Breeding season and breeding potential of the greater cane rat (*Thryonomys swinderianus*) in captivity in South Africa

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Received 20 July 1998; accepted after revision 18 January 1999

The cane rat, *Thryonomys swinderianus*, is an aseasonal breeder. It has a very low fecundity rate with an average litter size of 2.9 (range 1–5), producing a maximum of two litters per annum. The low annual fecundity is the direct result of the extended gestation period of the cane rat which exceeds 150 days in duration.

Key words: Cane rats, *Thryonomys swinderianus*

Little is known about reproduction in the cane rat (*Thryonomys swinderianus*) in the southern African subregion. It occurs in most countries of west, east and southern Africa, its distribution being determined by the availability of adequate or preferred grass species for food (National Research Council 1991). In the southern African subregion it can be found in certain areas of Namibia, Botswana, Zimbabwe, Mozambique and South Africa. In South Africa it occurs in the northern Kwazulu-Natal Province, Eastern Cape Province, and in parts of Gauteng, North-West Province, Mpumalanga and Northern Province (Skinner & Smithers 1990). The greater cane rat is the second largest rodent in Africa with an average mass of 4.54 kg (range 3.18–5.22 kg) and 3.58 (range 3.41–3.8) for adult males and females respectively (Skinner & Smithers 1990).

In South Africa, little is known about the reproduction of the cane rat, especially when compared with the situation in West Africa where organized cane rat husbandry has been successfully initiated (National Research Council 1991). The cane rat is a very valuable resource in West and Central Africa, where its meat is consumed in large quantities (Jori, Mensah & Adjanohoun 1995).

The aim of the present study was to investigate the possibility of breeding *T. swinderianus* as a potential protein source. Therefore it is important to establish whether it is a seasonal or aseasonal breeder, and what the average litter size and litter interval is.

Materials and methods

Animals were kept under roof at the Agricultural experimental farm of the University of Pretoria, Gauteng (28°16'S, 25°45'E). Breeding groups, consisting of one male and 1–3 females were able to run freely in concrete enclosures (3.05 × 2.07 m) which were 1.04 m in height with extensions of a similar height composed of mesh-wire. The roofs consisted of corrugated iron and wire-mesh, with the latter covered by transparent plastic to keep out the rain. The rest of the cane rats (non-breeding females, excess males, lactating females and young) were housed in vertically stacked wire-mesh cages (each cage: 1.8 × 0.46 × 0.4 m) kept within the enclosures. Vertical stacking of cages is more economical with space. As soon as a female gave birth, she and her pups were removed and placed in one of the wire-mesh cages to separate them from the breeding male. This was done to prevent the female with new-born from fighting with the male, and further to protect the young from possible harm by the males. When the pups reached an age of about 40 days, the female was removed and placed in a separate cage or back into one of the enclosures to breed again. At five months of age, when males are becoming sexually mature (Alexander 1992; pers. obs.), the young males of a litter were separated from the females and placed individually in wire-mesh cages to prevent inbreeding and fighting amongst the males.

The number of breeding animals in the enclosures (running free) varied from time to time, because females were removed as soon as they gave birth. Breeding males not in use were also kept separately in the wire-cages. Therefore the numbers of free-running animals, as well as those kept in the wire-cages fluctuated.

Additional information was obtained from E. Pieterse (Agricultural Research Council: Animal Nutrition and Animal Products Institute, Irene, Pretoria) from animals donated to her by me to initiate a breeding colony. The greater cane rats we use originated from the breeding stock of the late Ann J. Alexander (Biology Department, University of Natal; Durban, SA).

The number of breeding animals used in this study comprised four males and 11 females (University of Pretoria) while the Irene stock consisted of two males and eight females. Information from the university colony was gained from 15 litters (comprising 46 individuals), and from the Irene colony, three litters comprising seven individuals. The animals at Irene were also kept in large wire-enclosures under a roof.

Enclosures and cages were cleaned weekly and fresh straw was provided for bedding. The animals were fed daily and water was freely available. All animals were exposed to natural light and temperature regimes, including the Irene stock. The diet comprised a combination of maize (*Zea mays*), commercial rabbit pellets (Epol) and fresh cut grass.

Data used in the present study were collected between January 1994 and October 1998.

Because of the difficulty of sexing fetuses and young accurately without dissection, sex ratios are given for ten litters with larger young which are easier to sex. Sex ratio data could also not be obtained from the three litters of the Irene breeding colony.

Monthly mean maximum and minimum temperatures for the years January 1994 to September 1998, were obtained from the Climatological Office of the Weather Bureau in Pretoria for the university area. In Figure 1, the average for the monthly maximum and monthly minimum temperatures for the period January 1994 to September 1998 (i.e. 4.75 years) are given, as well as the average maximum and minimum monthly temperatures for the periods April 1994 to March 1995, April 1997 to March 1998 and April 1998 to September 1998 (data for the rest of October still unavailable). Temperature data for the other intermediate periods (April 1995 to March 1996 and April 1996 to March 1997) are not included, because they are not relevant to the present study.

Results

Breeding occurred throughout the year (Table 1). The gestation period is very long for a rodent of this size and exceeded 150 days. The known time interval between the date when males and females were placed together and the date when parturitions occurred was determined for eight litters and varied from 156–206 days. The six shortest intervals were 156, 161, 161, 164, 165, 165 days (Mean ± SD = 162 ± 3.2 days). Although it is not known exactly when fertilization occurred, it is expected to be within a few days after a male and female are placed together. In this study the minimum period between introducing a male to a female and the date of birth was 156 days, and is taken as the gestation length in this study. The various months during which conception was estimated to have occurred (Table 1), and the months during which births were recorded, strongly suggest that these animals are aseasonal breeders. In captivity, environmental factors did not appear to influence the gestation period. Of the six shortest periods between the time when a male and female were put together and birth, three litters (B-164 days; C-165 days; D-156 days) were recorded in 1994 during the period May to October/November, with pregnancy occurring throughout the cold winter (June, July and August) (Table 1; Figure 1). During both 1997 and 1998 the duration for the same time of year (April to September and May to October) was 165 (Litter J) and 161 days (Litter R) respectively, again with pregnancy occurring throughout the cold winters. Comparing the situation with the warm to hot conditions of the Highveld spring and summer months, the situation was similar. The duration for the period October 1997 to April 1998 was 161 days (Litter P) (Table 1, Figure 1). A single female who had three consecutive litters from the same male (Litters J, P and R), was for the first time placed with the male on 11 April 1997. She gave birth 165 days later on 22 September

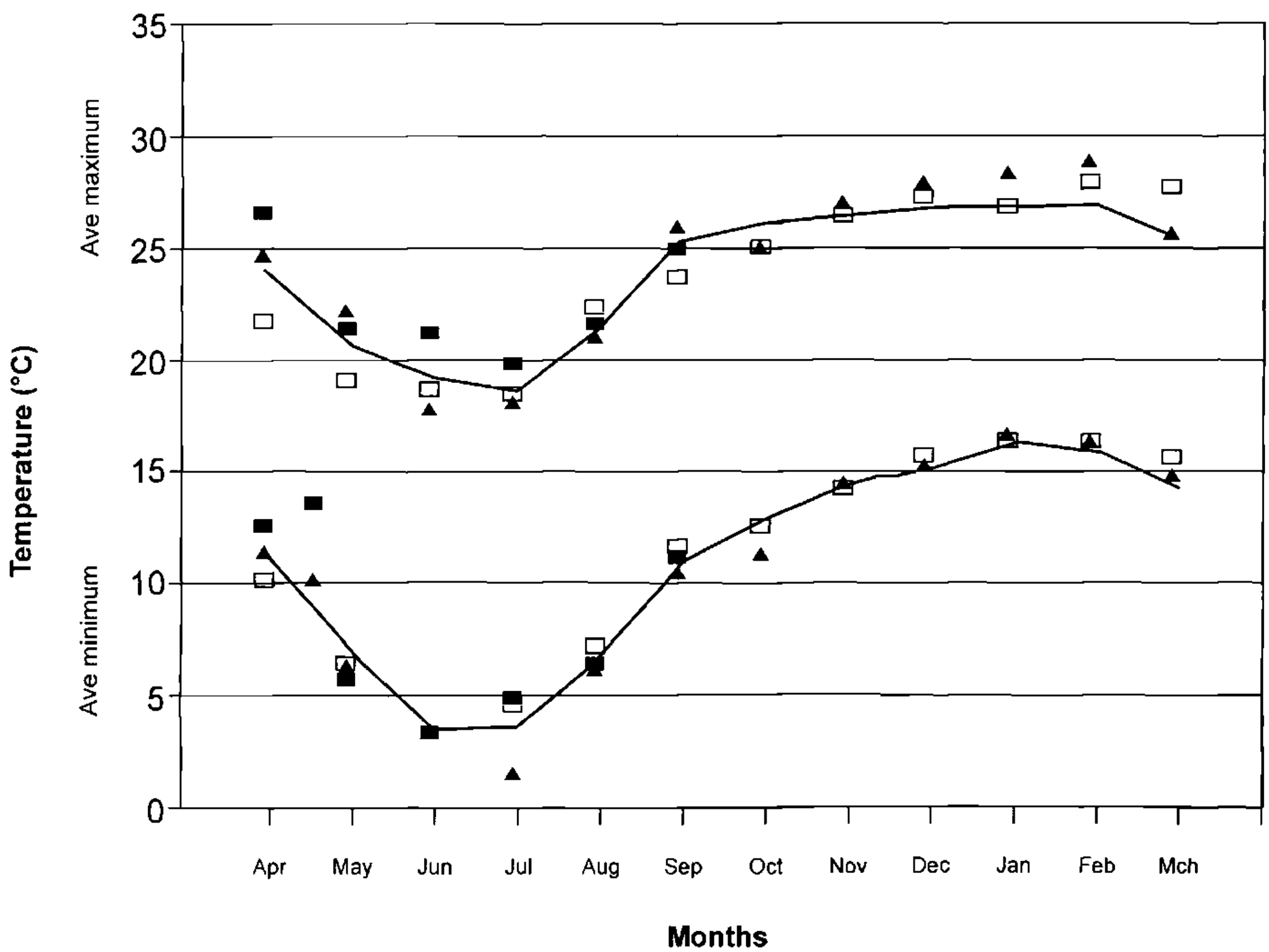

Figure 1 Average monthly maximum and minimum temperatures for the periods: ▲ April 1994–March 1995; ❑ April 1997–March 1998; ■ April 1998–September 1998
— The monthly averages (for both maximum and minimum temperatures) for the period 1994–1998 (4.75 years)

1997 (Table 1). Thirty nine days later on 31 October 1997, she was again placed with the male, and gave birth 161 days later on 10 April 1998 (Table 1). The third time she was placed with the male thirty nine days later on 19 May 1998, and gave birth 161 days later on 27 October 1998 (Table 1). From the above information it is clear that with an interval of 39 days between two breeding cycles, a maximum of two litters per annum is possible (165+39+161=365 days and 161+39+161=361 days respectively). The first two pregnancies occurred throughout the cold winter months, while the third pregnancy was during the warm to hot spring and summer months (Figure 1). Nevertheless, the time difference between the three breeding cycles did not exceed four days.

The sex ratio of ten litters was about 50% males : 50% females (19 males : 18 females). The average litter size for 18 litters was 2.9 (range 1–5). With a gestation period of approximately 156 days (taken for this study) and a suckling period of 28 days (see discussion), the earliest that a female can be re-introduced to a male after one breeding cycle is approximately 184 days (6.1 months). Thus if a female conceives immediately, the second litter can be born 340 days (11.3 months) after she became pregnant for the first time. This however approximates the minimum time required to produce two litters. With an average of 2.9 pups per litter the maximum breeding potential of a single female is 5.8 pups per year.

Table 1 Breeding data for the greater cane rat, *Thryonomys swinderianus*

Litter	Litter size	Date[1] (m+f)	Date[2] (birth)	Date[3] (conception)
A	4	–	16 Jun 94	11 Jan 94
B	3	13 May 94	24 Oct 94	21 May 94
C	5	13 May 94	25 Oct 94	22 May 94
D	5	30 May 94	02 Nov 94	30 May 94
E	2	30 May 94	28 Nov 94	25 Jun 94
F	4	13 May 94	05 Dec 94	02 Jul 94
G	4	–	30 Sep 95	27 Apr 95
H	3	–	04 Jun 96	30 Dec 95
I	1	–	11 Jun 96	06 Jan 96
J	3	11 Apr 97	22 Sep 97	19 Apr 97
K	2	–	17 Mar 97	12 Oct 96
L	2	–	04 Apr 97	30 Oct 96
M	3	–	04 Apr 97	30 Oct 96
N	3	–	c 23 Jul 97	18 Feb 97
O	3	–	c 23 Apr 97	19 Nov 96
P	4	31 Oct 97	10 Apr 98	06 Nov 97
Q	1	31 Oct 97	c 09 Jun 98	05 Jan 98
R	1	19 May 98	27 Oct 98	24 May 98

1. Date (m+f): known dates when male and female(s) were placed together.

2. Date (birth): observed dates of birth (Estimated dates of birth indicated as c).

3. Date (conception): estimated date of conception (taking gestation time as 156 days).

Litters K-M: data obtained from the breeding colony of E. Pieterse (Agricultural Research Council: Animal Nutrition and Animal Products Institute, Irene)

Litters N + O: these fetuses were from pregnant females killed and dressed at the Irene Animal Nutrition and Animal Products Institute on 10 April 1997.

N – had three fetuses at about 1/3 term.

O – had three fetuses at full term.

Litter Q: mid-term fetus from a pregnant female that died on 26 March 1998.

Discussion

Hystricomorphs for which gestation lengths are known have long pregnancies for their sizes (Weir 1974) (Table 2). Although it may be expected that geographical or regional differences play a role in the length of gestation and or litter size, recent studies indicate that average gestation time and litter sizes in the greater cane rat may be very similar in the various geographical regions. The gestation time for cane rats in Ghana was reported to be 70 days (Ewer 1969, in Asibey 1974) and three months in Nigeria (Ajayi 1971). For East Africa the gestation length is also given as three months (Kingdon 1974). These periods, however, seem to be an underestimation. Asibey (1974), who initially also reported fairly short gestation periods for cane rats in Ghana (approximate length: 107 days; range 68–133 days), adjusted the gestation length to 155 days (range: 137–172 days) after gathering new data which he incorporated as an appendix in the same paper. Asibey (1974) originally determined the gestation time by taking the interval between the date when the vaginal closure membrane was first observed to be closed to the date of birth of the young. Contrary to evidence in the literature, Schröder & Mensah (1987) found that a vaginal closure membrane does not occur in the cane rat. They suggested that Asibey (1974) noted the 'vaginal-scab' ('mucus vaginal secretion which hardens to form a kind of scabby plug') as a vaginal closure membrane. The scab is a different structure that occurs at variable time intervals in pregnant and non-pregnant females. Nevertheless a gestation period of approximately 150 days (five months) appears to be the norm for countries of West Africa (National Research Council 1991; Asibey 1974; Schröder & Mensah 1987), as well as for South Africa (Alexander 1992, 1996; present study).

Although two to four pups per litter seem to be the norm in all countries for which data are available (Kingdon 1974; Rosevear 1969; Oduor-Okelo & Gombe 1982; present study), larger litters appear to be fairly common in countries of West Africa. Litter sizes of up to eight have been recorded in Ghana (Asibey 1974) and even 11 or 12 in Benin and Togo (National Research Council 1991). For East African countries two to four pups have been recorded (Kingdon 1974; Oduor-Okelo & Gombe 1982), although as many as six may also occur (Kingdon 1974). From the information available in South Africa (Alexander 1991, 1996; present study), mean litter size falls towards the lower end of the range given for other African countries. A gravid female collected during November in Mpumalanga had four foetuses (Rautenbach 1982), and the range found in the present study was from one to five. Litters larger than five have not been recorded yet for the southern African subregion.

The breeding potential of a female per year seems to be two litters (Asibey 1974; Ajayi 1971; Alexander 1991, 1996; Baptist & Mensah 1986). A further influence is the time laps between parturition and the time when a female is fertilized

Table 2 A comparison of factors associated with reproduction and parturition for the African suborder Hystricognathi

Species	Sex	Mean body mass	Breeding season	Occurrence of pregnant & lactating females	Gestation (days)	Maximum no. of litters per year	Mean litter size & range	Reference
Bathyergus suillus	m	933 g	Yes	Jul–Oct	±52	2	2.4 (1–4)	Jarvis 1969; Jarvis & Bennett 1991.
	f	635 g						Van der Horst 1972; Bennett *et al.* 1991
Bathyergus janetta	m	451 g	Yes	Aug–Dec	–	2	3.5 (1–7)	Bennett *et al.* 1991; Jarvis & Bennett 1991
	f	332 g						
Georychus capensis	m	181 g	Yes	Aug–Dec	44–48	2	6 (4–10)	Bennett & Jarvis 1988a; Jarvis & Bennett 1991
	f	180 g						
Heliophobius argenteocinereus		160g	Yes	Apr–Jun	±87	–	- (2–4)	Jarvis 1969; Jarvis & Bennett 1991
Cryptomys h. hottentotus	m	77 g	Yes	Oct–Jan	59–66	2	3 (1–6)	Bennett 1988, 1989, Jarvis & Bennett 1991
	f	57 g						
Cryptomys damarensis	m	104 g	No	All year	78–92	4	3 (1–5)	Bennett & Jarvis 1988b;
	f	97 g						Jarvis & Bennett 1991, 1993
Cryptomys amatus		–	No	All year	100	3	2 (1–2)	Burda 1989
Cryptomys darlingi		–	No	All year	56–61	4	1.7 (1–3)	Bennett *et al.* 1994
Cryptomys mechowi		–	No	All year	97–111	3	2 (1–3)	Bennett & Aguilar 1995
Heterocephalus glaber		23 g[1]	No	All year	66–74	4	13 (1–27)	Jarvis 1991, Jarvis & Bennett 1991
		33.9 g[2]						
Thryonomys swinderianus	m	4.5 kg	No	All year	156	2	2.9(1–5)	Present study
	f	3.6 kg						
Hystrix africaeaustralis	m	11.0 kg	No	All year	93–94	1	–(1–3)	Van Aarde, R.J. 1985, 1987;
	f	12.3 kg						Van Aarde, R.J. & Potgieter, H.C. 1986

Body mass: 1 (northern Kenya); 2. (southern Kenya)

again for a following breeding cycle. Even with the possibility of a post partum oestrus (Asibey 1974; Baptist & Mensah 1986), or a reduced suckling period, the maximum potential of a female will remain two litters a year. Although a breeding potential of 1.8 litters per year was reported for breeding colonies in Bordeaux (Adjanohoun 1992), the present study confirms a breeding potential of two litters a year.

The natural weaning age of the cane rat is given as 4 weeks (Skinner & Smithers 1990) and 4–6 weeks (Alexander 1992). However, although young can be removed from the mother at two weeks, the best time appears to be at one month (Asibey 1974). In the present study it was decided to keep the mother with the pups for approximately six weeks, to decrease the possibility of stress amongst the pups by removing her too soon.

In Ghana cane rats breed throughout the year (National Research Council 1991; Asibey 1974), although there is a peak at certain times of the year correlated with weather conditions in West African countries (National Research Council 1991). Breeding colonies at Bordeaux also breed throughout the year (Adjanohoun 1992). Based on incomplete information, it has been suggested that breeding behaviour of cane rats in the southern African subregion is seasonal (Skinner & Smithers 1990). This assumption was based on the fact that neonates were recorded in the Okavango Swamps between June and August (Shortridge 1934), juveniles in Zimbabwe in August and November and a gravid female with three foetuses in November (Smithers 1983). Spring and early summer is given as the time of parturition in Gauteng, Mpumalanga, North-West and Northern Provinces (Stevenson-Hamilton 1947). Rautenbach (1982), however, also working in the same provinces suggested aseasonal breeding in the cane rat, which is supported by the present study.

It is expected that in the wild there may be a tendency for them to pup more frequently during certain seasons (presumably the rainy seasons when more food will be available). However, in captivity, where conditions are manipulated, maximum births can occur during any month depending on the time when males and females are placed together.

Acknowledgements

I am grateful to the University of Pretoria for financial assistance, and to Dr N.C. Bennett and Mr N.S.H. Wilson for critically reading the manuscript.

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