Ghana J. Sci. **40** (2000), 33-38

GESTATION AND PRENATAL LOSSES IN THE CANE RAT, *THRYONOMYS SWINDERIANUS* TEMM (RODENTIA: THRYONOMIDAE) IN GHANA

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Abstract

The reproductive organs of 101 pregnant females of the cane rat (*Thryonomys swinderianus*) were examined over a period of 5 months in an attempt to estimate prenatal losses at various stages of pregnancy. The study revealed that the vaginal orifice closure occurs for the first time after 51 days of pregnancy when the mean embryo weight is about 1.8 g, and not the first day of gestation as reported elsewhere. There was an occurrence of post-partum oestrus which increased in frequency with the monthly rainfall. Resorption rates also correlated with the rainfall. The mean and modal litter sizes were 3.42 ± 1.16 and 4, respectively. Total prenatal loss was 50.4 per cent of which 8.7 per cent was at the pre-implantation stage. The implication of this and the high significant correlation between the body weight of females and the number of implantation sites for the domestication of the cane rat are discussed.

Résumé

YEBOAH, S. & ADU, E. K.: *Gestation et pertes prénatales dans le rat de canne,* Thryonomys swinderianus *Temm (Rodentia: Thryonomydae) au Ghana.* Les organes reproducteurs de 101 femelles gravides de rat de canne (*Thryonomys swinderianus*) étaient examinés sur une période de cinq mois pour essayer d'estimer les pertes prénatales en diverses étapes de gestation. L'étude révélait que la fermeture d'orifice vaginal a lieu pour la premiére fois aprés 51 jours de gestation lorsque le poids embryonnaire moyen est environ 1.8 g, et non pas le premier jour de gestation comme présenté ailleurs. Il y avait l'événement d' œstrus post-partum qui augmentait en fréquence avec la pluie mensuelle. Les proportions de réabsorption corrélaient avec la pluie. Les dimensions moyennes et modales de litiére étaient respectivement 3.42 ± 1.16 et 4. La perte prénatale totale étaient 50.4% de laquelle 8.7% étaient à l' étape de pré-implantation. L' implication de ceci et de la corrélation considérablement élevé entre le poids corporel des femelles et le nombre des sites d'implantation pour la domestication de rat de canne ont été discuté.

Introduction

The grasscutter or cane rat, *Thryonomys swinderianus* Temm (Rodentia, Hystricomorpha, Thryonomidae) is an important game and pest animal in many parts of Africa. The flesh is a delicacy in many parts of West Africa and an important source of protein in Ghana. It is one of the animal species which do not, at the moment, fall within the scope of conventional livestock farming but are currently receiving much attention as having the potential to supplement the production of protein for human consumption (Feror, 1995; Yeboah & Adamu, 1995). In various parts of Ghana, this rodent has been domesticated for its meat. Its adaptive features also make it a useful study animal in biology (Ewer, 1969).

Despite its ecological and economic importance, very little is known about the reproductive biology of the grasscutter. Most of the previous work has concentrated on its habitat and geographical distribution (Shortridge, 1934; Cansdale, 1946; Ellerman, Morris-Scott & Hayman, 1953; Booth, 1960; Bere, 1962; Ansell, 1966; Paradiso, 1968; Dorst & Dandelot; 1970). Den Hartog & Den Vos

(1973) described its ecology, and Asibey (1971a, b) documented its role as an agrarian pest. Ewer (1969) worked on its form and function, and Cox, Marinier & Alexander (1988) investigated auditory communication in this species. The only available account of reproduction in the cane rat are those of Asibey (1974a, 1981).

Ecologically, a study of the reproductive biology of an animal is of great importance as it provides information on both its natality and life expectancy. Thus, until the reproductive biology of the cane rat is fully studied, knowledge of the species will remain inadequate. For the domestication and farming of the cane rat to be successful in order to supplement the protein requirements of the people of West Africa, an indepth study of its reproductive biology is imperative.

Experimental

Female cane rats were collected weekly from April to August 1996 from hunters in the Central Region of Ghana. Each specimen was examined for signs of lactation and for the presence or absence of vaginal closure membrane which forms during pregnancy. All carcasses were weighed before dressing, and the number of cheek teeth was used to estimate the age of the animals. Animals with two cheek teeth were considered as juveniles while those with three and four cheek teeth were considered to be young adults and adults, respectively (Asibey, 1974b).

The reproductive organs of only the pregnant individuals were examined after which they were washed in water to facilitate easy removal of the paired ovaries from the rest of the reproductive system. The uteri were then dissected out, and all healthy embryos counted and weighed after blotting dry with filter paper.

For the purpose of litter size estimation, two groups of embryos were identified: (1) those with mean body weight of more than 31 g, which were considered as belonging to early pregnancies, and (2) those with mean body weight of more than 31 g considered as belonging to late pregnancies, and, therefore, likely to be carried through pregnancy to full term. The weight of 31 g was chosen as the threshold because only embryos with body weight 31 g and above had traces of hair on their body and were, therefore, not likely to be resorbed. These were used in the litter size estimation.

For all specimens, the number of implantation sites visible to the naked eye, resorption sites and placental scars (which ever applied) were counted. Resorption sites looked yellowish and smaller than normal implanted embryos, and the placental scars were dark.

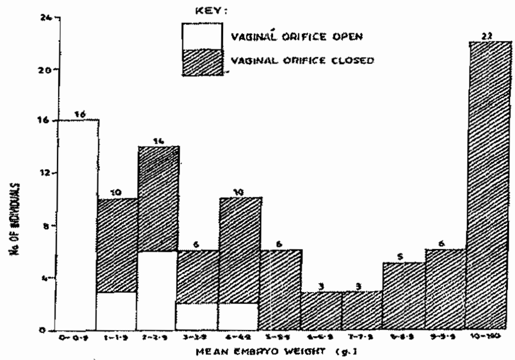

Fig. 1. The activity of the vaginal closure membrane during prenancy in the cane rat.

Ten-micron histological sections of the pairs of ovaries from 18 pregnant females were prepared and stained with hematoxylin and eosin by standard histological methods. Serial counts of new *corpora lutea* (new *corpora lutea* have less connective tissue between the lutein tissue) were then made under the microscope.

Results

Out of a total of 126 female specimens collected, 101 were found to be pregnant, and were, therefore, used for the study.

Vaginal orifice closure

Fig. 1 shows the activity of the vaginal closure membrane during pregnancy. The vagina does not close immediately after conception; it does so only when the mean body weight of the embryo is about 1.81 g. Using Hugget & Widdas (1951)

TABLE 1
Pre-implantation losses in the cane rat

Serial No.	*No. of* corpora lutea *in both ovaries*	*No of implantations*
1	8	7
2	10	9
3	7	8**
4	6	5
5	8	6
6	6	6
7	7	7
8	9	9
9	7	5
10	6	5
11	4	4
12	9	8
13	6	6
14	7	6
15	5	7**
16	6	4
17	9	4
18	5	5
Mean	6.9	6.3

*This includes resorption sites

** Anomaly explained in text

TABLE 2
Mean number of implantations according to age in the cane rat

Age according to number of cheek teeth	*Sample size*	*Mean number of implantations*	*SD*
3	30	3.89	1.36
4	71	7.90	1.90

formula, and specific growth rate of 0.0614 g/day (Asibey, 1974a), this corresponds to 50.8 days.

In a few individuals, however, the viginal orifice was found to be open even when the mean foetal weight had exceeded 1.8 g. No pregnant animal was, however, found to have the vaginal orifice open after the mean foetal weight had reached 5 g (58.8 days) (Fig.1).

Pre-implantation losses and number of implantations

Data on pre-implantation losses in 18 randomly selected pregnant individuals are shown in Table 1. Both the number of *corpora lutea* seen on the ovaries and the corresponding implantations in the uteri ranged from 4 to 10, and the means were 6.9 and 6.3, respectively, giving a mean pre-implantation loss of 8.7 per cent.

TABLE 3
Mean monthly resorption rate in relation to mean monthly rainfall

Month	*Sample size*	*Mean resorption rate %*	*SE*	*Mean monthly rainfall*
April	15	38.91	5.89	88.7
May	23	46.26	5.63	195.4
June	25	65.85	8.45	324.7
July	21	24.56	2.31	46.3
August	17	18.42	2.01	16.3
Mean	-	38.82	-	-

The number of implantations was influenced by both the age and body weight of the pregnant animal. Those with four cheek teeth had more implantation sites than young individuals with three cheek teeth (t-test, $P < 0.05$) (Table 2). The weight of pregnant females (excluding foetal weight) also correlated positively with the number of implantation sites ($r = 0.45$, $n = 101$, $P < 0.001$).

Resorption rates and litter size

Table 3 shows data on the rate of resorption calculated as a percentage ratio of resorbed embryos and total implantation sites. Resorption rates ranged from 0 to 100 per cent with the mean monthly rates ranging from 18 to 66 per cent. This correlated positively with the mean monthly rainfall ($r = 0.9$, $n = 101$, $P < 0.01$).

TABLE 4
Litter size in cane rats as revealed by foetal and placental scar counts

	Source		
	Foetal counts		Placental scar counts
	≥31g	≥81g	
No. of females examined	19	12	15
No. of embryos	65	40	83
Mean litter size	3.42± 1.16 (SE)	3.33± 1.32 (SE)	5.50±0.71 (SE)

Mean litter size was calculated using only full term embryos (≥ 81 g), and all embryos with body weight ≥ 31 g. There was no significant difference between these two types of mean litter size estimates (t-test, $P > 0.05$) (Table 4). Mean litter sizes estimated by using embryos of body weight ≥ 31 g and ≥ 81g were 3.42 ± 1.16 and 3.33 ± 1.32, respectively. Litter size of four was the most frequent, followed by litter size of two. Based on placental scar counts, the mean litter size was 5.50 ± 0.71.

Monthly changes in the proportion of pregnant females

Data on the monthly changes in the proportion of pregnant and/or lactating females are shown in Table 5. A minimum of 75 per cent of the female population were pregnant each month throughout the study period, the highest being in June, the peak of the major rainy season. Out of the 101 pregnant individuals examined, 48 (representing 47.5 per cent were both pregnant and lactating, indicating the occurrence of *post-partum* oestrous. The highest incidence of *post-partum* oestrus (76.7%) was in June and the lowest in April, the beginning of the rainy season.

TABLE 5
Number and proportion of females pregnant /pregnant and lactating during the study

Month	No. of females examined	Pregnant only No.	Pregnant only %	Pregnant and lactating No.	Pregnant and lactating %	Pregnant/Pregnant and lactating %
April	20	14	70.00	1	5.00	75.00
May	28	16	57.14	8	28.57	85.71
June	30	7	23.33	23	76.67	100.00
July	25	9	36.00	11	44.00	80.00
August	23	13	56.52	5	21.74	78.26
Total	120	101		48	-	-

Discussion

Vaginal orifice during pregnancy in the cane rat has been reported by Asibey (1974a) and used as day one of gestation. This assertion is based on the premise that the vaginal closure membrane is formed soon after fertilization. The present study has, however, revealed that the vaginal orifice closure occurs after 51 days of pregnancy when the mean embryo weight is about 1.8 g. Also, the fact that some pregnant individuals with mean foetal weight between 1.8 g and 5 g had their vaginal orifices open suggests that permanent vaginal membrane formation could be further delayed in some individuals. Thus, the vaginal orifice closure may not be a reliable means of estimating gestation period in the cane rat. This probably explains why Asibey (1974a) obtained a lower gestation period of 107 days using this method as against 155 ± 9 days (Asibey 1974) using mating marks on the female's back.

At least 75 per cent of females every month of the study period were pregnant (both early and late pregnancies) indicating that breeding takes place in the major rainy season from April to July, as well as the short dry season in August. Since full-term embryos were obtained every month during the period of study, and on the assumption of 5-month (155 days) gestation period (Asibey, 1974b), conception of the April embryos may have taken place earlier, probably from December to February, the major dry season. This indicates that breeding in the cane rat can take place in the major dry season too; and possibly throughout the year as suggested by Asibey (1974a,b). *Post-partum* oestrus also seemed to increase with the peak of the rains in June. This phenomenon probably enables the species to maximize the use of resources such as food and cover which become abundant with the rains. It is also probably to compensate for the high post-implantation losses (up to 100% in some individuals) during the period.

A mean pre-implantation loss of 8.7 per cent in the cane rat suggests that nearly all ova released from the ovaries get implanted in the uterus. Prenatal losses or intra-uterine mortalities are, therefore, mainly due to high resorption rates. There were two instances where the number of implantation sites was found to be more than the number of *corpora lutea* (Table 1). This excess of embryos over *corpora lutea* may be accounted for by assuming the occurrence of poly-ovuly or twinning of some ova in these animals as found in the Norway rat (Hall & Davis, 1950). The likelihood of some Graafian follicles luteinizing without discharging ova, and being mistaken for *corpora lutea* in making count can also not be overlooked. The former possiblity will tend to increase implantation site counts while the latter will increase the *corpora lutea* counts.

In either case, the accuracy of pre-implantation loss estimates may be compromised. In the present study, resorption rates are positively correlated with rainfall, a finding which has also been reported by Asibey (1974a). These findings are, however, contrary to expectation since resources in the form of nutritious food and cover for the pregnant animals are optimal during the rainy season. This is further supported by the findings of Moore (1965) and Thompson (1965) that the nutritional status of the mother, albeit in a controlled environment, has an influence on resorption. This anomaly could be possibly explained by considering the effects of rainfall on foraging time and environmental temperature in the wild. The heavy and persistent rainfall as occurs in the major rainy season, especially in June, reduces the time available for foraging. The accompanying low environmental temperatures may also have a deleterious effect on the health of the pregnant mother leading to high resorption rates.

Mean litter size based on foetal counts was 3.42 as compared with 5.50 based on placental scars. The latter high figure may be due to difficulties in differentiating between placental scars and resorption sites in certain cases, leading to less reliability as compared with the former. Thus, with a mean litter size of 3.42, and a mean number of ova released (based on *corpora lutea* counts) of 6.90, the total intra-uterine mortality is approximately 50 per cent. This gives a post-implantation loss of about 41 per cent which is mainly due to foetal resorption. Mean litter size could be increased substantially, however, if appropriate measures such as improved husbandry practices and food quality, including vitamin supplements (Moore 1965), could be instituted to reduce resorption and, thereby, restricted intra-uterine mortality to pre-implantation loss. This will invariably make cane rat farming a profitable venture.

Finally, the high significant correlation between maternal body weight and the number of implantation sites found in the study could be exploited in cane rat farming. Heavy animals could be raised through food supplements, proper husbandry and selective breeding to increase litter size.

Acknowledgement

The authors are grateful to Mr. C. T. Agbele (Chief Technician, Department of Zoology, University of Cape Coast, Cape Coast, Ghana) for his assistance in the histological examination of the *corpora lutea*. Special thanks also go to Dr (Mrs) Mary Botchey for her help during the preparation of the manuscript.

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Received 23 Jun 98; revised 5 May 2000.