Reproductive rhythm of the grass rat, *Arvicanthis abyssinicus*, at the Entoto Mountain, Ethiopia

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ABSTRACT. Data on the reproductive rhythm of the grass rat, *Arvicanthis abyssinicus*, were collected in a bush area and a crop field at the Entoto Mountain for a one-year period from August 2000 to July 2001. Very few individuals of *Arvicanthis* were captured from the bush area. The number of captures from the crop field, however, was much higher. Higher percentages of reproductively active males and females were recorded during the rains and the couple of months that followed. Breeding decreased in the dry months. The presence of cereals on the field did not seem to augment breeding during the dry months. The outcome of the present study is consistent with most previous results where breeding in *Arvicanthis* sp. primarily occurs during the rains and the few months that follow. It is recommended that physiological studies should be conducted for a better understanding of the reproductive timing of *Arvicanthis* in an eco-physiological context.

KEY WORDS : Entoto, Breeding rhythm, *Arvicanthis abyssinicus*, Ethiopia.

INTRODUCTION

Arvicanthis (Lesson, 1822) is an endemic genus to Africa and distributed along the equatorial belt from Senegal to Somalia and across the Nile Delta from Egypt to Tanzania (DELANY & MONRO, 1986). It is identified as one of the major pest rodents whenever occurring around cultivated lands (TAYLOR & GREEN, 1976). The taxonomy of the genus is controversial. With an understanding of the need for further revision of its taxonomy, populations of the Nile Delta and West Africa are conventionally grouped under *Arvicanthis niloticus* (Ruppell, 1842). About 5 species are described from East African populations. These are *A. blicki* (Frick, 1914), *A. abyssinicus, A. dembeensis* (Ruppell, 1842), *A. somalicus* (Thomas, 1903) and *A. lacernatus.* The first 4 species occur in Ethiopia (YALDEN et al., 1976). Some authorities tend to lump *A. dembeensis* with *A. abyssinicus* (MUSSER & CARLETON, 1993).

The breeding rhythm of the genus is well documented in various parts of Africa. However, results show that further investigations are always needed to understand its breeding rhythm more comprehensively. Most studies show that breeding in *Arvicanthis* begins with the start of the rains (DELANY, 1964; GHOBRIEL & HODIEB, 1982; FISHER, 1991; BEKELE & LEIRS, 1997). Even then, the exact timing of breeding during the rainy season showed inconsistencies. In Central Kenya, *Arvicanthis* started breeding few weeks after the start of the rains (NEAL, 1981). While in Nakuru, another Kenyan locality, breeding began about a month later (DELANY & MONRO, 1986). In Nigeria, breeding began a month before the rains (RABIU & FISHER, 1989). In Ethiopia and Burkina Faso, however, *Arvicanthis* bred only during the dry season (MULLER, 1977; SICARD et al., 1996). NEAL (1981) reported a year round reproduction in Western Uganda where the climate is described as uniform and less seasonal.

Several explanations have been proposed to explain the various patterns of reproductive timing in *Arvicanthis*. SICARD et al. (1996) suggested that *Arvicanthis* stopped breeding during the rainy season in Burkina Faso due to the gonadoinhibitory effect of long day photoperiod that prevails during the season. MULLER (1977), on the other hand, explains his observation on Ethiopian *Arvicanthis* as one happening due to physiological stress from the cold in the Simien Mountain Highlands of the country. He suggested that the rats could be physiologically too stressed to reproduce under the prevailing cold. NEAL (1981) did not observe any correlation between quality of food and reproduction in central Kenya. Rather, he attributes the cessation of breeding at the end of the dry season to increased temperature. He also concludes, based on his results from Western Uganda, that *Arvicanthis* is capable of continuous breeding and as such the question that shall be addressed is "What makes *Arvicanthis* to stop breeding?" and not "What initiates it to?" GHOBRIEL & HODIEB (1982) on the contrary, emphasized the importance of nutritious food (cereals, seeds and animal matter) in playing crucial role to determine the timing of breeding in *Arvicanthis*. The gonadostimulatory effect of green stuffs and the availability of drinking water were also suggested by other researchers (References in NEAL, 1981) to explain the reproductive timing of *Arvicanthis.*

The present study documents data on the breeding activity of *A. abyssinicus* at the Entoto Mountain, Ethiopia from August 2000 to July 2001.

METHODS

The Entoto Mountain is located about 8 km North of Addis Ababa. Most part of the mountain is covered with eucalyptus trees. The forest is under government protection. Part of it is inhabited by farmers who cultivate cereal crops like wheat, barley, and teff. Since eucalyptus trees discourage growth of ground cover, rodents were not expected to be found in the forest proper of the mountain. Within the forest there were clearings covered with dense bushes which were thought more suitable for rodents. One area (100 m x 50 m) with this kind of vegetation (height up to 175 cm) was selected to be one of the two study sites. It was dominated by plant species like *Helichrysum shimperi, Chilocephalum shimperi, Echinops macrochaetus* and *Conyza schimperi*. The grass species *Andropogon amethystinus* was also found abundantly. The second study site was established inside and around a cultivated land. This site was planted with barley. The two sites were distantly separated (about 4 km) with few chances of migration of rodents between one another.

The study area has one rainfall peak during the months of June-August. During the study period, there was also a small rainy period in March and May. The smallest amount of rainfall was recorded during the months October to February. February was the month with the highest average maximum temperature while December and January recorded the lowest (Fig. 1a).

In the bush, trapping started at the beginning of August and continued for a year on a monthly interval. In the crop field trapping started from November. Each trapping session of the month lasted for three consecutive days and nights. Victor Mouse Snap Traps were used (small and large versions). Traps baited with peanut butter were set near rodent pathways, burrows or sites with good bush cover under rocks and in crevices. Traps were checked in the morning (9 :00 a.m.) and late afternoon (5 :00 p.m.). After retrieving the catches, standard body measurements (body weight and length of head-body, tail, hind foot and ear) were taken. Females with perforate vagina, large nipples or well vascularized and distended uteri were considered to be reproductively active. If implanted embryos were observed, they were identified as pregnant. Males with scrotal testes, very well visible epididymal tubules and large seminal vesicles were considered to be sexually active. Individuals that weighed less than 35 g were identified as juveniles, since there were no individuals below that weight, which showed any sign of sexual maturity.

TABLE 1

Captured rodents from the two study sites at Entoto Mountain.

Species	Bush	Crop
Arvicanthis abyssinicus	24	167
Desmomys harringtoni	126	7
Praomys albipes	74	32
Lophyromys flavopantatus	34	17
Total	**258**	**223**

RESULTS

A total of 481 rodents belonging to four species were captured (Table 1). Of these, 258 were captured in the bush habitat and the other 223 in the crop field. The bush habitat rodent fauna was dominated and heavily infested by *Desmomys harringtoni* (Thomas, 1903) with a total capture of 126 individuals (48.8%) while *Arvicanthis abyssinicus* was the least abundant (n=24) making up only 9.3% of the total. On the other hand, the crop field was completely dominated by *A. abyssinicus* (n=167 or 74.9 %) and *D. harringtoni* was the least abundant species (n=7 or 3.1%). The other two species, *Praomys albipes* (Ruppell, 1842) and *Lophyromys flavopunctatus* (Thomas, 1888), were also more abundant in the bush habitat than in the crop field (Table 1).

TABLE 2

Seasonal variation of captured *Arvicanthis abysinicus* from the bush habitat (light font) and the crop field (bold font)

	2000					2001						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.
Females	0	3	2	2	0	1	0	0	0	0	0	0
				3	**11**	**15**	**16**	**8**	**6**	**5**	**8**	**4**
Males	2	5	2	2	0	0	0	0	0	0	1	0
				4	**3**	**13**	**18**	**13**	**8**	**6**	**9**	**2**
Juveniles	0	0	0	0	1	3	0	0	0	0	0	0
				3	**2**	**3**	**2**	**3**	**1**	**0**	**0**	**1**
Total	2	8	4	4	1	4	0	0	0	0	1	0
				10	**16**	**31**	**36**	**24**	**15**	**11**	**17**	**7**

Table 2 summarizes the catch distribution of *A. abyssinicus* in both study sites. In the bush area, the highest number of *A. abyssinicus* was recorded in September while between February and July none was captured except for the single specimen in June. The adult male to female sex ratio was 1.4 :1. Only 4 juveniles were captured, in December and January. In the crop field, the highest numbers of *A. abyssinicus* were recorded in February (n=36), the lowest in July (n=7). The male to female sex ratio was 1 :1.

Figure 1B shows the percentage of reproductively active males and females from the crop field. Higher proportions of reproductively active males and females were obtained during the rains and the first two months that followed. In the crop field, there was a high percentage of reproductively active males and females in November and December. During these two months, all the captured males were sexually active and except for one individual in December, all the females were pregnant. Reproductive activity declined in both sexes from January onwards. For the bush area, data were too scarce to discuss reproduction.

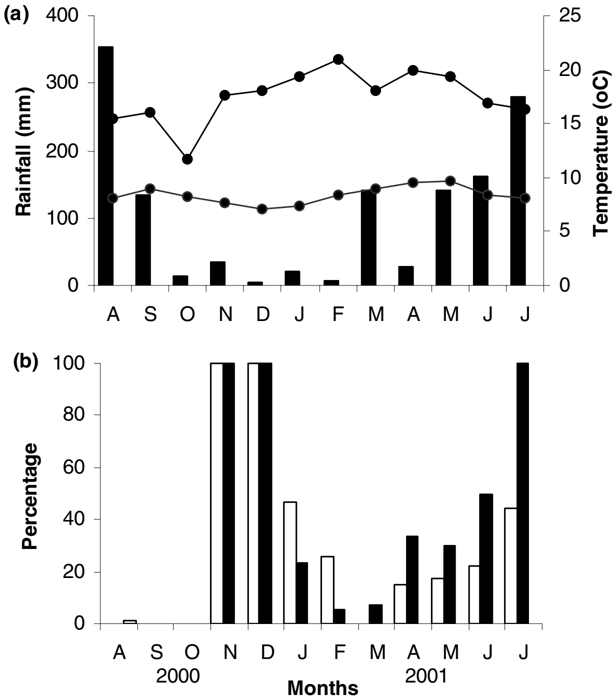

Fig. 1. – (a) Monthly total rainfall (bars) and average maximum and minimum temperature (lines) and (b) percentage of reproductively active males and females from the crop field (white bars : females;

DISCUSSION

A. abyssinicus was always rare or absent in the bush area. Earlier studies showed that *Arvicanthis* prefers habitats which have good hiding places and aerial cover (WUBE & BEKELE, 2001). The bush habitat of the present study was also such a habitat. However, it can be suggested that *Arvicanthis* here gave priority to cultivated fields where cereals can be obtained abundantly while avoiding the less nutritious and crowded bush area. During the study period, the bush habitat harboured a number of other rodent species while *A. abyssinicus* dominated the crop field. Generally it can be hypothesized that, 1) there might have been competition among rodents of the region for the most nutritious crop fields and the competition ended in favour of *A. abyssinicus* while the rest of the species were relegated to the bush habitat or 2) the other rodent species did not show interest for the crop habitat even though it was nutritious. Rather they gave priority to the presence of cover and hiding places while *A. abyssinicus* managed to survive in the more exposed crop fields by digging nests and taking refugee under the available rocks and crevices. It has been suggested earlier that there is always one dominant species in an area which is shared by different populations that have similar niche (FOX & BROWN, 1993).

In the crop habitat several individuals of *A. abyssinicus* were captured. The observed reproductive activity rhythm was in conformity with most previous observations that report peak reproduction in *A. abyssinicus* during and shortly after the rains (TAYLOR & GREEN, 1976; NEAL, 1981; GHOBRIEL & HODIEB, 1982). Of course, in the present study it is not clear what happened during August - October 2000 because the data collection started only in November. Even then, the fact that the reproductive activity started to increase together with the start of the rain in the 2001 rainy season i.e. June, it could be reasonable to speculate that there had been the same trend during August - October 2000.

Reproductive activity was highly reduced during the dry months, despite the presence of cereals (nutritious food) in that season. This was against Taylor and Green's observation in Western Uganda where artificially supplied cereals modified the breeding peak (TAYLOR & GREEN, 1976). Even though the barley harvest was completely collected in April and May, the crop was on field during all the previous months. If the presence of cereals had any gonadostimulatory influence, the percentage of reproductively active *A. abyssinicus* should not have significantly decreased in the dry months. However, this needs to be substantiated by data from a longer study period.

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