Annals of Arid Zone 36(1): 65-72, 1997

Food Preference and Calorific Requirements of the Cutch Rock-rat, *Cremnomys cutchicus medius*

Pratap Singh and Ishwar Prakash
Desert Regional Station, Zoological Survey of India, Jodhpur 342 009, India

Abstract: The Cutch rock rat, *Cremnomys cutchicus*, inhabits rocky outcrops in the Thar desert and has been found to be the most abundant small mammal on the Aravalli mountains in India. Due to the recent increase in irrigated agriculture in the valleys, it has altered its niche from rock-crevices to the vicinity of crop fields and damages the standing crops. To control its population below the threshold level, experiments were carried out in laboratory cages to determine its preferred food which can be used for poison formulations. Pearl millet in whole form, and green gram in cracked form were the best ranked foods when they were given in no choice test. Among six exposed foods, no statistically significant difference was evidenced in whole and cracked forms of sorghum ($t=1.09$) and wheat ($t=2.24$), while a significantly increased consumption of cracked forms was observed in green gram ($P < 0.001$) and bengal gram ($P < 0.001$). The consumption decreased significantly in cracked pearl millet ($P < 0.001$). The average daily intake of food and caloric requirement (18 to 39 kcal) of this muried rodent is highest among the species in the region, probably because it inhabits difficult rocky terrain and needs much more energy while ascending and descending rocky slopes. Based on food preference studies, it is recommended that single food item should be used as bait material, and that too, during October to January, for the effective control of this species.

Key words: Aravalli mountain, calorific requirement, *Cremnomys cutchicus*, Cutch rock-rat, food preference.

The Cutch rock-rat, *Cremnomys cutchicus* (Wroughton) inhabits rocky outcrops in the Thar desert and is the most abundant rodent of Aravallis (Prakash *et al.*, 1995a). It has been observed that due to introduction of multiple cropping system on flat lands in the hilly ecosystem, even at very high altitudes, this rodent has altered its abode from rock crevices to spaces between loosely piled stone-wall boundaries constructed around crop fields. Because of the niche alteration, it is becoming a serious pest of crop fields in addition to forests (Prakash *et al.*, 1995b). Poisoning is the humane method of rodent control (Fitzwater and Prakash, 1978), but implementation of the actual management technology requires a thorough knowledge of an appropriate bait carrier of poison. Experiments were, therefore, designed to investigate food preference of *C. c. medius* (Thomas), through which rodenticides could be administered if their control is desired.

Methods

The experimental animals were captured from Aravallis using Sherman live traps. Each rock-rat was individually caged and acclimatized for two weeks before experimentation. Every feeding test was conducted on ten randomly selected adult rock-rats. Whole series of experiments was completed in two phases - (A) single food choice (SFC), and (B) multiple food choice (MFC).

Six baits, pearl millet, sorghum, wheat, green gram, bengal gram and maize, were selected for SFC phase and each bait was tested for six days on each rodent. Similarly, these six foods were given individually in cracked form for six days to each rock-rat. In phase B (MFC), a combination of three types of baits, selected from 10 candidate baits (5 whole and 5 cracked) with the aid of random number tables, were exposed to every rock-rat. The body weight of each *C. c. medius* and consumption of each bait was measured daily. Fresh bait (10 g) was provided every day and the daily average intake of each bait was transformed to relative values (g per 100 g body weight). The percentage of total consumption for every bait and its acceptability position (rank) was computed for each test. Water was available *ad libitum* to each rodent throughout the course of the experimentation. Student t-test was applied to find out the difference in consumption of various foods. The tests were conducted as per the following schedule:

Phase A : Single food choice.

Test 1 - Air dried whole grains.

Test 2 - Cracked grains.

Phase B : Multiple food choice.

Test 3 - Whole and cracked grains.

The calorific value contained in each food was determined following Aykroyd *et al.* (1960). Average daily intake of each food was converted to calorific value. The calorific intake through food under two choices (SFC and MFC) was computed by multiplying average daily intake (ADI) of each food with calorific value of each gram of that food.

Results

Test 1: Whole grains (SFC)

In this trial, the average daily intake (ADI) of first food, pearl millet (*Pennisetum glaucum*), was highest and significantly different ($t=5.83$, $P<0.001$) from second most preferred food, wheat (*Triticum aestivum*) (Table 1). Similarly, wheat was consumed significantly more ($t=4.10$, $P<0.001$) than the third preferred food, sorghum (*Sorghum vulgare*). However, no significant difference was observed between third food, sorghum, and fourth food, maize (*Zea mays*) ($t=0.02$), and fourth and fifth food, green gram (*Phaseolus aureus*) ($t=0.9$). Bengal gram (*Cicer arietinum*) was consumed in least amount by six candidate baits and its consumption was significantly less ($t=2.79$, $P<0.001$) than fifth preferred food.

Table 1. Consumption of whole and cracked food grains (g per 100 g body weight) by C. c. medius

Grains	Mean ADI (g) ± SE	Per cent	Rank
Whole food grains			
Pearl millet	10.87 ± 0.35	26.30	1
Bengal gram	4.32 ± 0.28	10.45	6
Sorghum	6.15 ± 0.44	14.88	3
Maize	6.14 ± 0.49	14.86	4
Green gram	5.61 ± 0.42	13.57	5
Wheat	8.24 ± 0.35	19.94	2
Cracked grains			
Pearl millet	6.26 ± 0.60	15.34 (-)*	4
Bengal gram	7.48 ± 0.42	18.33 (+)	2
Sorghum	5.55 ± 0.41	13.60 (-)	5
Maize	4.35 ± 0.40	10.66 (-)	6
Green gram	10.19 ± 0.34	24.97 (+)	1
Wheat	6.98 ± 0.51	17.10 (-)	3

*+ and -, respectively, denote increase and decrease in percentage consumption as compared to whole forms.

Test 2: Cracked grains (SFC)

This test was intended to compare the consumption of whole grains against cracked grains. A significant difference between the consumption of whole and cracked grains was observed. The results indicate that among whole grains, rock-rats liked pearl millet > wheat > sorghum > maize > green gram > bengal gram; however, order of preference changed in cracked form and was green gram > bengal gram > wheat pearl millet > sorghum > maize (Table 1). A significant increase or decrease was observed in all but sorghum (t=1.09) and wheat (t=2.24), while comparing whole and crakcked form. A statistically significant increase in consumption was evidenced in cracked forms of green gram (t=9.21, P <0.001) and bengal gram (t=6.90, P < 0.001); however, contrary results were observed in pearl millet (t=7.29, P<0.001) and maize (t=3.11, P <0.001). It is evident, therefore, that texture of bait plays important role in amount of consumption, but size of grain material does not influence the amount consumed. Pearl millet and maize were, respectively, first and fifth in order of consumption when given in whole form, but the order of preference dropped to fourth and sixth places in cracked form. On the contrary, more proteinaceous green gram and bengal gram were fifth and sixth in order of preference in whole form and their ranks shot to first and second places in cracked form. It is, therefore, clear that when the hard coat of more proteinaceous grains is removed (in cracked form), their consumption rises manifold. During the SFC test (cracked form), when both protein rich grains, green gram and bengal gram were consumed in higher amount, not only the size of faecal pellets decreased considerably,

Table 2. Consumption of whole and cracked food grains (g per 100 g body weight) in MFC test by C. c. medius

Grains	Mean ADI (g) ± SE	Per cent	Rank
Whole food grains			
Pearl millet	3.23 ± 0.56	15.36	2
Sorghum	1.32 ± 0.38	6.24	8
Maize	1.02 ± 0.33	4.82	10
Green gram	1.96 ± 0.30	9.26	6
Wheat	2.57 ± 0.50	12.15	3
Cracked grains			
Pearl millet	4.00 ± 0.74	18.90 (-)*	1
Maize	1.57 ± 0.41	7.42 (-)	7
Sorghum	1.09 ± 0.35	5.15 (-)	9
Green gram	2.38 ± 0.45	11.25 (+)	4
Wheat	2.00 ± 0.64	9.45 (-)	5

* + and - respectively denote increase and decrease in percentage consumption as compared to whole forms.

due to lesser amount of roughage, but the water consumption also increased immensely, for protein metabolism.

Test 3 : Multiple food choice

Randomly selected samples of 3 foods from 5 whole and 5 cracked forms were exposed to rock-rats. The results of MFC test differ from those of no choice test. Consumption of cracked pearl millet, maize and green gram increased than whole forms while those of cracked sorghum and cracked wheat decreased (Table 2). During MFC experiment, the consumption of cracked pearl millet and cracked maize increased while it showed a decline during no choice test. However, no change in the trend of consumption was observed in cracked forms of sorghum, green gram and wheat in two phases of tests. The order of consumption in MFC was observed to be cracked pearl millet > pearl millet > wheat > cracked green gram > cracked wheat > green gram > cracked maize > sorghum > cracked sorghum > maize.

Calorific requirement

Rodents, like other animals, consume enough food to balance energy output (Barnett, 1988). Many evidences of their ability to adapt feeding to energy need have been recorded (Gorecki and Gebeczynska, 1962; Vickery, 1984). In addition to calorigenic value of food, proteins, water contents, minerals and vitamins play important role in food selection. In addition, the preference for various food keeps on changing, depending on physiological need of the animal.

The average calorie intake for *C. c. medius* through food during SFC is 25.79 (range 18.74 to 39.24) kcal per 100 g body

Table 3. Comparison of average daily intake (ADI) in various rodent species

Species	Average body weight (g)	ADI (g *per 100* g body wt.) of best ranking food	Source
Tatera indica	139.3	3.98	Prakash and Jain (1971)
Gerbillus gleadowi	25.1	7.95	Prakash *et, al.* (1975)
Golunda ellioti	53.2	2.96	Soni *et al.* (1979)
Funambulus pennanti	100.0	5.87	Soni *et al.* (1980)
Millardia meltada	54.1	3.70	Soni and Rana (1982)
Cremnomys cutchicus	59.2	10.87	Present study

weight. This value is quite high as compared to those from other rodent species. Average daily intake of first ranked food by *C. c. medius* was 10.87 g. A comparison of its food consumption with that of other rodent species shows that it consumes relatively larger amount of food than *Tatera indica, Gerbillus gleadowi, Golunda ellioti, Funambulus pennanti* and *Millardia meltada* (Table 3). The higher consumption may be linked to its ecological niche in the mountain ecosystem. It has to clamber up and descend down the rocks and this requires a high energy budget (18 to 39 kcal). To substantiate it, this rodent species consumes more quantity of food.

Discussion

The rodents owe their success largely to three features in which they resemble humans; they can live in great variety of environments, they can tolerate a wide range of food, and they are restlessly inquisitive and exploratory (Barnett, 1988). Their inquisitiveness makes them neophilic, and in the process, they are able to explore newer areas for food and shelter.

In captivity, if a fasting rodent is offered several foods, one of which is known to be preferred to the others, a meal is made of the preferred food, water is taken, and there is movement about the cage during which the other foods are sniffed and small amount is sampled (Barnett *et al.*, 1978; Olton *et al.*, 1977). During our experiments, however, a significant difference was observed in the ADI of same food when provided in no and multiple choice tests; and relatively more food was consumed in SFC tests than in MFC tests (Tables 1 and 2). Vickery (1984), while exposing a choice of acceptable foods to three rodent species found that preference was mainly for the food with highest energy value, though alternative foods were always sampled. Our results of MFC and SFC (whole form) tests conform with his findings, but during SFC (cracked form) test, the results deviated from his inferences during which green gram (food having lowest calorific value among exposed foods) became number one in order of preference.

The removal of hard coat of proteinaceous green gram made it preferred one to other foods. It indicates that not only the calorific value makes food most preferable but texture, protein contents, minerals and vitamins also influence the food behavior of mammals. A significantly higher consumption of single food items prompt us to recommend that single food should be used as bait material to have dual benefit - more poison will be consumed, and in case of development of bait shyness, next preferred food can be used.

A significant seasonal variation in the feeding habits of desert population of rodents has been observed (Prakash, 1962; Advani *et al*., 1982; Prakash, 1992). Depending on these observations, the authors have recommended to take up the control measures during lean periods of food availability. But *C. c. medius*, inhabiting the montane ecosystem of Aravallis, has no dearth of food material all the year round and the best time period to take up control measure is thus, non breeding season, from October to January. During this period when the temperature is extremely low at higher elevations of Aravallis, the rodent has to maintain high BMR to keep body temperature constant and, therefore, needs more amount of food. Moreover, *C. c. medius* shifts very easily to relatively more nutritive foods like insects and fishes (Singh and Prakash, 1997). This omnivorous behavior of rock-rat can be advantageous in control operations if a preferred food is used as bait material.

The rodents have been classified into two categories, depending upon food consumption in relation to body weight (Jain *et al*., 1975): field rodents (body weights, 20-140 g) and urban rodents (body weight, 120-220 g). An inverse relation is noticed between body weight and average daily food consumption - lighter rodents consuming more quantity of food in relation to their body weights. Such an inverse relationship has also been reported for various other rodent species (Harrison and Woodville, 1950; Barnett and Spencer, 1953; Khan, 1974). Among the two classes of rodents, *C. c. medius* has a unique position (Fig. 1). Depending on the body weight this species falls in field/wild category of rodents, but contrary to field rodents, it consumes fairly large amount of food like commensal and peri-commensal species. This unique position of *C. c. medius* indicates that this sylvan species is expanding its niches and is becoming a peri-commensal species. The trapping data also support this conjecture as quite a substantial number of rock-rats were entrapped from crop fields and human dwellings. Thus, due to perpetual human interferences in the hilly ecosystem, a sylvan rodent species is becoming peri-commensal.

Acknowledgements

We express our sincere thanks to Director, Zoological Survey of India and Dr. Q.H. Baqri, Joint Director, Desert Regional Station, ZSI, Jodhpur, for providing necessary facilities. The help extended by Central Arid Zone Research Institute authorities during laboratory experiments is also gratefully acknowledged. We are thankful to Department of Science and Technology, Government of India, for financial support. The second author gratefully acknowledges Indian National Science Academy for nominating him as "Senior Scientist".

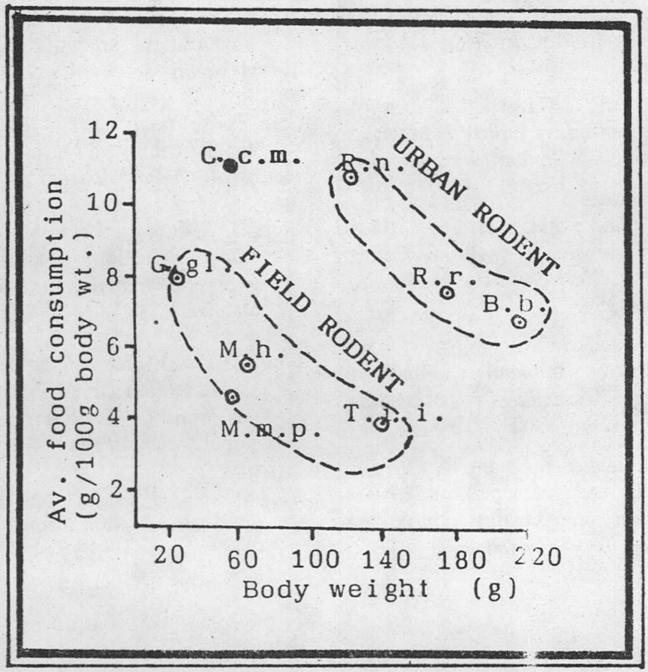

Fig. 1. Position of C. c. medius in two groups of rodent species depending upon consumption value.

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