Spatial and temporal patterns in *Mastomys* cf. *natalensis* (Smith, 1834) as revealed by radio-tracking

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Introduction

Mastomys natalensis (Smith 1834) is a common rodent species in Africa and has been extensively studied (e.g. VEENSTRA, 1958; COETZEE, 1975; NEAL, 1977; TELFORD, 1989; LEIRS, 1995; OGUGE, 1995; MONADJEM, 1998). However, knowledge of its spatial and temporal patterns of activity is still scanty. Until now home range sizes of this species have been determined using the capture-mark-release method (CMR) (CHEESEMAN, 1975; LEIRS, 1995; CHRISTENSEN, 1996) except for one investigation that used radio-tracking, in fallow fields in Tanzania (LEIRS *et al.*, 1996). Previous investigations of activity patterns were carried out mainly in the laboratory (VEENSTRA, 1958, DELANY AND KANSIIMERUHANGA, 1970; CHEESEMAN, 1975; DUPLANTIER AND GRANJON, 1990) and little information is available from the field (DELANY, 1964; NEAL, 1970). In this study radio-tracking was used to elucidate home range size, home range utilization and activity pattern of *M.* cf. *natalensis* in its natural habitat. The data presented here are part of a larger study of the ecology of these populations (HOFFMANN, 1999). The name *Mastomys* cf. *natalensis* is given here to highlight the fact that the specimens under study may not belong to *M. natalensis*. Indeed, Volobouev *et al.* (2001) have shown the presence of a 38-chromosome species in the immediate vicinity of the study site, a karyotype that may be closer (although not identical) to the one of *M. erythroleucus*.

Methods and materials

Study area

The investigation took place in the Queen Elizabeth National Park (00°15'S, 30°00'E), in south-west Uganda. From 1995 to 1997 the [illegible]

studied using live trapping methods (CMR) throughout the year (HOFFMANN, 1999). For the radio-tracking experiment two live trapping plots of 1 ha each, about 2.5 km apart and with different vegetation types, were selected in the crater region. Radio-tracking was done at the start of the rainy seasons in March (plot 1) and in August

Fitting the collar

The animals were equipped with radio-collars with TW-4 transmitters (BIOTRACK, UK) of about 2.5 g, which represented 5-7% of the individuals' body weight. This was within the commonly recommended value of less than 10% (KENWARD, 1987). The collars were fitted in the laboratory. Subsequently the animals were kept for a few hours under observation and then released at their original trap sites.

Locating the animals

Generally the signal could be detected at up to 90 m. The position of each animal was determined by the homing-in-technique (WHITE AND GARROTT, 1990) within a 5 x 5 m grid using marker posts. The rats were located within the live trapping grid of 1 ha and beyond. Tracking started in the evening before the animals left their nests and ended in the morning after they had returned. The animals were radio-tracked in each area for 9-10 nights. To check for possible diurnal activity some day fixes were also taken.

Analysis

Size and shape of the home ranges were calculated using the software program RANGES V (KENWARD AND HODDER, 1995) and the Minimum-Convex-Polygon-Method. The latter was found to be adequate as it allows for comparison with our CMR-results and with previous studies (JONES AND SHERMAN, 1983). To minimize the influence of "occasional excursions" (BURT, 1943), the home range sizes were calculated disregarding 5% of the outermost fixes. The core areas were defined as encompassing 60% of the inner fixes.

For comparison, the home range sizes based on recapture data were calculated for all radio-tracked individuals. For this purpose, data from several trapping sessions were pooled. The CMR home range results so calculated are based on 4-9 different trapping locations for each individual over periods of 2-11 months.

Habitat utilization in plot 2 was assessed using all fixes of the 3 individuals when outside the nest. The activity status was determined by the changes of location of a particular individual during its activity period. In plot 1 fixes were taken at 30 min interval. In plot 2 the larger home ranges of the residents required longer walks and therefore longer lapses between the fixes. This also minimized encounters with lions (*Panthera leo*) and elephants (*Loxodonta africana*). In plot 1 an individual was considered resting after 3 consecutive fixes

nal resting bouts counted still for the active period.

Results

Seven individuals were successfully radio-tracked, providing a total of 1.375 fixes, 121 to 289 for each individual. In 3 more individuals the transmitter failed (n = 1) and the animals disappeared (n = 2).

Spatial patterns derived by telemetry

Imperata-Cymbopogon **grassland**

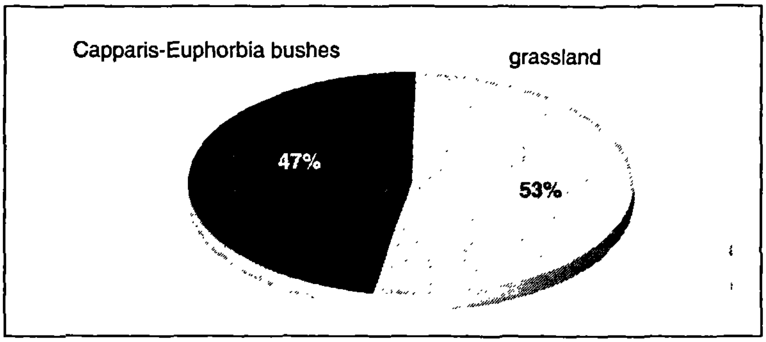

Figure 1
Habitat utilization of *M.* cf. *natalensis* [%] in the bushland-grassland-mosaic. Total fixes (n = 230) outside the nests of all individuals (n = 3) are pooled.

Spatial patterns derived by CMR-method

Home range sizes derived from the CMR-method were considerably smaller than those assessed by radio-tracking (tabl. 1). The CMR home ranges are about the size of the core areas (60%) as revealed by telemetry.

Activity patterns derived by telemetry

In both plots *M.* cf. *natalensis* was strictly nocturnal. The animals left their dens after dusk and returned to them before dawn. But their activity rhythms were different. In plot 1 all animals showed two distinct activity peaks, whereas in plot 2 they had just one (fig. 2). The mean activity patterns of the 2 plots are significantly different (Mann-Whitney U = 40, Z =-2.283, n = 13, p = 0.022)

In plot 1 the first peak of activity was about 1 hour after dusk, the

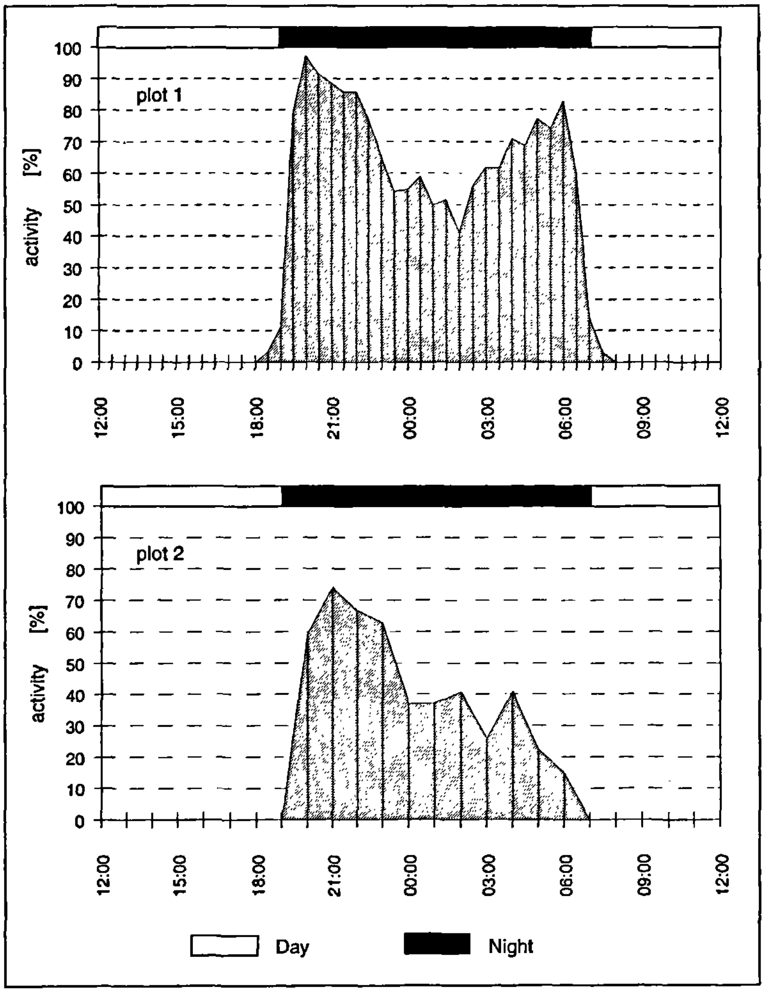

Figure 2
Activity records for *M. cf. natalensis* in both plots.
Fixes (N) of all individuals (n) in each plot are pooled:
plot 1 (n = 4, N = 959), plot 2 (n = 3, N = 377).

than in the *Imperata-Cymbopogon* grassland (plot 1). The activity period in the bushland-grassland-mosaic was on average 8.5 ± 1.3 h (n = 26) vs 11.2 ± 0.4 h (n = 25) in the *Imperata-Cymbopogon* grassland (HOFFMANN, 1999).

Discussion

Home range size and utilization

Home range sizes of *M.* cf. *natalensis* determined by radio telemetry in different vegetation types vary considerably, from 0.022 ha in a Tanzanian fallow field (LEIRS *et al.*, 1996), to 0.840 ha in a bushland-grassland-mosaic (this study, plot 2). Our plot 1 results and those of CHEESEMAN (1975) from the same *Imperata-Cymbopogon* grassland are intermediate. Home range sizes are likely to be correlated with density: in the fallow field of Tanzania an enormous density of up to 401 ind./ha was found (LEIRS *et al.*, 1996), vs 25 in the *Imperata-Cymbopogon* grassland (CHEESEMAN, 1975; HOFFMANN, 1999), and only 7 in the bushland-grassland-mosaic (HOFFMANN, 1999). These findings suggest that high densities are associated with reduced mobility. Home range overlap suggests a non-territorial range utilization pattern, which supports the conclusions of LEIRS *et al.* (1996).

Home range sizes calculated using the CMR-technique were very much smaller than those revealed by radio-tracking. This was also found by LEIRS *et al.* (1996).

Our sample is not large enough for assessing a possible correlation between spatial or temporal patterns of activity and sex or sexual activity. Home range sizes found with the CMR-method (HOFFMANN, 1999) suggest, for both plots, that the home ranges of males are on average larger than those of females. This is in contrast with the results of CHEESEMAN (1975) and LEIRS *et al.* (1996). Sexually active individuals of both sexes were found to have larger ranges than inactive ones (LEIRS *et al.*, 1996; HOFFMANN, 1999). Seasonal variations in home range sizes could not be found in this species (OGUGE, 1995; CHRISTENSEN, 1996; LEIRS *et al.*, 1996; HOFFMANN, 1999).

Activity patterns

The strictly nocturnal activity of the radio-tagged individuals substantiates previous trapping results (DELANY, 1964; NEAL, 1970). In the laboratory *M.* cf. *natalensis* has been found to exhibit short bouts of activity during the day (VEENSTRA, 1958; CHEESEMAN, 1975;

DUPLANTIER AND GRANJON, 1990), which may have been caused by the laboratory conditions. In our study an activity peak was found about 1 hour after dusk, whereas a second peak before dawn was not always distinct. The causes for the shorter activity period in plot 2 (fig. 2) are not clear. It may be because the quality and quantity of food available in the bushes were sufficiently high, so that feeding took less time than in plot 1. There, the animals spent less time resting during the nocturnal activity period. These differences can also be explained by differences of habitat use. The smaller home ranges in plot 1 (tabl. 1) may allow the animals additional time for e.g. exploration and foraging, after the main mid-night resting bout, which they spent in their nearby dens. In plot 2 the animals used bushes intensively (fig. 1). As the distances between the frequently used bushes were quite large (up to 80 m), returning to their nest sites for a short resting bout during the activity period would not be economical. The intensive use of the bushes and the reduced activity period in plot 2 should also result in reduced predation. Possibly the patchiness of food resources and shelters in plot 2 does not allow for high population density.

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