Turkish Journal of Zoology

Volume 23 | Number 2 Article 7

1-1-1999

Age Variations in Microtus guentheri Danford and Alston, 1880 (Mammalia: Rodentia) in Turkey

MUSTAFA SÖZEN

ERCÜMENT ÇOLAK

NURİ YİĞİT

ŞAKİR ÖZKURT

Tr. J. of Zoology
23 (1999) 145-155

Age Variations in *Microtus guentheri* Danford and Alston, 1880 (Mammalia: Rodentia) in Turkey

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

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

Received: 17.12.1997

Abstract: The skull, teeth, phallus and bacula of *Microtus guentheri* specimens raised in the laboratory were investigated at different stages of postnatal development. The most of the cranial measurements attained those of adults on day 60. There were determined to be some morphological differences between the skulls of young and adult voles. The incisors and the molars began to erupt at 3 and 6 days, respectively. It was shown that there was no difference in respect to the phallic and bacular morphology between young and adults except for size. The proximal bacula became larger during the period between juvenile life and adulthood. Findings showed that the morphological peculiarities of skull, teeth, phallus and baculum during postnatal development may be also useful in determining the age of the sepicimens.

Key Words: *Microtus guentheri*, age variations, phallus, baculum, cranium.

Türkiye'de *Microtus guentheri* Danford and Alston, 1880 (Mammalia: Rodentia)'nın Yaş Varyasyonları

Özet: Bu çalışmada *Microtus guentheri*'nin kafatası, diş, phallus ve bakulum gelişimi doğum sonrası gelişim boyunca yaş gruplarında laboratuvarda yetiştirilen hayvanlar üzerinde araştırıldı. Kafatası ölçülerinin çoğu 60 günde yetişkinlerin ölçülerine ulaştı. Yetişkin ve genç örneklerin kafatasları arasında bazı morfolojik farklılıkların olduğu belirlendi. Kesici ve azı dişleri sırasıyla 3. ve 6. günde çıkmaya başladı. Genç ve yetişkin örnekler arasında phallus ve bakulum morfolojileri bakımından büyüklük dışında bir farkın olduğu görüldü. Gençlerden yetişkinlere doğru proksimal bakulumun bazal kısmı daha geniş hale gelir. Bulgular, doğum sonrası gelişim boyunca kafatası, dişler, phallus ve bakulumun morfolojik özelliklerinin örneklerin yaşının belirlenmesinde de kullanılabileceğini gösterdi.

Anahtar Sözcükler: *Microtus guentheri*, yaş varyasyonları, phallus, bakulum, kafatası.

Introduction

Microtus guentheri was firstly described by Danford and Alston (1) from Maraş (Turkey). Thomas (2), Miller (3), Blackler (4), Neuhäuser (5) and Kefelioğlu (6) recorded this vole from various areas of Turkey.

While taxonomic status of *M. guentheri* is in question, its biology is also poorly known in Turkey. Cohen-Shlagman et al. (7, 8) examined its biology and ecology in both captivity and the field in Israel. Recently Çolak et al. (9) studied reproduction biology of *M. guentheri* and made some ecological observations. The aim of this study is to investigate the growth of skull, tooth, baculum and phallus, and to contribute to age determination.

Materials and Methods

We constructed a colony of *M. guentheri* from Ankara province, and maintained this colony from 1994 to 1997. Voles were kept in stocking cages 60x60x60 cm until breeding condition, and then a female and a male were housed in a cage 30x30x30 cm for mating. Animals were provided with nesting materials, food (wheat seeds, fresh grass, sunflower seeds and carrot) and water. All living specimens were kept in ambient conditions similar to the climate (temperature, photoperiod and humidity) in their natural environment. To determine their birth date and mating, animals were inspected daily and nightly. After copulation, the male was removed from the parental cage. Pups were killed at intervals of 12, 16, 20, 25, 30, 43 and 60 days, and then skulls and phalli were removed from each animal to examine the postnatal development. Phallic preparations were made according to Lidicker (10). Tooth terminology followed that used in Ognev (11).

Nineteen measurements were taken from each of the skulls with a calliper with accuracy of up to 0.1 mm (Fig.

1). The measurements of molars and bacula were made by micrometer with accuracy of up to 0.01 mm. All dawings were made with a camera lucida attached to the binocular.

Abbreviations used in text: GtL.: Greatest length of the skull, CBL.: Condylobasal length, ZB.: Zygomatic width, IC.: Interorbital constriction, MdB.: Mastoid breadth, TBL.: Tympanic bullae length, OL.: Occipito-nasal length, BL.: Basal length, NL.: Nasal length, FL.: Foramen incisivum length, NB.: Nasal breadth LFcS.: Length of facial region of the skull, BW: Braincase length, HBB.: Heigh of braincaise in bullae, HB: Heigh of braincaise, OW: Occipital width, BW: Braincase width, DL: Diastema length, PL: Palatal length, M: Mandible, C-M^3: The maxillary tooth row, C-M_3: The mandibulary tooth row, M^1: Length of first upper molar, M^2: Length of second upper molar, M^3: Length of third upper molar, M_1: The length of first lower molar, M_2: The length of second lowermolar, M_3: The length of third lower molar, BL: Baculum length BAH: Baculum base height, BW: Baculum width, BTW: Baculum tip width.

Results and Discussion

Skull: Measurements of cranial characters of *M. guentheri* during postnatal development are shown in Table 1 and Fig. 3. We monitored these measurements over 60 days, and then compared them with those of adults. The first skulls were obtained from a 17-day-old litter. Any earlier is impossible because of the insufficiently ossificated skull. The shape of the skull changed during development. It was oval, and its tympanic bullae was invisible in dorsal view at an age of 17-20 days (Fig. 3 A, B). Tympanic bullae became visible at 25-30 days (Fig. 3 C), and then many processes such as typanic bullae, auditory meatus, occipital and temporal region appeared in the skull in dorsal aspect (Fig. 3C). The skull has softer lines in pups than in adults. The

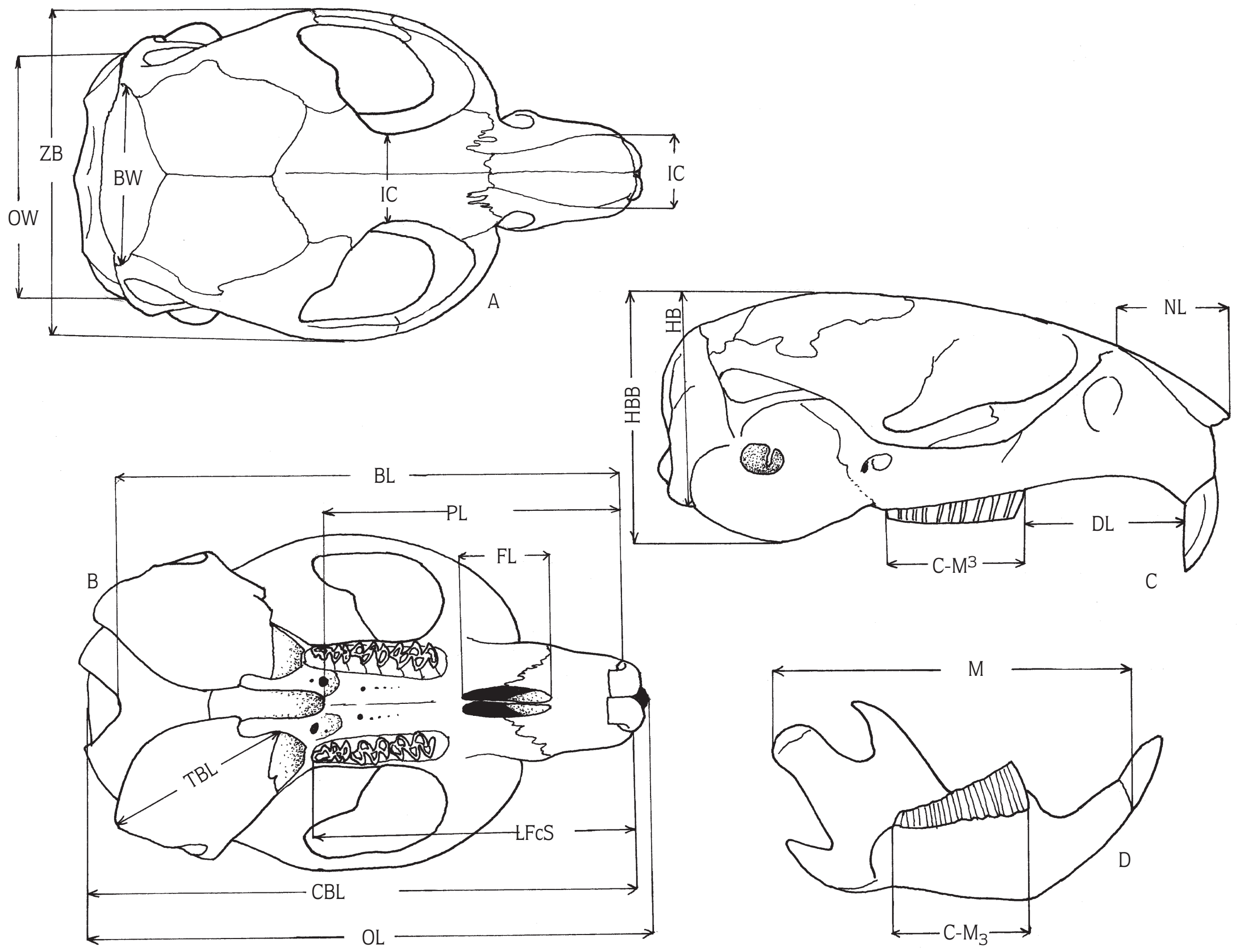

Figure 1. Measurements of cranial and mandibular variables of Microtus guentheri as used in text. A: dorsal view of cranium, B: ventral view of cranium, C: lateral view of cranium, D: external view of mandible.

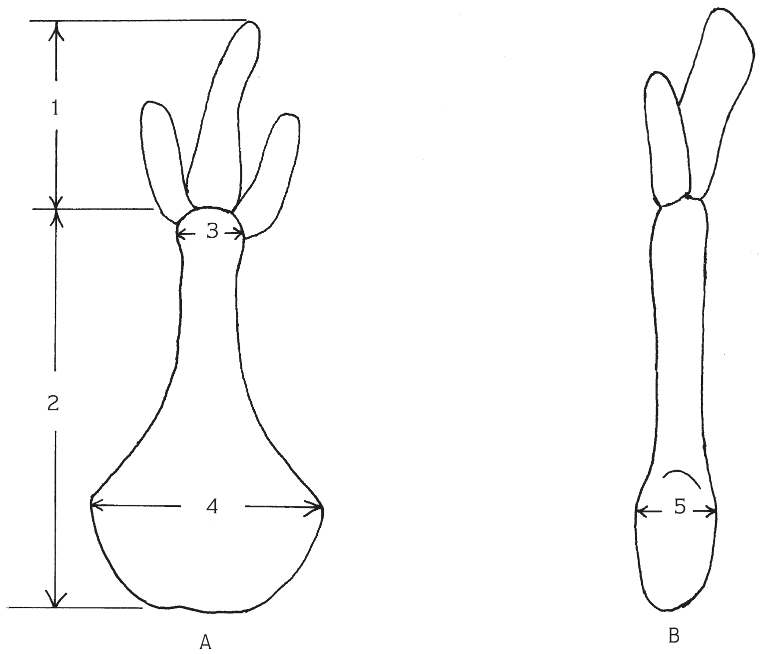

Figure 2. Baculum dimnesions and shape of Microtus guentheri. A. dorsal, B. lateral view. 1. distal part of baculum length, 2. baculum length, 3. baculum tip width, 4. baculum width, 5. baculum base height.

Table 1. The postnatal development of some cranial characters, by day.

	12	16	20	25	30	43	60	Adults
GtL	18.05±1.15	21.08±0.92	21.76±0.21	22.3	22.92±0.39	24.66±0.76	26.85±0.07	28.65±0.75
	17.2-19.7	19.8-22.6	20.1-22.4		22.6-23.6	23.5-25.4	26.8-26.9	27.5-30.0
	n=8	n=6	n=2	n=1	n=5	n=5	n=4	n=13
ZB	10.8±0.25	12.01±0.78	12.5		13.58±0.17	14.56±0.36	16.1±0.14	17.42±0.81
	10.5-11.1	10.4-13.1		-	13.4-13.8	14.1-15.0	16.0-16.2	16.0-18.9
	n=8	n=9	n=1		n=5	n=5	n=4	n=13
IC	3.51±0.12	3.67±0.11	3.76±0.25	3.8	3.82±0.16	3.84±0.08	3.9±0.0	3.95±0.12
	3.3-3.7	3.5-3.8	3.5-4.0		3.7-4.0	3.7-3.9	3.9-3.9	3.8-4.2
	n=8	n=10	n=3	n=1	n=5	n=5	n=4	n=13
CBL	16.97±0.71	19.63±1.00	20.0±0.28		22.2±0.25	23.88±0.99	26.4±0.28	27.96±0.77
	16.0-17.7	18.2-21.0	19.8-20.2	-	22.1-22.6	22.5-24.8	26.2-26.6	27.3-29.8
	n=8	n=6	n=2		n=5	n=5	n=4	n=13
OL	18.42±1.03	21.6±1.22	20.75±0.21	22.3	22.64±0.37	24.22±0.89	26.85±0.07	28.73±0.83
	17.3-19.8	19.6-22.9	20.6-20.9		22.2-23.1	22.8-24.8	26.8-26.9	27.8-30.4
	n=6	n=6	n=2	n=1	n=5	n=5	n=4	n=13
BL	15.97±0.66	18.53±1.03	18.55±0.63	18.8	21.06±0.39	22.84±0.66	25.3±0.14	26.32±1.01
	15.2-16.8	16.9-19.9	18.1-19.0		20.8-21.7	21.9-23.5	25.2-25.4	24.8-28.1
	n=8	n=6	n=2	n=1	n=5	n=5	n=4	n=13
NL	4.55±0.33	5.77±0.57	5.7±0.1	6.3	6.62±0.16	7.17±0.28	7.75±0.21	8.66±0.35
	4.2-5.0	5.4-6.3	5.6-5.8		6.5-6.9	6.8-7.5	7.6-7.9	8.3-9.2
	n=8	n=9	n=3	n=1	n=5	n=5	n=4	n=13

Continued Table 1

	12	16	20	25	30	43	60	Adults
NB	3.0±0.20 2.7-3.2 n=8	3.01±0.13 2.9-3.1 n=9	3.03±0.05 3.0-3.1 n=3	3.1 n=1	3.08±0.08 3.0-3.2 n=5	3.35±0.12 3.2-3.4 n=4	3.4±0 3.3-3.5 n=4	3.50±0.28 3.1-3.8 n=13
LFcS	10.75±0.40 10.1-11.3 n=8	12.45±0.59 11.6-13.1 n=7	12.53±0.32 12.3-12.9 n=3	13.2 n=1	13.6±0.29 13.2-14.0 n=5	14.42±0.40 13.8-14.9 n=5	16.40±0.28 16.2-16.6 n=4	17.33±0.91 16.2-18.8 n=13
BW	6.2±0.31 5.8-6.5 n=8	7.51±0.32 7.0-8.1 n=8	7.65±0.07 7.6-7.7 n=2	8.1 n=1	8.9±0.23 8.7-9.0 n=5	9.52±0.19 9.3-9.8 n=5	10.4±0.14 10.3-10.5 n=4	11.50±0.41 11.1-12.5 n=13
MdB	6.03±0.05 6.0-6.1 n=3	6.74±0.36 6.1-7.2 n=9	6.8±0 6.8-6.8 n=2	7.6 n=1	7.46±0.36 6.9-7.8 n=5	7.86±0.35 7.4-8.4 n=5	8.5±0.42 8.2-8.8 n=4	9.43±0.42 9.1-10.5 n=13
HBB	8.0±0.57 7.4-8.7 n=4	8.75±0.67 7.8-9.4 n=8	8.85±0.21 8.7-9.0 n=2	9.4 n=1	9.64±0.08 9.5-9.7 n=5	10.14±0.23 9.9-10.5 n=5	10.25±0.07 10.2-10.3 n=4	10.85±0.39 10.3-11.6 n=13
HB	6.70±0.25 6.4-7.0 n=4	7.44±0.48 7.3-8.1 n=7	7.85±0.35 7.6-8.1 n=2	7.4 n=1	8.08±0.49 7.2-8.4 n=5	8.66±0.23 8.4-8.9 n=5	8.7±0.14 8.6-8.8 n=4	9.08±0.47 8.3-9.9 n=13
OW	9.73±0.11 9.6-9.8 n=3	10.01±0.25 9.6-10.3 n=8	10.20±0.42 9.9-10.5 n=2	11.1 n=1	11.14±0.25 10.9-11.5 n=5	12.0±0.37 11.7-12.6 n=5	12.7±0.98 12.0-13.4 n=4	13.82±0.64 12.9-14.9 n=13
BW	10.40±0.30 10.2-10.8 n=3	11.20±0.64 10.2-12.0 n=9	11.23±0.20 11.0-11.4 n=3	12.1 n=1	11.94±0.30 11.6-12.3 n=5	12.66±0.33 12.3-13.1 n=5	13.15±0.35 12.9-13.4 n=4	13.28±0.56 12.9-14.0 n=13
DL	5.15±0.22 4.7-5.4 n=7	6.28±0.16 6.1-6.5 n=6	6.3±0 6.3-6.3 n=3	6.7 n=1	7.02±0.40 6.3-7.3 n=5	7.52±0.17 7.3-7.7 n=5	8.95±0.63 8.5-9.4 n=4	9.09±0.54 8.1-9.7 n=13
PL	10.05±0.19 9.3-10.8 n=8	11.28±0.88 10.3-12.1 n=5	11.65±0.31 11.4-11.9 n=3	12.5 n=1	12.50±0.23 12.2-12.7 n=5	13.78±0.47 13.1-14.4 n=5	14.75±0.21 14.9-15.6 n=4	15.56±0.59 14.8-16.9 n=13
TBL	5.91±0.29 5.5-6.3 n=7	6.78±0.48 6.1-7.8 n=9	7.35±0.21 7.2-7.5 n=2	7.6 n=1	8.42±0.26 8.0-8.7 n=5	9.24±0.30 8.9-9.6 n=5	9.55±0.35 9.3-9.8 n=4	9.7±0.63 8.8-10.8 n=13
M	11.62±0.63 10.8-12.3 n=7	13.16±0.63 12.2-14.0 n=9	14.36±0.37 14.1-14.8 n=3	14.9 n=1	14.72±0.57 13.8-14.9 n=5	15.82±0.81 14.8-16.6 n=5	17.4±0 17.4-17.4 n=4	18.52±0.70 17.8-20.3 n=13

Table 2. The postnatal development of molars, by day.

	12	16	20	25	30	43	60	Adults
	6.089±0.16	6.497±0.18	6.721±0.25	7.038	6.884±0.23	7.138±0.49	7.176±0.16	7.957±0.42
C-M^3	5.97-6.43	6.27-6.88	6.43-6.87		6.58-7.19	6.27-7.50	6.96-7.59	7.19-8.72
	n=8	n=9	n=3	n=1	n=5	n=5	n=4	n=12
M^1	2.161±0.15	2.410±0.16	2.509±0.08	2.295	2.542±0.08	2.45±0.11	2.48±0.04	2.73±0.22
length	1.99-2.32	2.14-2.75	2.45-2.60		2.45-2.63	2.29-2.60	2.45-2.51	2.45-3.06
	n=8	n=9	n=3	n=1	n=5	n=5	n=4	n=13
M^2	1.654±0.11	1.784±0.09	1.999±0.17	1.84	1.814±0.07	1.973±0.11	1.982±0.11	2.163±0.10
length	1.41-1.76	1.67-1.99	1.84-2.17		1.68-1.88	1.84-2.14	1.84-2.19	2.02-2.30
	n=8	n=9	n=3	n=1	n=5	n=5	n=4	n=13
M^3	1.190±0.36	1.324±0.24	1.36±0.26	1.68	1.929±0.14	2.102±0.26	2.188±0.14	2.616±0.21
length	0.80-1.73	0.92-1.76	1.10-1.62		1.68-2.11	1.84-2.52	1.99-2.69	2.32-2.98
	n=7	n=9	n=3	n=1	n=5	n=5	n=4	n=13
	5.625±0.75	6.29±0.19	6.426±0	6.732	6.627±0.23	7.033±0.43	7.305±0.27	7.729±0.40
C-M_3	4.77-6.58	5.97-6.42	6.426		6.27-6.88	6.45-7.50	7.11-7.50	7.27-8.41
	n=8	n=9	n=3	n=1	n=5	n=5	n=4	n=13
M_1	2.573±0.17	2.899±0.19	3.034±0.02	3.213	3.133±0.23	3.232±0.27	3.243±0.17	3.591±0.18
length	2.49-2.91	2.60-3.21	3.01-3.06		2.72-3.24	3.06-3.70	3.12-3.37	3.24-3.82
	n=8	n=9	n=3	n=1	n=5	n=5	n=4	n=13
M_2	1.365±0.05	1.496±0.06	1.591±0.01	1.530	1.581±0.38	1.673±0.11	1.690±0.03	1.822±0.17
length	1.25-1.42	1.41-1.57	1.48-1.68		1.47-1.68	1.56-1.84	1.67-1.71	1.51-2.09
	n=8	n=9	n=3	n=1	n=5	n=5	n=4	n=13
M_3	0.749±0.39	0.978±0.33	1.254±0.06	1.377	1.459±0.06	1.535±0.21	1.606±0.11	1.804±0.21
length	0.31-1.02	0.30-1.30	1.22-1.33		1.38-1.53	1.36-1.83	1.53-1.83	1.38-2.02
	n=3	n=9	n=3	n=1	n=5	n=5	n=4	n=13

lateral processes of the occipital condyles became much more marked with age. The occipital condyles are only seen at an age of over 3 months in dorsal view, and are very marked in aged samples. The orbital cavity got progressively larger and more rounded in shape. In the old voles, the postorbital processes were more spine-shaped than those of young (Fig. 3). The incisors also were visible after 40 days in dorsal aspect (Fig. 3 D). The mandible showed minor changes during development. Its lower edge was even in the old voles (Fig. 4).

The development of cranial characters is shown in Table 1. Interrorbital constriction increased only from 3.51 to 3.9 mm between the 12th and 60th days of postnatal develpoment, an increase of 0.45 mm. However, in the same-period the zygomatic breadth increased from 10.8 to 16.1 mm, a 5.3 mm increase. The net result of the differences in the increases of IC and ZB is that the orbital cavity gets larger and more rounded in shape.

According to Çolak et al. (9) the measurements of the external characters and weight of *M. guentheri* pups reach adult range by 60 days. These findings showed that the external and cranial characteristics of pups reach those of adults by 60 days. Of them, ZB, IC, BL, NB, LFGcS, HBB, HB, OW, BW, DL, PL, TBL reached the corresponding characteristics of adults by 60 days, and only 7 mesurements, namely, GtL, CBL, OL, NL, BrL, MdB, M took longer than 60 days to reach adult measurements (Table 1).

Dentition: The incisors and the molars erupted at 3 and 6 days, respectively. The growth of the maxillary

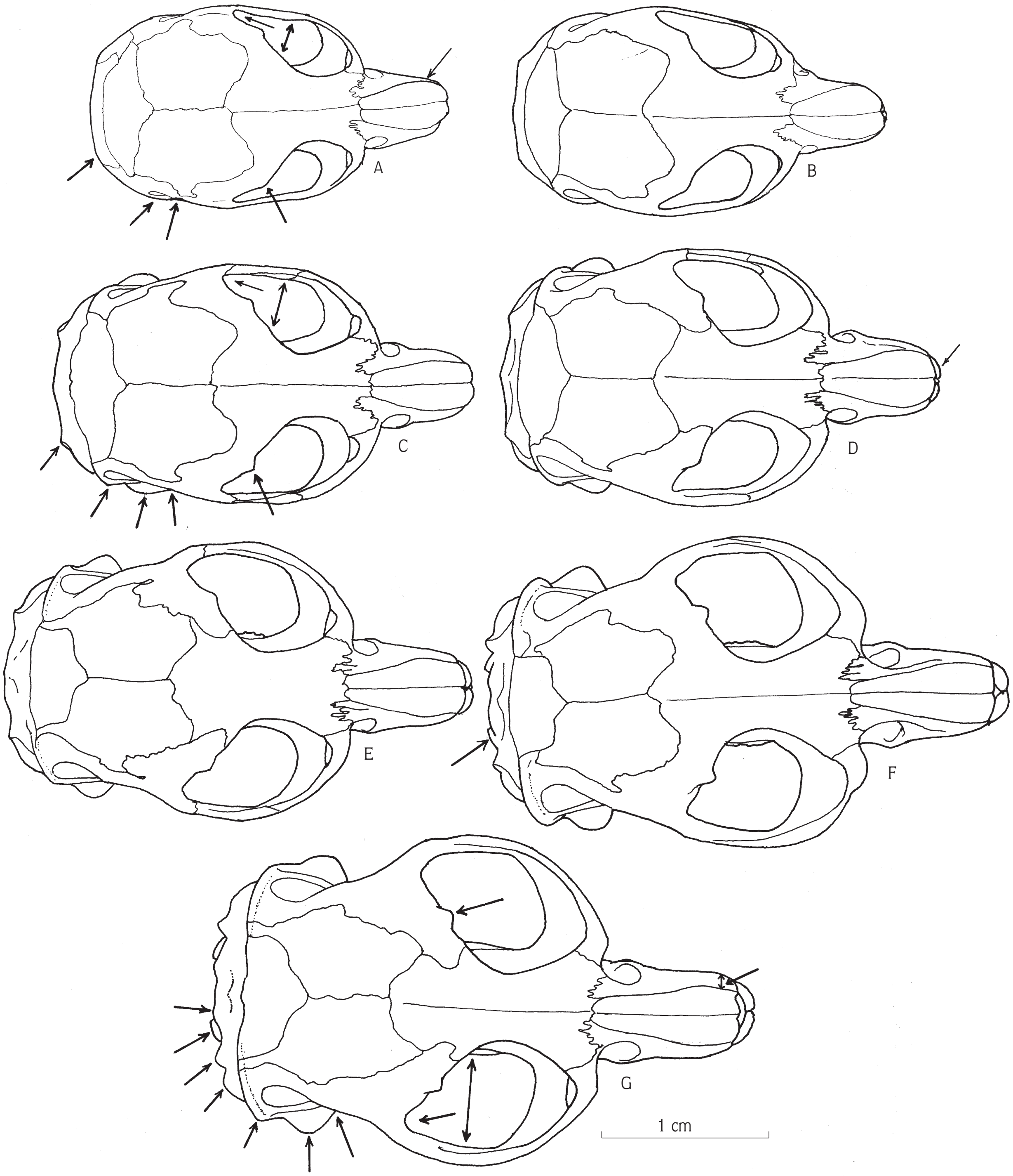

Figure 3. The postnatal development of cranium.
A. 17 days old; B. 20 days-old; C. 30 days-old; D. 43 days-old; E. 60 days-old; F. 100 days-old; G. aged (over two years-old).

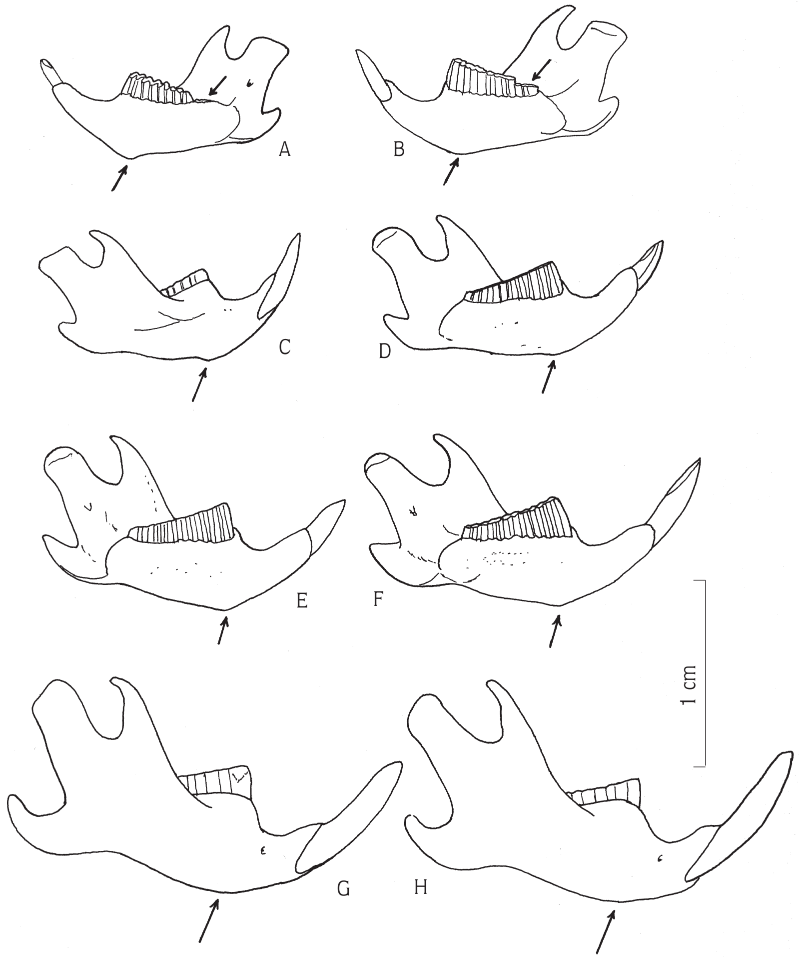

Figure 4. The postnatal development of mandible.
A. 15 days-old; B. 17 days-old; C. 20 days-old; D. 30 days-old; E. 43 days-old; F. 43 days-old; G. 100 days-old; H. aged (over two years-old).

toothrow was completed at 14 days, and that of mandibulary toothrow at 18 days. The M^1 and M_1 appeared firstly, and M^3 and M_3 lastly (Fig. 4 A, B). We determined some molar destructions in the aged voles (Fig. 5 F, 6 D). As the age progressed, some molars, particularly M^3, began to sink into the maxilla, and its upper ends began to appear in the orbital cavity, and some parts of teeth were broken in some specimens (Fig. 6 D). The malformations of molars may cause the death of the animal, because of insufficient feeding. The growth of morals is shown in Table 2 and Fig 5. According to this table, the length of upper and lower toothrow are almost the same, and M^1, M_1 are longer than M^2, M_2, M^3 and M_3. Most of the teeth length are getting closer to adult ones by 60 days.

In 15 day-old animals enamel fields on molars were opened and narrow. M^3 and M_3 begin to erupt, but they are still completely in alveolar cavity, and only their upper ends may be seen in dorsal view. The lobes of the upper and lower molars were not separated from each other. External and internal reentrant angles were relatively larger than those of other age groups (Fig. 5 A).

In 17-day-old animals the M^3 and M_3 had mostly erupted, but not completely (Fig. 4 B). As the age progressed, the chewing surface grew larger because of wearing of teeth. This is why the chewing surface of molars of 17 day-old animals was larger than that of 15 day-old animals, and the enamel fields were almost closed in this period except for M_3 (Fig. 5 B). This shows that animals began to feed freely in this period, and so the wearing of teeth also started. This result is in accordance with Çolak et al.'s (9) indication that the pups of *M. guentheri* started to feed freely by 15 days. In this period, the eruption of incisors was complete, and the first and the second lower and upper molars completed eruption, and then the last molars began eruption. Thus there seems to be direct correlation between starting to feed frelly and tooth development.

Figure 5. The postnatal development of molars. A. 15 days-old; B. 17 days-old; C. 30 days-old; D. 43 days-old, E. 100 days-old; F. aged (over two years-old). a. maxillary tooth row, b. mandibulary tooth row.

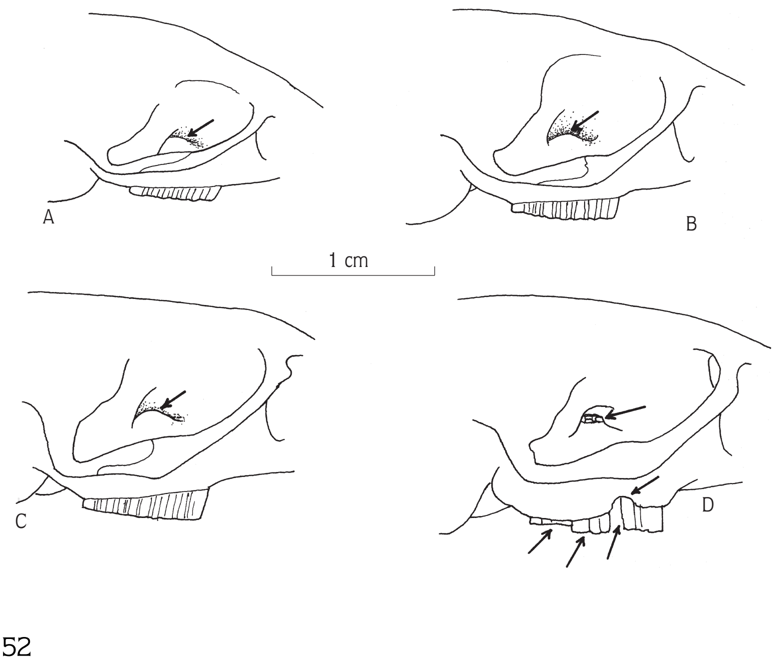

Figure 6. The view of the sinking of molars into the alveolar cavity on maxilla. A. 20 days-old; B. 60 days-old; C. 100 days-old; D. aged (over two years-old).

Table 3. The postnatal development of bacula.

	43 Days	60 Days	100 Days	1.5 Year-Old	Aged (Over 2 years)
BL	2.368	2.885	3.049	3.442	3.573
BAH	0.261	0.393	0.622	0.721	0.688
BW	0.909	1.213	1.704	1.868	1.806
BTW	0.360	0.459	0.459	0.491	0.524

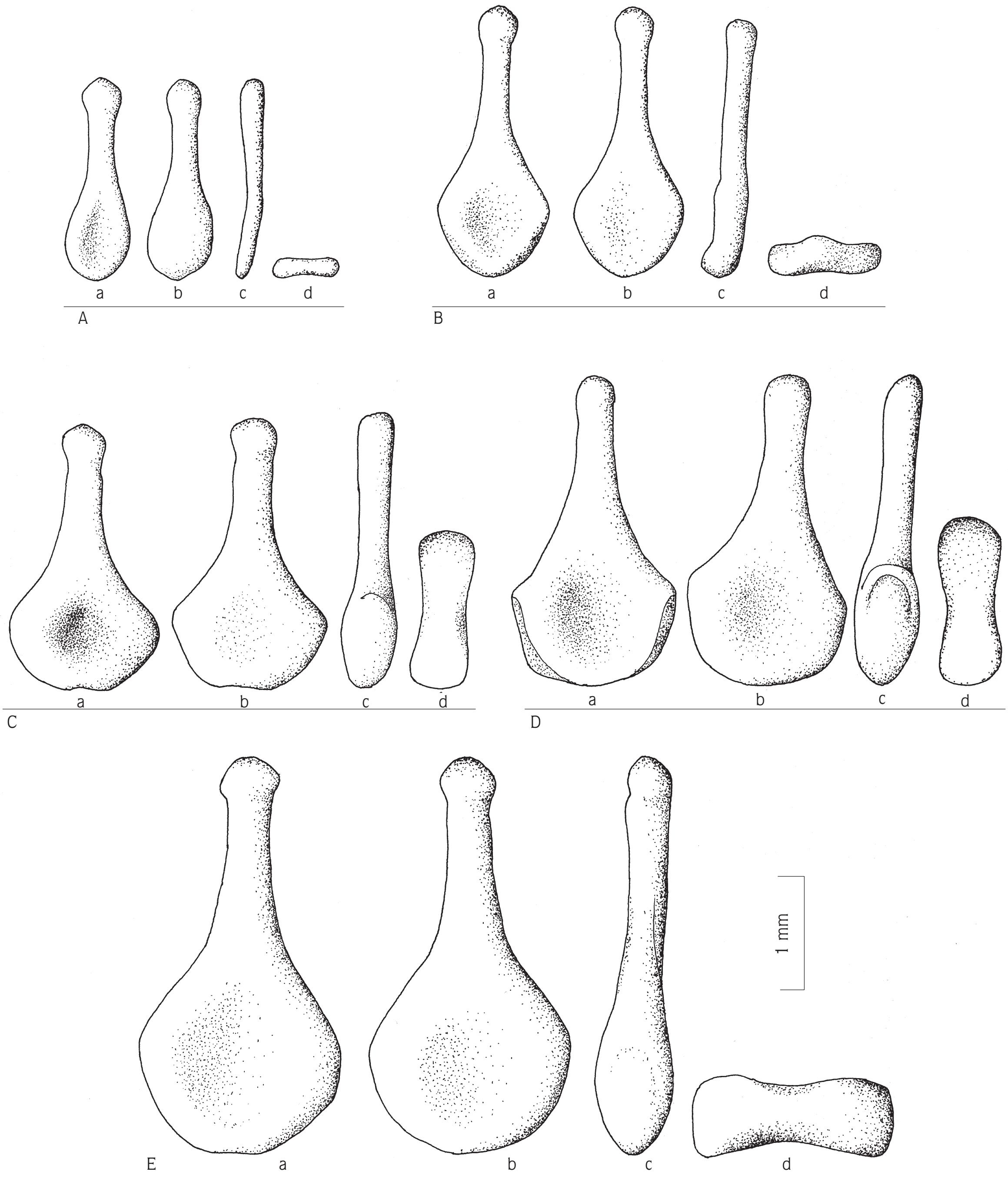

Figure 7. The postnatal development of bacula. A. 43 days-old; B. 60 days-old; C. 100 days-old; D. 1.5 years-old; E. aged (over two years-old). a. dorsal, b. ventral, c. lateral, d. basal view.

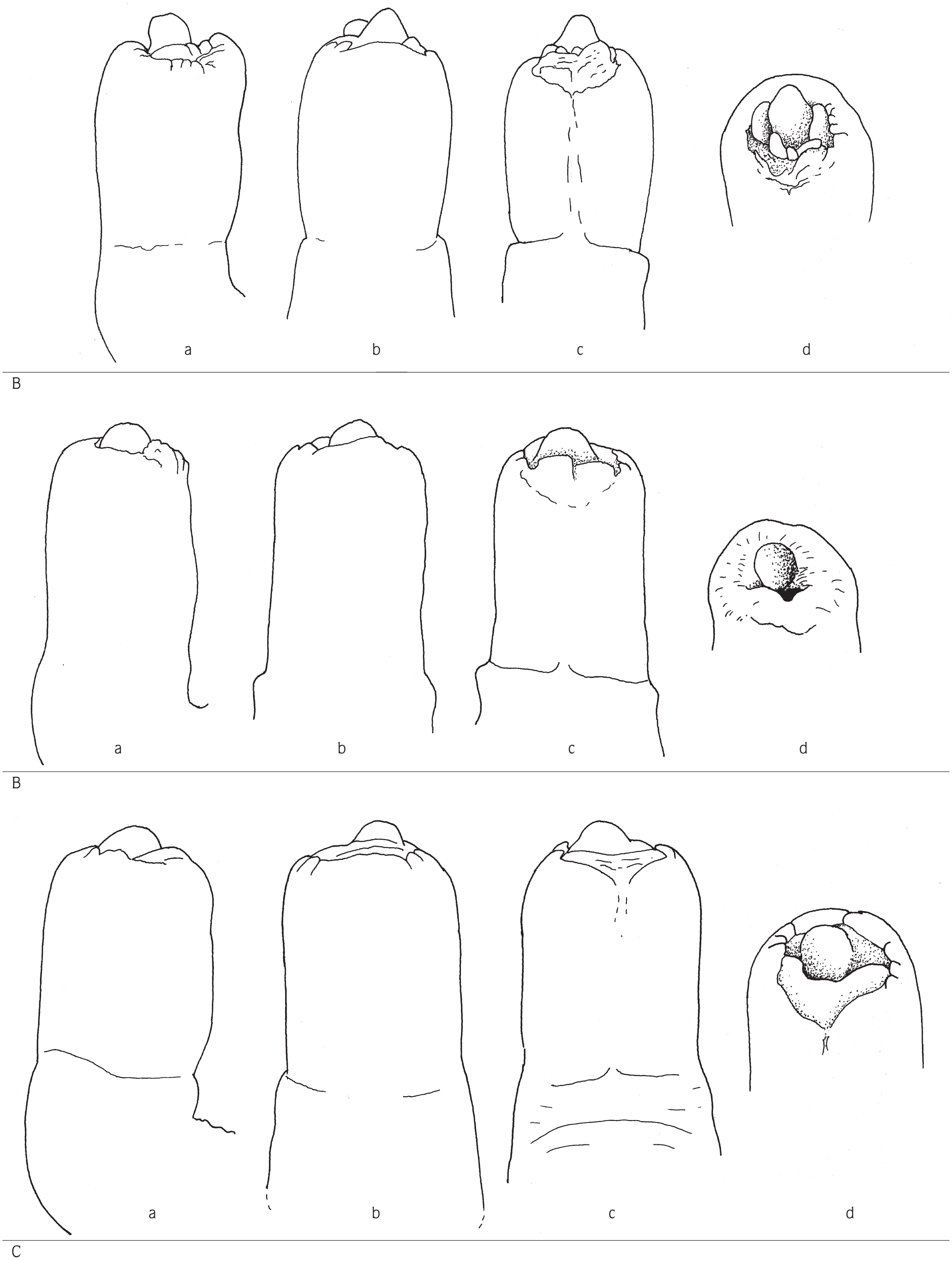

Figure 8. The postnatal development of phalli. A. 60 days-old; B. 100 days-old; C. 1.5 years-old. a. lateral, b. dorsal, c. ventral, d. tip view.

In 30-day-old animals, the enamel fields of molars were almost completely closed except that the enamel fields of M_3 had closed by this period. The anterior lobe of M_1 was rounder in shape (Fig. 5 C).

In 43-day-old animals, there was an extra process on the anterior lobe of M_3. The molars had some changes at the age of 100 days. For example, the chewing surface of the molars and particularly the posterior lobe of M^3 had become larger and smoother (Fig. 5 E). The first internal reentrant angle of M_1 had become even due to wearing (Fig. 5 E, b). The chewing surface of the molars of aged voles (over 2 year-old) was the largest, and external and internal reentrant angles were very small. The posterior lobe of M^3 and the anterior lobe of M_1 are very large and rounded in shape (Fig. 5 F). The first part of the posterior lobe of M^3 looks like a separate lobe (Fig. 5 F, a).

Baculum and Phallus: The baculum is composed of a trifid cartilaginous distal part and an ossificated proximal part. The cartilaginous part is usually removed during the preparation. We were not get any baculum from 30-day-old animals. It is possible that the bacula might be formed after the 30th day of development. Thus we examined bacula and phalli after the 43rd day of postnatal life (Table 3). In the young of 43 days, baculum is very thin, and the tip of proximal baculum is relatively more swollen than that of adults (Fig. 7 A). The base of the proximal bacula became larger during the period from 43 days to the old voles (Fig. 7). In the aged voles, the proximal bacula became spoon-shaped, and its base was swollen (Fig. 7 E). There were no differences in shape between the phallus of young voles and that of adults (Fig. 8).

References

1. Danford, Ch. and Alston, E., On the Mammals of Asia Minor, Proc. Zool. Soc., 50-64, 1880.
2. Thomas, O., Microtus roberti, Ann. Mag. N.H., 17, 418-419, 1906.
3. Miller, S.G. Microtus hermonnis. Ann. Mag. N.H., 1: 103, 1908.
4. Bleckler, W.F.G., Microtus lydius, Ann. Mag. Nat. Hist., 7, 426-427, 1916.
5. Neuhäser, G., Die Muriden von Kleinasien Zeit. Säugetierk. Vol. 11, 161-236, 1936.
6. Kefelioğlu, H., Türkiye Microtus (Mammalia: Rodentia) Cinsinin Taksonomisi ve Yayılışı. Tr. J. of Zoology. 19, 35-63, 1995.
7. 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.
8. Chen-Shlagman, Hollwing, 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.
9. Çolak, E., Sözen, M., Yiğit, N. and Özkurt, Ş.A study on biology of Microtus guentheri Danford and Alston, 1880 (Mammalia: Rodentia) in Turkey. Tr. J. Zoology, 22: 289-295, 1998.
10. Lidicker, W.Z. A phylogeny of New Guinea rodent genera based on phallic morphology. Journal of Mammalogy, 49: 610-643. 1968.
11. Ognev, S.I. Mammals of the U.S.S.R. and Adjacent countries. Vol. 5. Rodents, Translated from Russian, Isr. Prog. for Sci. Translations, Jerusalem 1963, 1947.