THE RELATION BETWEEN PAINFALL AND THE BREEDING SEASON OF MASTOMYS NATALENSIS (SMITH, 1834) IN MOROGORO, TANZANIA

by

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SUMMARY

In a three year study, monthly data were collected on the presence of young animals and pregnant females in a population of *Mastomys natalensis* (SMITH, 1834) in Morogoro, Tanzania. Relating these data to monthly rainfall showed that the breeding season starts soon after the onset of the rainy season in March-April. If rainfall at the end of the year is heavy, there is a short additional separate breeding period early in the beginning of the following year.

Key-words : Mastomys, ecology, reproduction.

INTRODUCTION

Murids of the genus *Mastomys* are extremely common and widespread in subsaharan Africa. They are not only important agricultural pests, but also reservoirs of human diseases such as plague and Lassa-fever.

Actions to control these pest-organisms by increasing mortality (e.g. poisoning), should be undertaken when both density and recruitment capacity (reproduction) are minimal, *i.e.* just before the start of the breeding season. Consequently, it is of utmost importance to be able to predict when reproduction in the target population is going to start.

Several ecological studies on *Mastomys* in Africa emphasize the relation between climate and reproduction : BRAMBELL and DAVIS (1940) in Sierra Leone, PIRLOT (1954) in Zaïre, CHAPMAN *et al.* (1959) in south-west Tanzania, COETZEE (1965) in Transvaal, SHEPPE (1972) in Zambia, TAYLOR and GREEN (1976) in Kenya and NEAL (1977) in Uganda. However, year to year variation in timing of reproduction was never investigated. Moreover, all these investigations were carried out in areas with very different climatological and ecological conditions, so that any comparison between these studies remains impossible.

Our study fills this gap since we collected a large number of data in Morogoro, Tanzania, in a three year period during which variation in climatological conditions could be successfully related to changes in breeding season.

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MATERIALS AND METHODS

All our specimens were collected from the campus of Sokoine University of Agriculture, in Morogoro, Tanzania. On this vast campus, our study area consisted of large fallow fields or deserted maize fields.

From November 1985 onwards, animals were collected monthly till August 1988, except for four months when logistic problems made trapping impossible. Sherman live traps or Museum Special breakback traps, baited with peanut butter mixed with maize, were being placed for several nights. The animals were weighed, measured and sexual condition was recorded after which they were fixed in formalin and preserved in ethylalcohol.

In November 1986, we started a capture-recapture study on two grids of 1 ha. From March 1987 to October 1988, animals were caught there monthly in Sherman live traps, weighed, their sexual condition noted, marked by toe-clipping and released.

In total, we collected 2304 dead *Mastomys* from the removal trapping, and we realised 6984 catches of 2946 individuals in the recapture study. Other species than *Mastomys* were caught very seldom.

The taxonomy of the genus *Mastomys* is still a point of serious discussion among specialists. Only recently, ROBBINS and VAN DER SPRAETEN (1989), commented extensively on the systematics of *Mastomys* and proposed names to be used for animals with different karyotypes from different regions, including the southern part of Tanzania in Southern Africa (pers. comm.). According to their taxonomical conclusions, we consider our animals, which show a diploid chromosomenumber 2n = 32, to be *Mastomys natalensis* (A. SMITH, 1834).

The climatological data we use in this study were obtained from the meteorological station on the campus of Sokoine University of Agriculture, approx. 2 km from our study area.

RESULTS

Fig. 1 shows the mean monthly rainfall for 1980-1988. The dry season lasts from June to October; then it starts raining until May. We can distinguish two peaks in the rainy season : a smaller one in November-December (in Kiswahili. « mvuli »-rains) and an important peak from March until May (in Kiswahili « masika »rains), linked through January and February by a fair amount of rain.

However, this pattern can vary considerably from year to year as illustrated in Fig. 2A, representing the monthly rainfall from November 1985 to October 1988 : e.g. in 1986 the mvuli-rains were very heavy, while in 1987 they were almost insignificant.

The monthly presence (from November 1985 to October 1988) of pregnant females and young animals weighing less than 20 g, is given in Fig. 2B and Fig. 2C. The monthly number of investigated animals averaged 213 (range 18-647, and only in December 1985 and March and May 1986 less than 30 animals). Fig. 2B shows that every year, pregnant females appear in the population one month after the onset of masika-rains, and then there are pregnant females for four or five months, so that breeding activity ceases totally after September. In 1987 pregnant females were caught in January.

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Young animals are caught for the first time approximately one month after the appearance of pregnant females, i.e. near the end of the masika-rains (Fig. 2C).



Fig. 1. — The mean monthly rainfall at the campus of Sokoine University of Agriculture, Morogoro, Tanzania, showing a two-peaked rainy season, Mvuli-rains in November-December and Masika-rains in March-May.

DISCUSSION

Our results show that in years with an average rainy season (e.g. 1988), there is only one reproductive season. Pregnant females are observed one month after the start of the masika-rains, and young animals towards the beginning of the dry season. This agrees with the results of CHAPMAN *et al.* (1959), PIRLOT (1954) and NEAL (1977). In Sierra Leone, with a rainy season from July to September, BRAMBELL (1940) reported most pregnant females towards the end of the rains, but he also found a constant reproduction throughout the year, albeit at a lower level. In Transvaal (South-Africa) COETZEE (1965) caught pregnant females throughout almost the whole year, but with a peak towards the end of the rainy season.

On the other hand, SHEPPE (1972) found maximal breeding soon after the end of the dry season, but his study was made in a Zambian floodplain, an area with a very peculiar ecology.

Comparing his results with those of former workers, NEAL (1977) concluded that the end of the breeding season was influenced by the duration of the rains, but, in his opinion, earlier rains did not seem to cause an earlier beginning of the breeding season. Moreover, he suggested that young animals had to reach a certain level of development before becoming sexually active and that rainfall was not the main inducer of reproduction. In contrast to these conclusions, our results show that there is a clear relation between the onset of rains and the start of the breeding season. In 1986 and 1988, when masika-rains started in March, females were pregnant from April onwards, but in 1987, masika-rains as well as pregnancies started one month later.



Fig. 2. — (A) Rainfall in mm, (B) percentage of pregnant females and (C) percentage of young animals monthly from November 1985 to October 1988. Months for which no data are available are indicated with *. In B and C months with > 100 mm rain are indicated by dotted columns. MV means mvuli-rains, MA masika-rains

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When, in 1986, mvuli-rains were very abundant, pregnant females were present in the population as early as January 1987, and in March young animals appeared in the population proving there had been successful reproduction in the beginning of 1987. In early 1988 after small mvuli-rains, there were also a few animals weighing less than 20 grams, but we were able to show that in late 1987 growth of young animals ceased until March 1988 (*), meaning that these light animals were young, born in the previous year. Thus, heavy rainfall during the mvuli-season causes an extra breeding period in the beginning of the year. A possible explanation could be that extra heavy mvuli-rains change the ecological conditions in a favourable way so that the growth rate of the young animals increases and sexual maturity is reached earlier than normal.

After the masika-rains, the reproduction continues into the dry season for some months, indicating that decreasing rainfall is not sufficient to end the breeding season. On the other hand, the mvuli-induced extra breeding period in early 1987 was not continuous with the main breeding season although there was still a fair amount of rain between mvuli and masika. This suggests that the increased growth during the mvuli season is probably not the only cause of the early reproduction. The proximate factor, inducing animals to start (and stop) breeding, remains to be established. In planning control actions however, the amount of rain at the end of the year can be an important timing factor.

CONCLUSIONS

The breeding season starts soon after the beginning of the masika-rains in March or April, and the first young appear in the population at the beginning of the dry season. Breeding activity lasts until September. However, if the mvuli-rains in November and December are abundant, a short extra breeding period exists in the beginning of the following year.

This result is important in control strategies. Our study shows that when rains are abundant near the end of the year, control actions should start before January. If those rains are poor, the optimal period for actions will be February or March.

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REFERENCES

BRAMBELL, F. W. R. and D. H. S. DAVIS (1940) — Reproduction of the Multimammate Mouse (Mastomys erythroleucus TEMM.) of Sierra Leone. Proc. Zool. Soc. Lond., 111B, 1-11.

(*) LEIRS et al., in preparation.

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64 H. LEIRS, W. VERHEYEN, M. MICHIELS, R. VERHAGEN AND J. STUYCK

- CHAPMAN, B. M., R. F. CHAPMAN and I. A. D. ROBERTSON (1959) The growth and breeding of the multimammate rat, *Rattus (Mastomys) natalensis* (SMITH) in Tanganyika Territory. *Proc. Zool. Soc. Lond.*, 133, 1-9.
- COETZEE, C. G. (1965) The breeding season of the multimammate mouse *Praomys* (*Mastomys*) natalensis (A. SMITH) in the Transvaal highveld. Zoologica Africana, 1 (1), 29-39.
- NEAL, B. R. (1977) Reproduction of the multimammate rat, Praomys (Mastomys) natalensis (SMITH), in Uganda. Z. Säugetierk., 42, 221-231.
- PIRLOT, P. L. (1954) Pourcentages de jeunes et périodes de reproduction chez quelques Rongeurs de Congo belge. Annls. Mus. r. Congo belge, Sér. 4 (Zoologie), 1, 41-46.
- ROBBINS, B. and E. VAN DER STRAETEN (1989) Comments on the systematics of *Mastomys* (Rodentia : Muridae), with the description of a new West African species. *Senckenbergiana biologica*, **69**, 1-14.
- SHEPPE, W. (1972) The annual cycle of small mammal populations on a Zambian floodplain. J. Mammal., 53 (3), 445-460.
- TAYLOR, K. D. and M. G. GREEN (1976) The influence of rainfall on diet and reproduction in four African rodent species. J. Zool., 180, 376-389.