

## A Study on Ecology and Biology of *Microtus guentheri* Danford and Alston, 1880 (Mammalia: Rodentia) in Turkey

Ercüment ÇOLAK, Mustafa SÖZEN, Nuri YIĞIT  
Department of Biology, Faculty of Science, University of Ankara, Ankara-TURKEY

Şakir ÖZKURT  
Department of Biology, Education Faculty of Kırşehir, University of Gazi, Kırşehir-TURKEY

Received: 12.11.1996

**Abstract:** In this study, ecology and biology of *Microtus guentheri* were investigated based on both field and laboratory observations along with its effects on agricultural crops. It was determined that this vole has a shallow burrow with numerous entrances and does not store food in its burrow. In captivity, *M. guentheri* gave litters from September to June and a female produced 42 pups, being seven litters during a reproduction season. The duration of pregnancy varied 20 to 21 days. The average litter size was 5.5 and young were born in an average weight of 3.3 g. The fur developed at an age of 10 days, the eyes and the ears opened on 12 - 16 days. The young began to feed freely on 15 days. Weaning took place at an age of 21 - 24 days. It was determined that, if outbreaks of this vole occurs and holes are abundantly seen in the edge of fields, control measures should be taken by deep ploughing of the field edges and using snap trap to avoid its likely harmful effects.

**Key Words:** *Microtus guentheri*, ecology, biology, Turkey

### Türkiye'deki *Microtus guentheri* Danford and Alston, 1880 (Mammalia: Rodentia)'nin Ekoloji ve Biyolojisi Üzerine Bir Çalışma

**Özet:** Bu çalışmada *Microtus guentheri*'nin tarım ürünleri üzerine etkisiyle beraber ekoloji ve biyolojisi hem laboratuvar, hem de arazi gözlemlerine dayanarak araştırıldı. Bu türün çok girişli sığ yuvalara sahip olduğu ve yuvasında besin depolamadığı tespit edildi. Laboratuvarında *M. guentheri* Eylül ayından Haziran ayına kadar doğum yaptı ve bu süre içinde bir dişi yedi doğumda 42 yavru doğurdu. Hamilelik süresi 20 - 21 gün arasında değişti. Ortalama yavru sayısının 5,5 olduğu, yavruların ortalama 3,3 gr. ağırlığında doğduğu tespit edildi. Kürk 10 günde tamamlandı. Gözler ve kulaklar 12 - 16 günde açıldı. Yavrular 15 günde serbest beslenmeye başladılar. Sütten kesilme 21 - 24 günde oldu. Bu türde popülasyon patlaması olursa ve tarla kenarlarında çok sayıda yuva görülürse muhtemel zararlı etkilerinden korunmak için tarla kenarlarının derin bir şekilde sürülmesiyle ve yaylı kapan kullanılmasıyla mücadele edilmelidir.

**Anahtar Sözcükler:** *Microtus guentheri*, ekoloji, biyoloji, Türkiye.

### Introduction

Ellerman and Morrison-Scott (1) and Corbet (2) from Palaearctic region listed 24 and 25 *Microtus* species, respectively. The distribution records of genus in Turkey were provided by Danford and Alston (3), Thomas (4), Miller (5), Blackler (6), Neuhäuser (7) and Kefelioğlu (8). *Microtus guentheri* investigated in present study was collected in Ankara. Kefelioğlu (8) who performed a taxonomic study on *Microtus*, considering morphologic similarity between *Microtus epiroticus*, *M. arvalis* and *M. guentheri*, stated that specimens from Ankara are *M. epiroticus* based on diploid number of chromosomes. Additionally, researcher suggested that *M. epiroticus* and *M. guentheri* drastically have same diploid number of chromosomes and their only fundamental numbers are

different. As shown by these findings, taxonomic positions of these species are in question, and taking into consideration this point, the specimens captured in four stations around Ankara province were karyotyped in case incorrect identification. Our karyological findings showed that the specimens evaluated in this study are *Microtus guentheri*. Members of the genus *Microtus* widely ranged in Turkey according to the published papers. Specimens of *Microtus* are usually evaluated as a agricultural pest without giving any information on how and when their harmful effects occur (9, 10, 11, 12). Nevertheless, especially ecology and biology of *M. guentheri* are very poorly known in Turkey and scanty in other adjacent countries. That is why, findings obtained in this research were compared to other species mentioned above, which ranged in the neighboring countries of Turkey, then

revealed its ecology and biology and determined effects on cultured grains fields.

### Materials and Methods

In this study, both laboratory and field observations performed between the years 1993 and 1996 were evaluated in order to reveal their ecological and biological features. Dead and live specimens were captured by snap trap and digging burrow. Standard four external measurements (Total length, tail length, hind foot and ear), weight and reproductive signs such as lactation, pregnancy, swollen testes and placental scars were recorded in the field and laboratory. Stomach was placed in 4% formaldehyde solution to keep it fresh for later examination and weighted. Of these studies, field ones were conducted in two stations selected around province of Ankara; first one is in near Gölbaşı (south of Ankara), second one is around Gümüşlük village, in the north of Ankara. These two stations were visited periodically during this research. Information about burrow structure are obtained from excavated burrows (n=7). After diggings was completed, the whole length and depth of burrows were documented and drawn (Fig. 1). Plants around burrows and in their tunnels were picked up and identified to find out their feeding habits. Live specimens were transferred into the laboratory to observe reproductive biology and behavior in captivity and here housed as pairly, singly and mixed groups in the cages. Animals were provided with nesting materials, food (wheat seeds, fresh grass, sunflower seeds and carrot) and water. To determine their behavior, birth date and mating, animals were inspected daily and nightly. Duration of pregnancy was estimated by separating pair after mating occurred and as minimal interval time between successive births. All living specimens were kept in ambient conditions similar to climate (temperature, photoperiod and humidity) in their natural environment. In addition to ecological and biological observations, karyological preparations were performed in accordance with Ford and Hamerton (13) to confirm species identified.

### Results

**Karyology:**  $2n=54$ ,  $NFa=52$  and  $NF=54$ . The X chromosome is medium-size and acrocentric, and the Y chromosome is small and acrocentric.

**Habitat:** In central Anatolia, this species colonially live in steppe, plains, unploughing grain fields and fallow lands. When food is scanty and their natural

environments in which they live are destroyed, these voles concentrate on cereals, fallow lands and in the field edges where food is available.

**Behavior:** On the basis of both field and laboratory observations, it was determined that voles did not hibernate and had activities at any time of day. When snap trap set close to the entrance holes, it was seen that voles were easily trapped during day time. This species was seen out of burrows in the field works performed in winter season when ground was covered with snow. Their intensive daily activities around burrows resulted in the pathway traces through grass, connecting one entrance hole to another and they defecate near the entrance holes and these are identical signs of these voles. We also heard their voice in the field. It was seen in the excavated burrows that voles accumulate fresh plant materials in their tunnels where they eat these food latter. Fighting usually does not occur in group contained by females and males in the same cage. This finding indicates that voles establish the little colonies by means of closely constructed burrow systems.

**Feeding habits:** To determine feeding habit, we evaluated both fields and laboratory findings. The chewed plant parts and seeds were seen in stomach contents. The plants such as *Cirsium* sp., *Silene* sp., *Allyssum* sp. along with some Graminae species were abundant in their tunnels. Stomach weight varied from 3 g to 5 g. In captivity, when the fresh plants were provided to their cages, they preferred to eat these rather than seeds.

**Burrows:** The burrows of *M. guentheri* consist of tunnel systems with more than one nest chamber and numerous entrances. The total length of burrows is about 10 meters and sometimes even more. It was also found that some burrows had only a few entrances in tunnels systems, these were considered as new constructed or temporary burrows. The shape of tunnel systems and numbers of entrance were determined to be changeable. The entrance to the burrow was round, its size being about 5 - 7 cm in diameter and the entrances slope gently down at an angle of 20 to 30 degrees or sharply drop. There are a few lateral galleries (blind gallery) in some burrows. Tunnels are located at the depth of 10 - 15 cm. It was determined that some tunnels extend to the depth of 30 - 40 cm and then ascend to the depth of 10 - 15 cm again, and sometimes ends at the depth of 50 - 80 cm without enlarging. No storage chamber, wastage room and food stored were found in excavated burrows (n=7), the nest chamber are usually at the same level of whole tunnel systems and located either at the end of tunnel or in the middle of tunnel. If the nest is located in the middle

Animal No.	Birth	Litter size	Date	Interval time between successive births (Days)
1	(I.Birth)	5	30 September	
1	(II.Birth)	6	20 October	20
1	(III.Birth)	5	17 November	26
2	(I.Birth)	2	28 November	
1	(IV.Birth)	7	11 December	24
2	(II.Birth)	5	22 December	24
3	(I.Birth)	3	2 January	
2	(III.Birth)	2	17 January	23
1	(V.Birth)	10	22 January	30
3	(II.Birth)	6	25 January	23
4	(I.Birth)	5	27 January	
2	(IV.Birth)	3	8 February	21
4	(II.Birth)	4	15 March	20
3	(III.Birth)	5	17 March	52
1	(VI.Birth)	4	20 March	60
2	(V.Birth)	6	3 April	55
4	(III.Birth)	5	12 April	27
3	(IV.Birth)	6	16 April	51
2	(VI.Birth)	5	2 May	29
1	(VII.Birth)	5	18 May	58
3	(V.Birth)	7	1 June	39

Table 1. Reproductive Data of Four Females. *Microtus guentheri* in Captivity.

of tunnels, it continues through the nest chamber. The nest chamber which is lined with dry grass is 7 to 9 cm in diameter and about 13 cm long (Fig. 1).

**Reproduction:** At the end of May, we found an adult male and an adult female in some excavated tunnel systems with two nest chambers. In other tunnel systems with an adult pair and five neonates in two nest chambers were found in December. In captivity, *M. guentheri* gave birth during the period of September to June, also in the field, we did not observe any reproductive sing in specimens collected in July, August and September. These findings show that *M. guentheri* is capable of breeding during a season ranging from September to June.

Mating occurred dorso-ventral and lasted in intervals during an hour. It was observed that mating may occurs 20 - 30 times in this period. If another adult male occurs in the same cage during mating, this male tries to

interfere mating by using forefeet, but this intervention is not destructive. Duration of pregnancy was determined to vary from 20 to 21 days. In a breeding season, the minimum interval between two births was determined to be 20 days and maximum one 60 days. The mean number of litters was 5.5 ranging from 2 to 10. A female gave seven litters during a reproduction season, totally 42 newborns (Table 1).

Newborns were born blind, naked and pinkish in coloration; their eyes were also colesed with skin. In spite of that they were naked, a few vibrissae, in length of 1 - 2 mm, occur on both side of the rostrum. The formation of fore and hindfeet fingers is not completed at this stage. After two days of birth, hairs began to grow on dorsal and then dorsal side of body was getting darker. Claws and lower incisors began to appear at an age of 2 - 3 days. In this period, vibrissae reached to a length of 4

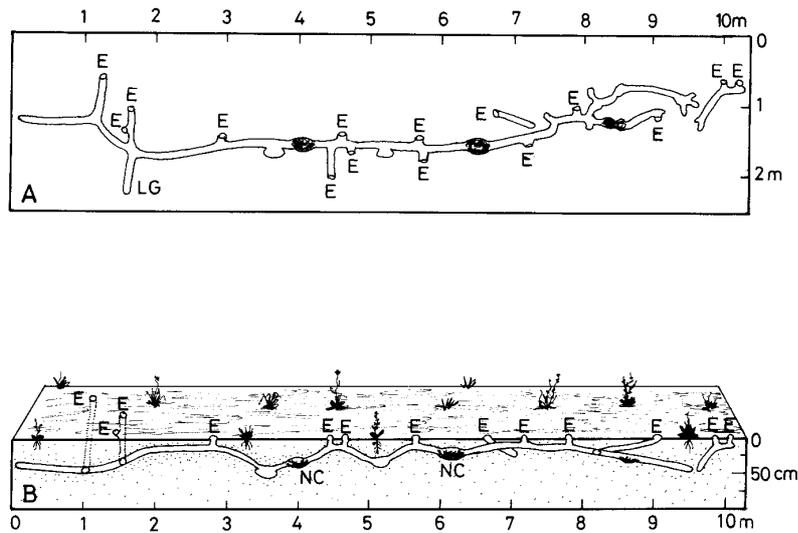


Figure 1. General shape (A) and position in the ground (B) of burrow system belonging to *Microtus guentheri*. E: entrance hole, NC: nest chamber, LG: lateral gallery.

mm. Forefeet fingers complete their formation between 5 and 8 days. While hairing intensively occurs in dorsal and very scarce in ventral, and upper incisors began to appear in this period, then hairs covered through the whole body in exception to the genital region after first weekend of birth. The hairing of the genital region was completed for 10 days. The formation of hind feet occurred after 11 - 12 days. Their eyes and ears began to open on 12 - 13 days and completed on 16 days.

After eyes open the young started to move freely in the cage and to feed green matters. These young weaned after 21 - 24 days and attained to sexual maturity by 30 - 35 days. The earliest births were observed in some females at an age of two months. It was determined, in considering pregnancy lasted 20 - 21 days, that sexual maturation occurred in these female at an age of 35 days. Similarly males, at an age of 30 days with adult female kept in the same cage managed to mate and then one of this female gave 5 young. Newborn's external measurements and weights were given in Table 2 and 3. Their average external measurements and weight; total length: 45.61 mm, tail length: 5.53 mm, hind foot: 6.65 mm, ear: 0 mm and weight: 3.30 gr. While, ear length in newborns reached to adult's ones until a month their other measurements such as total length, tail, hind foot and weight did not attain to those of these adults (Table 2). These external measurements and weight of one vole attained to those of adults by two months.

**Effect on Cultivated Fields:** It was determined, in I. and II. stations in which field works were performed, that this vole seldomly occupies or constructs its burrows in

grain fields. But their burrows were usually found along the unploughing edge of fields. The holes of some burrows near the field edges sometimes open to grain field. In this case, grain atreams shorn and their gungs might be found around these holes. However, if green matter is abundantly available, their harmful effects on cereals remain in the lowest level, but their natural habitats were restricted by the ploughing steppe, these voles try to occupy the edge of grain field and occupy especially fallow lands. Even though their harmful effects on grain fields takes place in minimum level, if measures are necessary, methods offered are to ploughing and using snap trap. It was determined that deep ploughing edge of the fields prevent this vole from construct their burrows in fields and field edges. If the outbreaks of this vole even occur, using snap trap might be feasible when germination starts. Instead of these methods offered, the use of pesticides can cause serious damage to non-target animals such as birds and raptors.

## Discussion

Kefelioğlu (8) stated that *M. guentheri* occur in grain fields, vegetable gardens and the edge of forests. Researcher's findings partly supported our results in this paper. Additionally Kral and Benli (9) described specimens collected in central Anatolia as *M. guentheri* and stated that this vole commonly found in many localities of Anatolia. Harrison and Bates (14) suggested that *M. socialis* which is conspecific with *M. guentheri* occurs from sea level to above 2000 meters and is very abundant in grass terrain, agricultural lands, busy scrub

Table 2. Changes in External Characters and Body Weight of *Microtus guentheri*.

Days	n	Total length (mm)	Tail length (mm)	Hind foot (mm)	Ear length (mm)	Weight (g)
Birth	26	45.61 (42 - 52)	5.53 (5 - 7)	6.65 (6 - 7)	0 (0 - 0)	3.30 (2.76 - 4.41)
8	19	59.94 (52 - 66)	10.68 (9 - 14)	10.00 (8 - 11)	3.36 (2 - 5)	6.00 (4.48 - 8.01)
15	14	73.35 (68 - 82)	13.92 (13 - 17)	13.84 (12 - 15)	6.35 (5 - 8)	9.09 (7.43 - 11.51)
22	10	94.10 (91 - 101)	16.80 (16 - 18)	16.90 (16 - 18)	10.80 (10 - 11)	13.91 (10.31 - 15.90)
29	10	103.40 (94 - 110)	18.18 (17 - 19)	18.40 (17 - 21)	12.20 (11 - 14)	17.08 (13.77 - 20.26)
36	10	113 (105 - 120)	21 (18 - 24)	18.80 (18 - 20)	13.60 (13 - 14)	22.35 (19.31 - 25.00)
43	10	117.40 (112 - 123)	21.86 (19 - 25)	19.20 (18 - 20)	13.80 (13 - 15)	23.83 (20.27 - 27.17)
Adult	10	150.10 (141 - 160)	29.50 (26 - 33)	22.10 (21 - 24)	13.90 (13 - 15)	49.10 (31 - 59)

and open oak forests in Arabian countries. Vinogradov and Argiropulo (15) determined that *M. arvalis* occur in steppe with herbaceous vegetation, meadows, semideserts and fields in Russia. Harrison and Bates (14) noted in Arabian countries, and Ondrias (12) stated in Greece, that *M. guentheri* lives colonially. Their findings are consistent with our results. Ondrias (12) also informed that burrows of *M. guentheri* did not contain storage chamber, and a nest with thirteen young voles were found belonging to different litters in burrows systems with three nest chambers. These findings also supports our opinions that this vole lives colonially and their burrows do not contain food storage chamber. In contrast to our findings, Vinogradov and Argiropulo (15) stated that *M. socialis* and *M. arvalis* had several store rooms. According to Cohen-Shlagman et al. (11), in Israel, embryo numbers in *M. guentheri* varies from 1 to 11 with a mean size of 8.8 and this vole attains to sexual maturity at an age of 30 days and breeding season takes place between October and April in Israel. Ondrias (12) stated that mean embryo numbers of *M. guentheri* is 5.6 with a range of 4 to 8, and pregnancy lasts 21 days and

these voles are capable of producing 3 and 4 litter in their breeding season in Greece. While mean litter size and duration of pregnancy determined in present study are exactly consistent with Ondrias (12), findings of Cohen-Shlagman et al. (11) remain much lower.

Cohen-Shlagman et al. (16) determined that weaning occurred between 15 and 20 days. In this study, neonates weaned 21 and 24 days, this is longer than their findings. However, in this study sexual maturity is consistent with Cohen-Shlagman et al. (11). Guenther's voles were determined to cause damage to grain and vegetable fields by Kral and Benli (9). In addition to this, Tunçdemir (10) suggested that *M. guentheri* caused to damage in Black sea region in Turkey. Both researchers' results do not depend on objective findings and all of them are their personal opinions. In this study, it was observed that Guenther's voles prefer to construct their burrows in steppe rather than grain fields. However sometimes these voles were rarely found in the edge of cultivated fields, this situation might be depended on restriction of their natural habitat and outbreak of this vole. Misonne (17) reported that no less than 27 tons of voles (*M. guentheri*)

Table 3. Developmental Data of *Microtus guentheri*.

	n	Total length (mm)	Tail length (mm)	Hind foot (mm)	Ear length (mm)	Weight (g)
Birth	26	45.61 (42 - 52)	5.53 (5 - 7)	6.65 (6 - 7)	0 (0 - 0)	3.30 (2.76 - 4.41)
Eyes opening	13	71.23 (64 - 82)	13.07 (11 - 17)	13.38 (12 - 14)	5.76 (4 - 8)	8.65 (6.59 - 10.86)
Free feeding	14	73.35 (68 - 82)	13.92 (13 - 17)	13.84 (12 - 15)	6.35 (5 - 8)	9.09 (7.43 - 11.51)
Weaning	10	94.10 (91 - 101)	16.80 (16 - 18)	16.90 (16 - 18)	10.80 (10 - 11)	13.91 (10.31 - 15.90)
Sexual maturity	10	103.4 (94 - 110)	18.18 (17 - 19)	18.40 (17 - 21)	12.20 (11 - 14)	17.08 (13.77 - 20.26)
Adult	10	150.10 (141 - 160)	29.50 (26 - 33)	22.10 (21 - 24)	13.70 (13 - 15)	49.10 (31 - 59)

were destroyed in the province of Şanlıurfa when periodic mass multiplication of this vole occurred. In this study, it was determined that there was no population outbreak in 1. and 2. stations during three years. Cohen-Shlagman (11) suggested that if food is scanty in summer, *M. guentheri* concentrate in the field edges where food is available and control measures should take place at this

time of year by the deep ploughing fields and field edges. Researchers also offered that limited use of rodenticides in place only where ploughing is not feasible. Similarly, Ondrias (12) pointed out that control measures should take place by ploughing. Our findings are consistent with these researchers.

## References

1. Ellerman, J.R. and Morrison-Scott, T.C.S., Checklist of Palaearctic and Indian Mammals, 1758 to 1946. Brit. Nat. Hist., London. p: 810. 1951.
2. Corbet, G.B., The Mammals of the Palaearctic region: a taxonomic review. British Mus. Nat. Hist., London/Cornell. Univ. Press. p: 314. 1978.
3. Danford, Ch. and Alston, E., On the Mammals of Asia Minor, Proc. Zool. Soc., 50 - 64, 1880.
4. Thomas, O., *Microtus roberti*, Ann. Mag. N.H., 17, 418-419, 1906.
5. Miller, S.G., *Microtus hermannis*, Ann. Mag. N.H., 1: 103, 1908.
6. Blackler, W.F.G., *Microtus lydius*, Ann. Mag. Nat. Hist., 7, 426-427, 1916.
7. Neuhäuser, G., Die Muriden von Kleinasien Zeit. Säugetierk. Vol. 11, 161-236, 1936.
8. Kefelioğlu, H., Türkiye *Microtus* (Mammalia: Rodentia) Cinsinin Taksonomisi ve Yayılışı. Tr. J. of Zoology. 19 (1): 35 - 63, 1995.
9. Kral, E. ve Benli, O., Orta Anadolu'nun Kemirici türleri ve zarar yaptığı kültür bitkileri. Bitki Koruma Bült. Cilt 19 (4): 191-217, 1979.
10. Tunçdemir, U., Karadeniz Bölgesi'ndeki zararlı kemirici türlerinin yayılış alanlarının ve zarar yaptığı bitkilerin tespiti üzerine araştırmalar. Bit. Kor. Bült. 27(1-2): 65-85. 1988.
11. Cohen-Shlagman, L., Yom-Tov, Y. and Hollwing, S., The biology of the Levant vole, *Microtus guentheri* in Israel. I. Population dynamics in the field. Z. Säugetierkunde. 49: 135-147, 1984.
12. Ondrias, J.C., Contribution to the Knowledge of *Microtus guentheri* hartingi from Thebes, Greece. Mammalia 29: 489-506, 1965.
13. Ford, C.E. and Hamerton, J.L., Colchicine Hypotonic Citrate, Squash Sequence for mammalian chromosomes. Staintenchnol., 31: 247-251 (1956).

14. Harrison, D.L. and Bates, P.J.S., The Mammals of Arabia. Harrison Zoological Museum Publication Kent-England. 1991.
15. Vinogradov, B.S. and Argiropulo, A.I., Fauna of the USSR. Mammals, Key to Rodents. Moscow. Leningrad Pub. 1941.
16. Cohen-Shlagman, L., Hollwig, S. and Yom-Tov, V., The biology of the Levant vole, *Microtus guentheri* in Israel. II. The reproduction and growth in captivity. *Z. Säugetierk.* 48: 148-156, 1984.
17. Misonne, X., Mammifères de la Turquie Sub-orientale et du nord de la Syre. *Mammalia* 21: 53-67, 1957.