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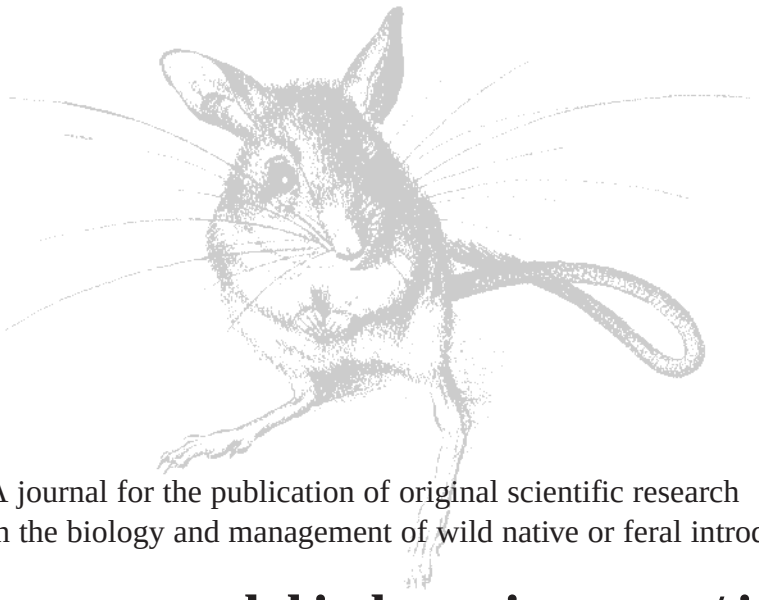

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Movements, dens and feeding behaviour of the tropical scaly-tailed possum (*Wyulda squamicaudata*)

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Abstract

I used trapping and radio-telemetry to study a population of scaly-tailed possums (*Wyulda squamicaudata*) in the Kimberley region of Western Australia. Radio-tracking of five adults over eight days provided detailed information on dens, and on size and shape of the home range, and facilitated nocturnal observations. *W. squamicaudata* used four different types of rock formations for diurnal dens: rockpiles, sunken rockpiles, large rock slabs and underground rock crevices. Radio-tagged possums of both sexes nested alone, used multiple dens and had overlapping home ranges. Both tagged and untagged possums appeared to be solitary and foraged alone. The average size of the home range was 1.0 ha (range 0.03–2.0 ha). Estimates of density ranged from 2.3 to 4.6 possums per hectare. Scaly-tailed possums fed on leaves of four species of trees (*Xanthostemon eucalyptoides*, *X. paradoxus*, *Eucalyptus* spp., and *Planchonia careya*) as well as the flowers and seeds of a perennial herb (*Trachymere didiscordis*). Feeding in trees is aided by the rough scaly tail, which sometimes supports the possum's full body weight. At this study site *W. squamicaudata* is sympatric with the rock-haunting possum (*Petropseudes dahli*), and they may compete for food and den resources.

Introduction

The scaly-tailed possum (*Wyulda squamicaudata*) is the only member of its genus and is endemic to the Kimberley region of Western Australia. Specimen records are sparse and patchily distributed, and the few captured possums have been associated with rocky outcrops (Calaby 1957; Kitchener and Vicker 1981; Bradley *et al*. 1987) and vine thickets (Kitchener and Vicker 1981; Humphreys *et al*. 1984; Bradley *et al*. 1987). Worora aborigines referred to the species as living deep in the rocks by day and feeding in the trees by night (Calaby 1957).

Of 46 possum species in Australia and New Guinea, *W. squamicaudata* is one of only three known to be saxicolous (Humphreys *et al*. 1984; Burbidge 1991), the other two being *Petropseudes dahli* of the Australian tropics (Kerle and Winter 1991) and *Burramys parvus* of the Southern Alps (Mansergh 1984). Most likely because of the remote and rugged terrain, there has been only one opportunistic study of *W. squamicaudata* (How *et al.* 1983; Humphreys *et al*. 1984; Bradley *et al*. 1987). This study found that one young is born between March and August and is weaned after eight months. Sexual maturity is reached by two years in females and 18 months in males. There was no sexual dimorphism in adult size, with females averaging 1438 g and males averaging 1540 g. Sex ratios of adults and pouch young were parity. Wild possums were observed eating blossoms (Burbidge 1990) of a eucalypt (Calaby 1957).

The aims of this study were to determine the extent to which *W. squamicaudata* uses rock outcrops, and to gain information on feeding and foraging behaviour.

Study Area and Methods

The study was carried out on the Mitchell Plateau in the Kimberley region of Western Australia (Fig. 1) during August 1997. The Mitchell Plateau has a tropical climate with a distinct wet and dry season. Average mean maximum temperature is 33ºC, which is consistent through the summer and winter months. A geomorphological description by Bradley *et al.* (1987), where a number of *W. squamicaudata* were trapped,

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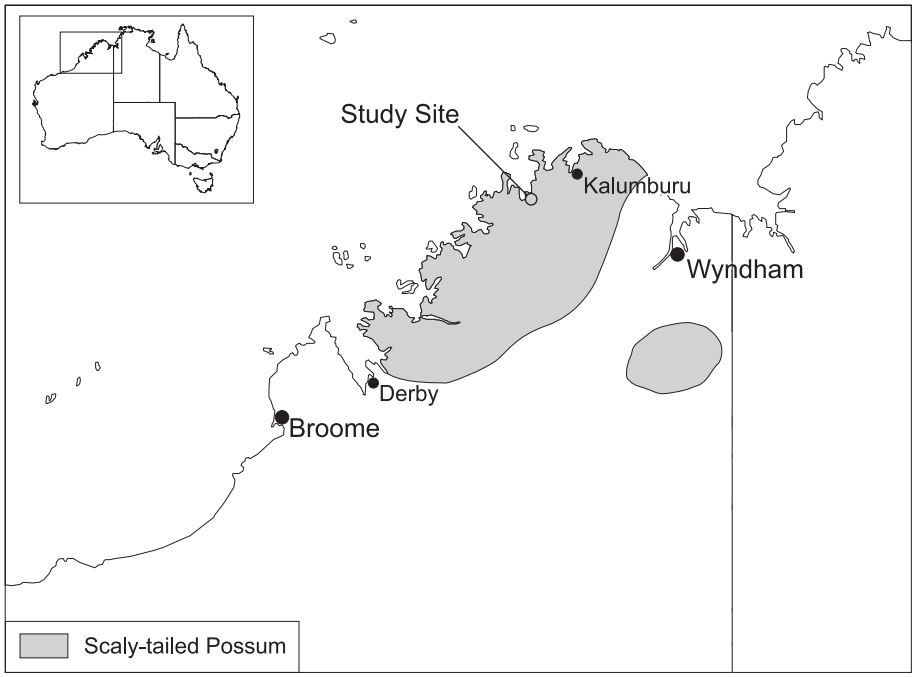

Fig. 1. Location of the study site and distribution of the scaly-tailed possum (from Strahan 1991).

is apt for the present study site: '… sandstone with its flat exposures, weathered platforms and massive boulders with a relatively cool and dry microenvironment, combined with a diverse flora …'. The vegetation was dominated by low open woodland, open woodland and closed forest. Four areas, each roughly 4.5 ha were identified as different habitat types on the basis of dominant tree type(s) and proportion of rock to vegetation, using methods from Specht's (1970) classification.

The study was carried out over 16 days. Individuals of *W. squamicaudata* were captured in cage traps baited with jam, apple and a mix of oats, honey and peanut butter. Three linear traplines, consisting of 12 traps spaced 20 m apart, were positioned perpendicular to each other in low open woodland. Trapping totalled 144 trap-nights.

The weight, measurements and sex of captured individuals were determined. I searched for sternal and paracloacal glands by palpation and assessment of fur discoloration. Possums were fitted with ear tags (Hauptner) and leather collars with a 2-stage radio-transmitter (Sirtrack Electronics, New Zealand). Coloured reflective tape was attached to collars to assist with nocturnal observations. Collars were retrieved at the end of the study. Age of pouch young was estimated by means of the formula of Humphreys *et al.* (1984).

Telemetry was used to locate diurnal possum dens (between 0900 and 1300 hours) and to locate possums at night for behavioural observations. The author and two volunteers spent a total of 109 hours spotlighting and observing at night using binoculars and 6-V miners' headlamps covered with red cellophane. Dens were observed from dusk (1815 hours) until 2200 hours. After this time, spotlighting in open woodland and closed forest was carried out until midnight.

Results

Habitat

The vegetation communities of the study site were classified into low open woodland, open woodland and closed forest. *W. squamicaudata* were caught in low open woodland. Spotlighting in the open woodland and closed forest was not fruitful, but evidence of *W. squamicaudata* in

these communities was found in the form of scats. However, fewer scats were found here than in low open woodland. No vine thicket grew within or near the study site.

Population size, composition and body dimensions.

Eight *W. squamicaudata*, not including pouch young, were trapped in the low open woodland habitats. A population size estimate, for an area of 8.4 ha, based on frequency of capture (Caughley 1977), was 39 from geometric distribution estimates, 19 from negative binomial estimates, 23 from Poisson distribution estimates and 21 from Chao's method (1988). Most possums did not appear to be trap shy. For example, two possums were trapped within sight of each other, while others were trapped numerous times. The density estimate based on frequency of capture was 2.3–4.6 possums per hectare.

Sex ratio of trapped and untrapped adult animals was 1 : 1. Of the three female possums trapped, two had pouch young and one had a swollen teat. Of the five males trapped, two were estimated to be less than 18 months old, whereas three were older. Estimated ages of two pouch young was 61 and 149 days. This suggests that one was born in June and the other in March. Female *W. squamicaudata* can lactate up to 250 days after the birth of young (Humphreys *et al.* 1984). The mean adult weights were 1500 g for females and 1233 g for males (Table 1). There was no sexual dimorphism in body size of adults, with both sexes having similar dimensions (*t*-tests, $P > 0.05$, see Table 1). Sternal and paracloacal glands were not found in either sex, but they may possess labial glands as face-washing was observed.

Dens

Diurnal dens were located in four different rock formations: rockpiles, sunken rockpiles, rock slabs, and underground rock crevices. Rockpiles consisted of similar-sized rocks grouped together to form a pile up to 3 m high. Sunken rockpiles consisted of similar-sized rocks grouped together in a concave shape. Rock slabs were large continuous rock segments. The fourth type of rock formation consisted of a horizontal fissure in a rock outcrop that extended for several metres underground. An estimate of the average rock size was calculated for each den. For rockpiles, areas were 2–50 m^2, those of sunken rockpiles were 0.25–4 m^2, and those of rock slabs were 3–200 m^2.

A total of 36 denning occurrences (representing 16 separate dens) was located after radio-tracking five possums for eight days. Nine of these 16 dens were used only once by an individual and seven were used more than once by the same individual. Six of the dens were in rockpiles, five were in rock slabs, four were in sunken rockpiles and one was underground. Possums of both sexes used multiple dens (Fig. 2). No radio-collared possums shared nests on the same day but two radio-collared possums used the same nest on different days. The

Table 1. Mean body dimensions for six adult *Wyulda squamicaudata*
All measurements are in millimetres

Measurements	Females ($n = 3$)		Males ($n = 3$)	
	Mean	Range	Mean	Range
Weight	1500	1450–1550	1233	1125–1425
Head length	87	85–89	84	78–90
Head width	50	50–51	47	44–50
Head–body length	415	379–470	375	350–420
Ear length	32	30–35	29	28–29
Ear width	18	15–22	17	16–17
Tail length	290	280–300	290	0
Forepaw length	34	33–34	32	30–34
Hindpaw length	48	43–51	50	49–50

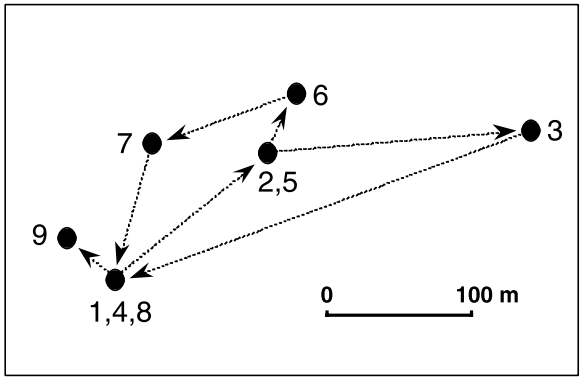

Fig. 2. Nine dens of one adult *W. squamicaudata* radio-tracked over a 9-day period. Numbers represent days that the possum was located at each den. Arrows indicate the order in which the dens were used.

maximum number of different dens used over the eight days by an individual was six and the minimum was one. The maximum distance between dens of an individual possum was 450 m. The minimum distance was 30 m and the mean distance was 178 m.

Home range

The total area of all home ranges was 5.1 ha and the average home range area was 1 ha (range 0.03–2.0 ha). Individual home ranges varied between 50 and 640 m in length (mean 391 m) and between 30 and 150 m in width (mean 99 m). Female possums had larger home ranges (mean = 1.3 ha, $n = 3$) than did males (mean = 0.5 ha, $n = 2$). For females the mean length of the home range was 517 m (maximum 640 m) and the mean width was 105 m. For males the mean length of the home range was 203 m (maximum 640 m) and mean width was 90 m.

All ranges overlapped to some extent with that of another possum (Fig. 3). Home ranges of females overlapped with those of males. The total number of records used to ascertain the home range of an individual was between 8 and 15. Sizes of home range are likely to have been underestimated for three reasons: (1) data were collected over a short time; (2) data were collected from only one season (home ranges may expand and contract at different times of the year depending on food supplies); (3) one of the home-range estimates was based only on den locations rather than on dens and foraging locations.

Feeding behaviour

All foraging observations (10) were of possums foraging on their own. Possums feeding in trees stretched their bodies along thin branches and used their forepaws to grab leaves growing at the ends of these branches. When a branch sagged under the weight of a possum the animal grasped the branch with its tail, swung down and grasped a lower branch with its forepaws, and finally dropped down to the lower branch. The tail appears to be specialised for feeding in trees. As suggested by the name, the tail possesses a scaly, rough outer layer for grip and support. On one occasion a possum was observed hanging vertically and attached to a branch solely by its scaly tail while it fed on leaves directly below. Observations showed *W. squamicaudata* to be very agile in both trees and on rocks. Leaps of over 1 m between branches of about 5 cm in diameter were common when moving in tree canopies.

Wyulda squamicaudata not only fed in trees but also foraged in open areas to feed on *Trachymere didiscordis,* a perennial herb with a stem 2 cm in diameter and an average height of

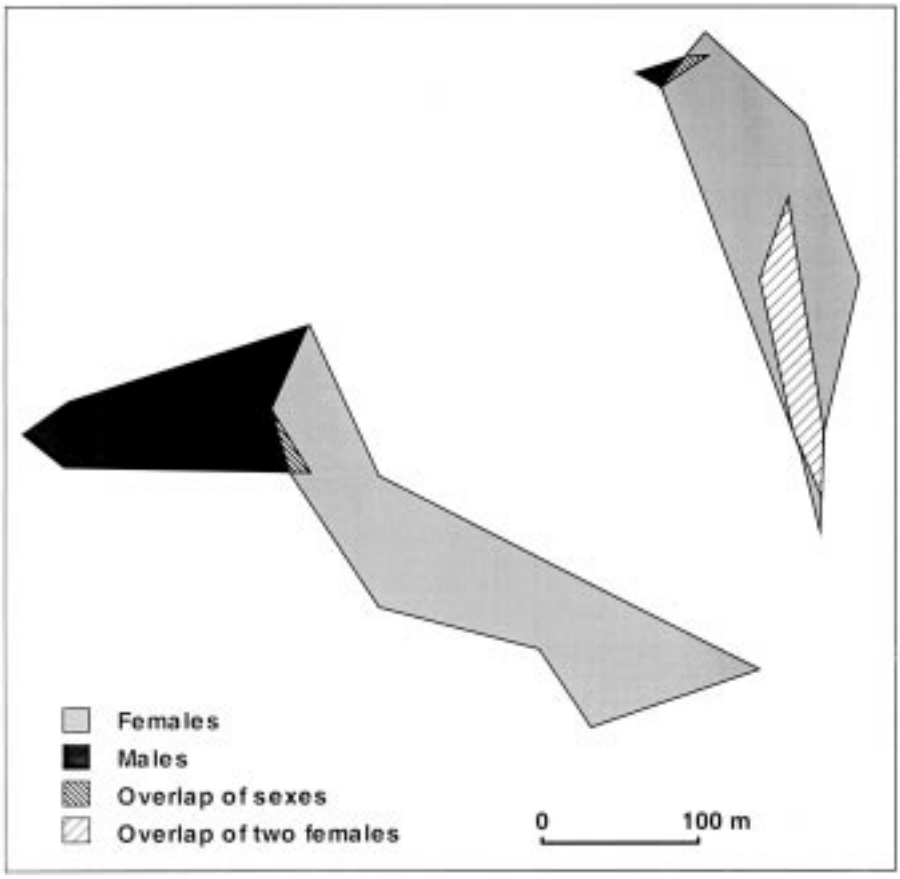

Fig. 3. Home-range estimates of five adult *W. squamicaudata* radio-tracked over an 8-day period.

150 cm. An adult radio-collared female possum was observed to climb up a stem of *T. didiscordis*, ascending even after the stem bent over under her weight. Finally the stem broke at the base and the possum fell to the ground on her back while still gripping the stem. She then righted herself and walked to the end of the stem and ate the flowers and seeds located there and part of the spongy stem. In some areas many *Trachymere* had broken stems with the tops containing seeds and flowers missing. Examination of broken stems revealed possum paw imprints on the surface.

Wyulda squamicaudata were also observed to feed on leaves of the tree species *Xanthostemon eucalyptoides*, *X. paradoxus* and *Planchonia careya*, and possibly also on old blossoms and nuts of *Xanthostenom* spp. An unidentified *Eucalyptus* species in the low open woodland is also highly likely to be a food species as many trees had old and new possum scratch marks on their trunks and partially eaten leaves. Scats of *W. squamicaudata* were found around the base of some of these trees.

When feeding in trees, both paws are used to pull leaves attached to branches towards the mouth. Segments of leaves are cut by the incisors then pushed back to the molars to be chewed. When a subadult possum was offered apple it took a piece in one or two paws, placed it in the side of its mouth, then pushed it using one paw to the rear of the mouth.

Behaviour

Agitated behaviour was observed in the form of 'tail wagging' by an adult when it was in a tree watching a trap. This behaviour involved the tail being moved from side to side repeatedly in the air at a near horizontal level. It was also observed in adults and a subadult when caught in traps. No social interactions between possums were observed.

Sympatric possum species

Another possum species present at the site was the rock-haunting possum (*Petropseudes dahli*). I found scats and rocks marked with the scent of *Petropseudes dahli* along two of the traplines. This is of biogeographical significance as this is the first record of *W. squamicaudata* and *P. dahli* occurring sympatrically. Extensive survey work has been carried out throughout the Kimberley (Kitchener *et al.* 1981; Wilson 1981; Bradley *et al*. 1987) with no evidence being found of the two possum species inhabiting any area together.

Discussion

The results of this study suggest a high dependence by *W. squamicaudata* on rock outcrops, which supports earlier observations of Humphreys *et al*. (1984). The possums' exclusive use of rocks for resting sites (instead of the more usual tree hollow) is perhaps because rock crevices offer more effective protection from predators, fire and rain, and provide better opportunities for thermoregulation in a tropical climate. Also, there are very few tree hollows in the area.

Petropseudes dahli also relies on rocks and has been radio-tracked to diurnal dens within rock torrs in Kakadu National Park (author's unpublished data). As *W. squamicaudata* and *P. dahli* both use rocks for resting, there is a possibility that the two species compete for den and food resources.

Like *Trichosurus vulpecula* (Winter 1977) and *Phalanger orientalis* (Winter 1991) (both also of the Phalangeridae), *W. squamicaudata* seems to be solitary. *W. squamicaudata* do not appear to share dens but alternate between dens within an area. The habit of changing dens regularly may be due to a combination of antipredatory behaviour and the proximity of the den to the last food plant used during the night. For a stable *W. squamicaudata* population to exist, many dens may be required in a given area. This requirement, coupled with suitable food plants, is perhaps not available elsewhere in Australia and thus may explain the restricted distribution of this species. Although vine thicket has been noted in records of *W. squamicaudata* (Kitchener and Vicker 1981; Humphreys *et al*. 1984; Bradley *et al*. 1987), none grew in or near the study site and it is evidently not an essential element of *W. squamicaudata* habitat.

Home-range lengths in the present study, which used radio-tracking, were substantially longer (85% longer for females and 28% for males) than those determined by Humphreys *et al.* (1984), whose study relied on traps alone. With a maximum range length of 640 m, *W. squamicaudata* have a longer range length than the maximum for six populations of *Trichosurus vulpecula* (480 m for males and 437 m for females: Kerle 1984). Home ranges of *W. squamicaudata* (mean of 1 ha) are within the range of those recorded for other species in the Phalangeridae (0.4–11.1 ha: Kerle 1984). The population density estimated was nearly five times higher than that calculated by Humphreys *et al*. (1984).

The two estimates of births in the months of June and March are consistent with the findings of Humphreys *et al.* (1984), who estimated births to occur between March and August. Also consistent with the study of Humphreys *et al.* (1984) is the absence of sexual dimorphism (Table 1). However, mean weights of adult males were 307 g lower than those documented by Humphreys *et al.* (1984). The apparent lack of sternal and paracloacal glands in either sex of *W. squamicaudata* is unlike the situation in other phalangerid species. For instance, *Trichosurus* species have both sternal and paracloacal glands, as does *Phalanger orientalis* (Biggins 1984). *Phalanger maculatus* has paracloacal but no sternal glands (Biggins 1984).

Wyulda squamicaudata rely substantially on their rough tail to hang from branches when foraging, which is unusual for a phalangerid possum. When the third museum specimen of

W. squamicaudata was collected from a tree for Calaby (1957), it was shot with its tail wrapped around a small branch high in the canopy. It hung 'pendulously' with the tail grip persisting after death. Thus, while *W. squamicaudata* displays some aspects of behaviour, biology and morphology that are similar to other species in the Phalangeridae, it also exhibits some unique features.

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