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Food Selection and Feeding Behavior of Giant Mole Rat (*Tachyoryctes macrocephalus*, Ruppell, 1842) from the Sanetti Plateau of Bale Mountains National Park, Ethiopia

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ABSTRACT

The giant mole rat (*Tachyoryctes macrocephalus*) is one of the endemic mammals of Ethiopia and the diet of endemic and endangered Ethiopian wolf (*Canis simensis*). The study was carried out from March, 2006 to January, 2007. Hay pile analysis, Direct observation, fecal analysis and stomach content analysis methods were used. The consumed plant materials and hay pile components from ten samples indicated that *Alchemilla abyssinica* and *Festuca* species were the major food items in terms of percentage frequency and dietary occurrence. Stomach contents from four animals and ten faecal samples showed higher percentage of dicots than monocots ($\chi^2 = 23.8$, $df = 1$, $p < 0.01$). In addition, different species of dicots were also consumed. Although there was a preference of occurrence, all plant materials surrounding the feeding holes were gathered. A large proportion (75.6%) of time was spent under the ground compared to above ground activities. Among the above ground activities of the giant mole rat, feeding takes larger time compared to time spent for observation and digging.

Key words: Giant mole rat, food selection, feeding behavior, feeding ecology, bale mountains

INTRODUCTION

The giant mole rat (*Tachyoryctes macrocephalus*, Rüppell, 1842) is endemic to the Bale Mountains National Park occupying Afro-alpine heath, moor and grasslands (Yalden, 1985; Hillman, 1986b, 1993; Beyene, 1986; Yalden and Largen, 1992). *T. macrocephalus* belongs to the family Rhizomyidae which comprises three genera: *Tachyoryctes* in Eastern Africa; *Rhizomys* and *Cannomys* in Southeastern Asia. Rüppell originally described giant mole rats in the genus *Tachyoryctes*: from “Shoa” using specimens that were collected by another collector. This locality is currently known as Wollo or Begemidir, in the Lasta area of Lalibela. But, the species has never been found on the western plateau of Ethiopia since its original description (Beyene, 1986).

Erlanger and Neumann have collected specimens in 1900 from Bale province of southeastern plateau of Ethiopia and subsequently described as a distinct subspecies *T.m. heckii*. Since then, studies have been carried out to some extent by different scholars (Yalden, 1985; Sillero-Zubiri, 1994; Marino, 2003). The two African species of Rhizomyidae, the root rat,

T. splendens (Ruppell, 1835), type locality Gonder, Ethiopia and the giant molerat, *T. macrocephalus* (Ruppell, 1842), type locality "Shoa, Abyssinia" are differentiated mainly by their size. *T. macrocephalus* is heavier in body weight (300 to 1000 g) than *T. splendens* (160 to 280 g) in addition to morphological differences. The giant molerat is currently confined to the Southeastern Ethiopian Afroalpine highlands of the Bale Mountains with high densities in the Sanetti Plateau, followed by Web Valley (Sillero-Zubiri, 1994; Marino, 2003).

The Afro-alpine habitats of BMNP are categorized based on the vegetation type, height of vegetation, slope and terrain. *T. macrocephalus* mainly occurs within low herb dominated habitats, swamp communities, alpine short grassland, *Helichrysum* bush and other moorland habitats (Beyene, 1986; Sillero-Zubiri, 1994). *T. macrocephalus* feeds by gathering vegetation from a newly opened burrow during the day time. On Sanetti Plateau, giant molerats gather vegetation near to feeding holes (Lavrenchenko, 2000; Marino, 2003).

Wildlife population is decreasing in the world (Idris *et al*, 2001; Gundogdu, 2011) because of habitat loss and agriculture expansion. Hence, to conserve wildlife the study of their habitat association and diet are crucial (Maan and Chaudhry, 2001). The aim of the present study was to gather information on the diet and feeding behavior of *T. macrocephalus* in selected habitat types of Sanetti Plateau, Bale Mountains National Park (BMNP). The study will provide basic information on food source, food preference and feeding behavior of the giant molerat.

MATERIALS AND METHODS

Study area: The Bale Mountains National Park (BMNP) is located Southeast of the Rift Valley about 400 km by road from Addis Ababa, between 6°29' and 7°10' N and 39°28' and 39°58' E. It covers an area of 2200 km², with an altitudinal range from 1500-4377 m (Hillman, 1986a). The typical afroalpine habitats in BMNP, Sanetti Plateau (3800-4050 m), Web Valley (3450-3550 m) and Tullu Deemtu (4000-4377 m.a.s.l) formed the main study area.

Preliminary survey: A preliminary survey in the present study sites was conducted during March-April 2006. During this period, observations were made to gather information on the topography, vegetation type and coverage, climatic conditions, distribution of giant molerats and habitat types. During the detailed investigations, during June-January, 2007, different approaches were used in data collection and diet identification of giant molerats. Quadrats, 0.5×0.5 m were marked outside active molerat burrows, where the molerat was foraging.

Data collection: To identify the major diets of Giant mole rat different methods were used and compared at the end. The number of plants in different species was counted before and after each feeding hours. The counting was conducted during early morning (beginning of the activities and late afternoon (termination of activities) per day. Two different quadrates, each within the ten foraging radius were sampled for both seasons. Thus, data were collected twice in each season.

Ten hay pile samples, measuring 0.2 kg each, were collected from periodically deposited old and /or fresh hay piles of functional holes in each season. The fragments of individual plant species in each hay pile sample were counted soon in sampled sites. The types of plant species and portion of the individual plant involved in the diet of giant molerats were recorded. Shoots and roots of the individual plant species were counted separately.

Fresh faecal pellets of giant molerats were collected randomly from the study area during both wet and dry season. A total of ten independent faecal samples, each with four pellets, were collected

in each seasons. These were preserved in 70% alcohol and latter used for analysis in the laboratory. Each faecal sample was washed, filtered and dried separately for observation under the microscope. Four slides were observed for each sample. The diet components were recorded by counting each fragment as monocot, dicot and undifferentiated (Putman, 1984).

For the stomach content analysis, four giant molerats were caught from different habitats during the two seasons. They were caught with the help of 15 to 30 m nooses-live trap. Fresh diets in Stomach contents were preserved in 70% alcohol and latter used for analysis in the laboratory. Each sample was washed, filtered and dried separately for observation under the microscope. Four slides were observed for each sample. The diet components were recorded by counting each fragment as monocots, dicots undifferentiated. Hide observations were also used to collect photographs, to record feeding pattern and ecological interactions.

To know the feeding behavior, new holes 10 during the wet season and 12 during the dry season) were selected to record how the species collect the diet, time of collection and foraging distance.

Data analysis: Data analysis was done using SPSS Vession 16. Significance difference between wet and dry season diet composition were assed using chi-square.

RESULTS AND DISCUSSION

Availability and selectivity: Among 2906 number of plants counted before feeding, around the newly opened holes, 1256 plant materials was gathered in to the holes by giant mole rat. This comprised 657 (52.3%) *Alchemilla abyssinica*, 379 (30.2%) *Festuca* species, 163 (13%) *Trifolium* species and 58 (4.5%) other species. This agree with the study of Beyene (1986) and Sillero-Zubiri (1994). The consumption was high during the wet season ($\times 2 = 11.65$, $df = 1$, $p < 0.05$). Percentage dietary occurrence, selectivity and availability were high for *A. abyssinica* and *Festuca* species (Table 1).

Out of the total consumed fragments, the majority were *Alchemilla abyssinica*, *Festuca* species and *Trifolium* species. This could be as a result of availability, selectivity and palatability of these species in the habitats of giant molerats (Beyene, 1986). This suggests that *A. abyssinica*, *Festuca* species and *Trifolium* species were major contributors to the diet of giant molerats compared to the other species.

Table 1: % dietary occurrence and selectivity of total eaten from available plant species during wet and dry seasons

Plant species	Wet season			Dry season			Total cons.	%
	Available	Con. (% d.o)	% selected	Available	Con. (% d.o)	% selected		
<i>A. abyssinica</i>	671	381 (55.3)	56.8	537	276 (49.0)	51.4	657.0	52.3
<i>Festuca</i> spp.	499	232 (33.7)	46.5	372	147 (26.0)	39.5	379.0	30.2
<i>H. rueppelli</i>	120	6 (0.9)	5.0	284	1 (0.2)	0.4	7.0	0.6
<i>Trifolium</i> sp.	114	46 (6.7)	40.4	363	117 (21.0)	32.2	163.0	13.0
<i>S. simensis</i>	43	11 (1.6)	25.0	21	7 (1.2)	33.3	18.0	1.4
<i>H. gofanse</i>	25	5 (0.1)	20.0	13	3 (0.5)	23.1	8.0	0.6
Other plants	87	8 (1.1)	9.2	67	17 (3.0)	25.4	25.0	2.0
Total	1559	689 (100.0)	100.0	1347	568.0	100.0	1257.0	100.0

(% d. o): Percentage dietary occurrence, Cons: Consumed gathered plant fragments in number, Available: The number of plants in each species counted before feeding hour, *A. abyssinica*: *Alchemilla abyssinica*, *H. rueppelli*: *Haplocarpha rueppelli*, *S. simensis*: *Satureja simensis*

Table 2: Hay pile components in percentage dietary occurrence during the wet and dry seasons

Hay pile components	Wet season		Dry season		Total	%
	C.F	% D.O	C.F	% D.O		
<i>Alchemilla abyssinica</i>	604	39.0	917	49.6	1521	44.0
<i>Festuca</i> species	752	48.6	813	42.7	1565	44.3
<i>Alchemilla</i> species	54	3.5	29	1.5	83	2.4
<i>Rumex abyssinicus</i>	22	1.4	13	0.7	35	1.1
<i>Saliva nilotika</i>	29	1.9	22	1.2	51	1.5
<i>Helichrysum gofanse</i>	20	1.3	7	0.4	27	0.1
<i>Trifolium</i> species	7	0.5	37	1.9	44	1.3
<i>Haplocarpha rueppelli</i>	6	0.4	2	0.1	8	0.2
<i>Galium aparinoides</i>	24	1.6	9	0.5	33	1.0

C.F.: Counted fragments%, D.O.: Percentage dietary occurrence

Table 3: Percentage of shoots and roots from consumed plant species in wet and dry seasons

Consumed plant spp.	Wet season				Dry season			
	Shoot	%	Root	%	Shoot	%	Root	%
<i>Alchemilla abyssinica</i>	237	62.20	144	37.80	112	40.58	164	59.42
<i>Festuca</i> species	218	93.97	14	6.03	40	27.00	107	72.79
<i>Haplocarpha rueppelli</i>	1	14.29	6	85.71	-	-	3	100.00
<i>Trifolium</i> species	34	73.91	12	26.09	50	42.74	67	57.26
<i>Satureja simensis</i>	11	100.00	-	-	-	-	7	100.00
<i>Helichrysum gofanse</i>	1	20.00	4	80.00	-	-	3	100.00
Other plant species	5	62.50	3	37.50	6	35.29	11	64.71

Out of the total 3455 hay pile fragments, 1521 (44%) comprised *Alchemilla abyssinica*, 1565 (44.3%) *Festuca* species and 83 (2.4%) *Alchemilla* species. There were higher proportions of *Festuca* species and *A. abyssinica* throughout the year ($\chi^2 = 0.05$, $df = 1$, $p > 0.05$). *A. abyssinica* and *Festuca* species were also obtained with higher percentage of dietary occurrence (Table 2).

In the present study, hay piles comprised a larger percentage dietary occurrence of *Alchemilla abyssinica* and *Festuca* species. The possible explanation for this could be the availability and relative preference of these plants in the surrounding surfaces of feeding holes (Beyene, 1986). *Alchemilla abyssinica*

The proportion of *Alchemilla abyssinica* was high during the dry season while *Festuca* spp. was high during wet seasons. This might be because of habitat change or 'migration' of giant mole rat from wetland site to rocky site during rainy season.

Shoots and roots: Among the consumed plant species, both shoots and roots were high during the wet season and low during the dry seasons. Percentages of roots were low during wet season and high during dry season because of availability effect. However, species like *Haplocarpha rueppell* and *Helichrysum gofanse* roots cover the highest percentage in both seasons (Table 3). And there was a significant difference between wet and dry seasons consumption ($\chi^2 = 58.8$, $df = 1$, $p < 0.01$).

However, the proportion roots and shoots of plant species varied from sampling plot to plot and plant to plant. This is because of the differences in soil hardness. On the areas where the soil is loose to dig, the animals collected both parts of plant species where as on soils that are too hard to

Table 4: Stomach contents from four captured giant molerats

Animal	Monocots	Dicots	Others (unidentified)	Total
A	26.0	75.0	35.0	136
B	55.0	68.0	36.0	159
C	39.0	69.0	26.0	134
D	59.0	72.0	29.0	160
Total	179.0	284.0	126.0	589
%	30.4	48.2	21.4	100

Table 5: Faecal contents

Season	Monocots	Dicots	Others (unidentified)	Total fragment
Wet (n = 10)	490	691.0	252.0	433
Dry (n = 10)	374	627.0	271.0	1272
Total	864	1318.0	523.0	2705
%	32	48.7	19.3	100

dig, they gathered only above ground parts (mostly shoots) of the plant materials. In the current study, more shoots were consumed during wet and more roots during dry seasons, because of availability effect.

Stomach content: A total of 589 fragments were counted from four stomach samples. Monocots comprised 179 (30.4%), dicots 284 (48.2%) and others 126 (21.4%). Dicot fragments were at a higher proportion than monocots ($\chi^2 = 23.8$, $df = 1$, $p < 0.01$; Table 4).

The proportion of dicots was higher (48.2%) compared to monocots (30.4%) in the stomach content of four individual giant molerats. This suggests that dicots are the frequent plants in the food compared to monocots. This is also shown in the components of the hay pile. Although only few animals were examined for stomach contents, hay pile and faecal component analysis also confirm this.

Faecal content: A total of 2705 faecal fragments (n = 10) were counted. Out of these, dicots comprised 1318 (48.7%), monocots 864 (32%) and others 523 (19.3%). Dicots occurred at a higher proportion than other components ($\chi^2 = 47.231$, $df = 1$, $p < 0.05$; Table 5).

In the faecal analysis, dicots contributed a major proportion of fragments compared to monocots. The higher proportion of dicot fragments suggests that dicot plants are the major part of dietary items for giant molerats. The results obtained from faecal analysis goes in line with the results obtained from stomach contents.

Feeding behavior: The number of bites per appearance (per out to the surface) varied from 3 to 15. Giant molerats gathered all parts of the plant materials (roots and shoots) and carry them to the holes (Sillero-Zubiri, 1994; Marino, 2003). However, they collect only above ground parts of plants where it is difficult to dig. The distance of areas from where food plants were collected varied seasonally. The preference on the surface among plant species was low. Giant molerats avoided rocky, hilly and outcrop sites. They frequent low herbaceous, alpine short grasslands and swamp vegetation communities. Giant molerats appear through new holes that are either not covered or covered by plants. Bare land (not covered) holes are avoided and holes covered by plants are frequented. They do not appear on bare land sites for foraging. They either plug the bare holes or

ignore them. During foraging, fighting was observed between two animals where approach the same newly opened hole. Frequent fight was observed when two live captured animals were kept together. The major activities of the giant molerats on the surface were observing, digging and foraging.

CONCLUSION

Analysis on consumed plants and hay pile composition suggests that *A. abyssinica* and *Festuca* species were the major dietary items of the giant molerats in the Sanetti Plateau. Similarly, analysis of stomach contents and faeces indicated that dicots were the frequent food items of *T. macrocephalus*. Furthermore, on visual observation, all plant species on the surface of feeding holes were taken. Therefore, on the Afro-alpine parts of BMNP, it is possible to conclude that *A. abyssinica* and *Festuca* species are the two significant food items for giant molerats. The endemic giant molerat is also a major dietary part for critically endangered Ethiopian wolf. So, sound management priorities must be taken to minimize disturbances by livestock in the area.

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