas (Table 3). This loss did not appear to be seasonal, as females which had lost young were collected at all times of the year and at no stage were weather and pasture conditions such as to make seasonal loss a reasonable expectation. Causes of death of young cannot be detailed at present, but separation of mother from dependent juveniles, leaving them exposed to predation

and starvation, was probably involved. Frith and Sharman (1964) considered that adequacy of nutrition of the female was a significant factor in survival of late pouch young and dependent juveniles of the red kangaroo; possibly this factor operated in the grey kangaroo, although this species characteristically inhabits a less harsh environment than the red kangaroo.

Sex ratios of the young in both areas did not differ significantly from 1:1 males to females (Table 5); this is in contrast to the observations of Caughley and Kean (1964), who found a highly significant discrepancy in favour of males in an area west of the St. George study area.

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