

The Bioecology of *Spermophilus xanthoprimum* (Bennett, 1835) in Kırıkkale (Mammalia: Rodentia)

Kırıkkale İli *Spermophilus xanthoprimum* (Bennett, 1835)'un Biyoekolojisi (Mammalia: Rodentia)

Research Article

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ABSTRACT

This study is based on 30 (11 ♂♂, 19 ♀♀) specimens of *Spermophilus xanthoprimum* collected in Kırıkkale province. Specimens were divided into two age groups as young and adult, according to field note, fur colour, molar teeth worn and baculum shape. In this study, habitat, fur colour, behaviour, hair morphology, baculum shape, external and cranial characteristics, karyological features and exoparasites of *Spermophilus xanthoprimum* were examined. Three animals (1 ♂, 2 ♀♀) were observed in terms of feeding and behaviour features in lab. The baculum shape was given and hair structure was determined as "crenate" type. In *S. xanthoprimum* diploid chromosome number was $2n=42$, fundamental number $NF=81$, and $NFa=78$. Data belongs to skull and baculum were compared with literature data and our specimens were represented the *Spermophilus xanthoprimum gelengius*.

Key Words

Spermophilus xanthoprimum, Anatolian ground squirrel, Biology, Ecology, Kırıkkale, Türkiye

ÖZET

Bu araştırma 19 Nisan 2007 ila 28 Ağustos 2008 yılları arasında Kırıkkale ilinden yakalanan 30 (11 ♂♂, 19 ♀♀) *Spermophilus xanthoprimum* örneğine dayanmaktadır. Örnekler arazi notu, kürk rengi, molar diş aşınım derecesi ve baculum şekline göre genç ve ergin olarak iki yaş grubuna ayrılmıştır. Bu çalışmada *S. xanthoprimum*'un habitatu, kürk rengi, davranışı, kıl morfolojisi, baculum özellikleri, iç ve dış karakter özellikleri, karyolojik özellikleri, ve ekzoparazitleri incelenmiştir. Üç hayvanın (1 ♂, 2 ♀♀) laboratuvarında beslenme ve davranış özellikleri kaydedilmiştir. Baculum şekli verilmiş ve kıl örneklerinin "crenate" tipte olduğu saptanmıştır. *S. xanthoprimum*'da diploid kromozom sayısı $2n=42$, temel kromozom sayısı $NF=81$, otozomal kromozomların kol sayısı $NFa=78$ dir. Baş iskeleti ve baculum verileri literatür verileriyle karşılaştırılmış ve örneklerimizin *S. xanthoprimum gelengius*'u temsil ettiği saptanmıştır.

Anahtar Kelimeler

Spermophilus xanthoprimum, Anadolu yer sincabı, Biyoloji, Ekoloji, Kırıkkale, Türkiye

Article History: Received March 08, 2013; Revised March 15, 2013; Accepted March 29, 2013; Available Online: September 1, 2013

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INTRODUCTION

There are 26 orders that belong to Mammalia. One of these, Rodentia (Rodents) are represented by 29 families, 443 genus and 2015 species, and Sciuridae family has 50 genus and 273 species (Wilson and Reeder, 1993).

Bennett (1835) recorded the first ground squirrel he defined in Erzurum as *Citillus (sic) xanthoprymna*. Danford and Alston (1877) have recorded this species as *Spermophilus xanthoprymnus*. Miller (1912) considered *Sciuropterus*, *Sciurus*, *Citellus* ve *Marmota* 4 kinds that belong to Sciuridae family, and reported that *Citellus* species is represented by *C. citellus* and *C. suslica*.

Karabağ (1953) made a research on the biology and struggle with ground squirrel in Ankara, and he studied the hibernation behaviour and ecology of this species for the first time. Mursaloğlu (1964) researched the spreading of *Citellus citellus* in Turkey and he noted that the nominative sub-species is found in Thrace and *C.c.gelengius* in Anatolia. Corbet (1978) defined *Citellus* genus as the junior synonym of *Spermophilus*, and acknowledged *Spermophilus* genus; also he reported that *Spermophilus citellus citellus* spreaded in Thrace and *Spermophilus citellus xanthoprymnus* spreaded in Anatolia. Turan (1984) reported that ground squirrel lives in agricultural areas and meadows in Thrace and steppes in Central Anatolia and Eastern Anatolia. Doğramacı et al. (1994) reported that the diploid chromosome number of *Spermophilus citellus* as $2n=40$ and the diploid chromosome number of *Spermophilus xanthoprymnus* in Central Anatolia as $2n=42$. Yiğit et al. (2000) and Kart (2000) made researches on the hibernation of *Spermophilus xanthoprymnus*.

There has not been any researches on *S. xanthoprymnus* in Kırıkkale, Central Anatolia which is a steppe. In this respect, some biological, ecological and taxonomical status of *S. xanthoprymnus* in Kırıkkale is the main purpose of this research.

MATERIAL and METHOD

In this study, a field research was realized between April 2007 and June 2008 in the

natural environment of Bahşılı, Balıseyh, Çelebi, Delice, Karakeçili, Keskin, Sulakyurt and central districts of Kırıkkale, and a total of 30 (11 ♂♂, 19 ♀♀) Anatolian ground squirrel (*Spermophilus xanthoprymnus*) samples were obtained. (Figure 1).

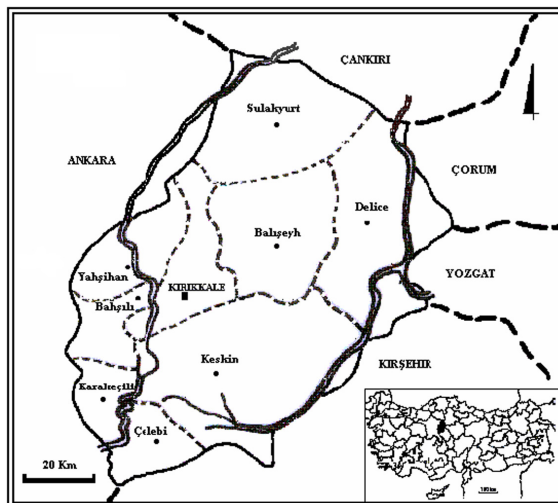


Figure 1. Kırıkkale city map, the place of study.

Taking habitat characteristics into consideration, animals are taken from inside the croplands and their borders as well as rural habitat areas. The nest entrance of *S. xanthoprymnus* were located and general characteristics of their habitat were recorded. The animals were caught via netting and wearing gloves were put into cages. Their weights and four standart measures (length of body, tail, hint foot and ear lengths) were recorded before they were embalmed in laboratory via standart museum procedures. In order to examine the diet preferences and behaviours of three animals (1 ♂, 2 ♀♀) a glass cage of 28x30x70 was used. 11 of the samples were prepared as posts and skulls, one of them was embalmed only as post, 17 of them were embalmed as only skulls and one sample was prepared as an example body in a research sample manner (Mursaloğlu, 1965). The samples are reserved in University of Kırıkkale, Faculty of Science and Art, Department of Biology.

Basing on degree of tooth wear, fur color, clarence of sagittal and lamdoidal crests and the field notes into consideration, the samples were seperated to two as young and adult. 16 character measures concerning the skull were taken from each of the samples (Figure 2). Only the measurements

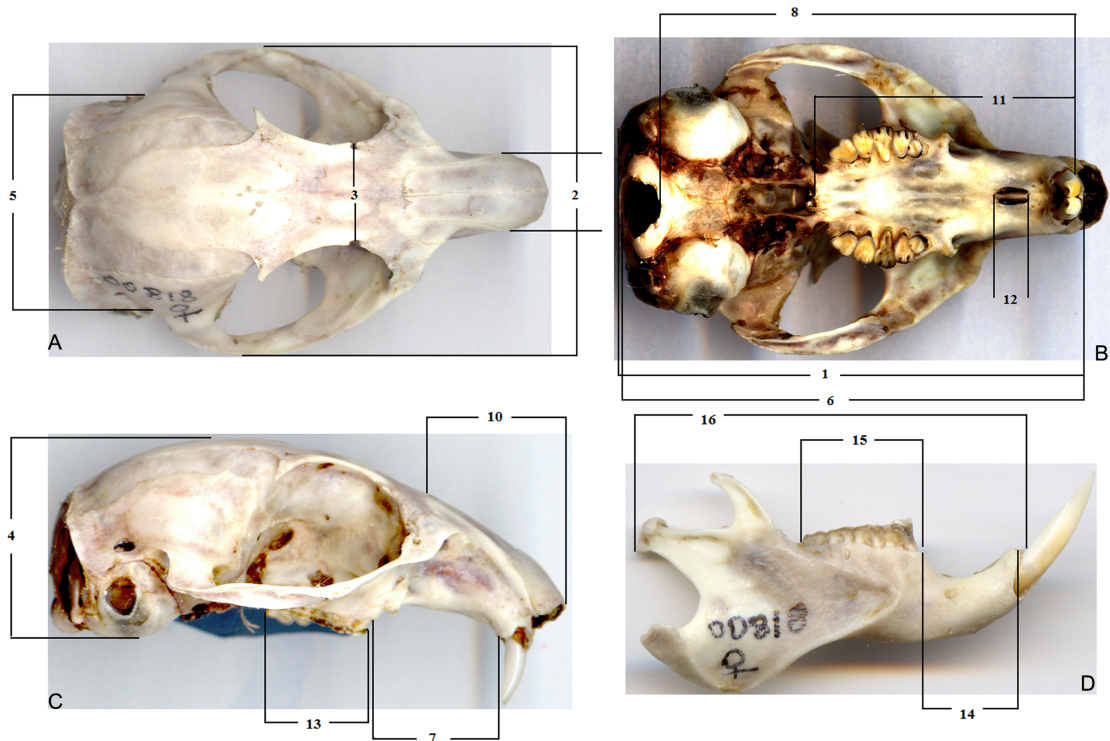


Figure 2. The areas where the character measurements were taken from *Spermophilus xanthoprimum*; top (A), bottom (B), lateral (C) view of skull; view of lower jaw (D).

of the adults were taken into consideration during the analysis.

Among gender and age groups of *Spermophilus xanthoprimum*, difference variance analysis related to gender was realized via T test. The diagnostic, biological and caryological properties of the species were recorded. The areas where samples had been taken were mentioned with the sample numbers.

Habitat, vegetation and nest entrances were examined as the ecological features of *Spermophilus xanthoprimum*, and fur color, diet behaviour, hair morphology, features of baculum as the structure of tooth were examined. Fur color was examined with reference to Ridgway (1886), hair morphology was examined with reference to Hayat (1972) and Benedict (1957), baculum was examined with reference to Lidicker (1968), karyologic analysis was examined with reference to Ford et al. (1956) and Patton (1967). 10 metaphase plaques out of the 20 slides were analysed, and the number of branches of diploid (2n), basic (NF) and autosomal chromosomes (NFa) were recorded.

Tick samples collected as ectoparasite from the animals were diagnosed to a specialist. Apple, sunflower seed, wheat, carrot, lettuce, potato and eater were fed to the animals in the laboratory. The samples in the cage were analysed with regard to diet habits and general behavioral features.

FINDINGS

Ground squirrel is defined as *Spermophilus xanthoprimum*.

Spermophilus xanthoprimum Bennett, 1835
1835. *Spermophilus xanthoprimum* Bennett, Observations on Several Mammalia from Trebizond and Erzurum. Proceed. Zool. Soc. of London, 89-90.

Area of sort: Erzurum, Turkey

Characteristic Features: Adults have a condylobasal length of 40.03-44.19 mm, a nasal width of 6.96-8.25 mm and mandible toothrow length of 9.24-10.31 mm. In an adult sample, the length of baculum is 3.5 mm, proximal length of baculum from lateral is 0.9 mm and distal is 0.9 mm.

Habitat Features: It was determined that *Spermophilus xanthoprimum* lives in farm fields and sides of roads where annual plants are present and on areas where the soil is loose. The nests of Anatolian ground squirrel are generally encountered on flat areas which are close to water resources and in which annual are present. Nests a simple system decline vertically from the ground and continues horizontally as a simple system. The diameter of the entrance of a nest that was examined measured 10-12 cm.

Biological Features: Dorsal color is pale yellowish grey, ventral color is pale yellowish, greyish dirty white in adults. Dorsal color is yellowish grey inclining to slight red in youngsters. It was determined that Anatolian ground squirrel checks its surroundings only by taking its head out and when it is disturbed, it retracts to its nest and makes a treble "tweet" sound. Animals which get out of their nests stand on their two feet and check the area, and when there is a trouble they enter a casual nest. Anatolian ground squirrels were seen eating the spicas and stalks of some wild herbs and plants like wheat and barley.

It was found out that the animals in the laboratory ate apples, potatoes, sunflower seeds and grass in the petri plates; however, there is no record of them drinking water. Hair morphology of the samples taken between the two shoulder bones is examined under an electron microscope, and base, shaft and tip parts were determined to be "crenate" (Figure 3).

In this species, the proximal part of baculum is like a pommel; after a thin stem, it attracts the attention with regard to distal part which has a jagged and fragmental surface. While the tip of the proximal part is concave, the sharp end of the distal part has two peaks.

When the baculum of an adult sample is viewed from dorsal, it is seen that the body part gradually widens to the distal end. Proximal tip is more flat. The tip of the fan like part on the distal part of baculum is more sharp. Baculum length is 3.5 mm, proximal width of baculum from lateral view is 0.9 mm, the distal width is 1.1 mm and base width is 0.5 mm (Figure 4).

Although the baculum morphology of a young male looks like to the adult's, it has a more jagged structure. Baculum length is 3.2 mm, proximal width of baculum from lateral view is 0.9 mm, the distal width is 1.1 mm ve base width is 0.5 mm (Figure 5).

Skull Features: From the lateral view, the skull interorbital area alignment is flat from the end of nasals to lambdoidal back is amazingly convex. The skull is concave starting from premaxill and ending at basioccipital. Occipital condyl is distinct. When the skull is viewed from dorsal point of view, the brain capsule seems ellipsoid and the paraoccipital bones at the back of the skull form two protrusions from the sides. The eyebrow which is formed with the eye sockets and frontal bones are long, thin and distinct. Zygomatic bones starts in front of lacrimal bones with a backwards curve and continues to the border of lambda. Nasal bones end wider after frontal bones. Palatine reaches to pterygoid protrusion as slightly concave.

Coronoid protrusion at the lower jaw resembles the back fin of a shark; condyloid protrusion makes a pommel and the angular protrusion ends with a flat tip.

Teeth formula is I 1/1, Pm 2/1 M 3/3= 22. The frontal surface of the upper incisor other than rostrum is yellowish. Pm¹ has single root, Pm² has multiple roots and M¹, M² and M³ have triple roots. The lower incisor is like a bow and longer than the upper one; Pm₁ has two roots, and M₁, M₂, M₃ and M₃ have four roots.

Karyologic Features: The number of diploid chromosomes of *Spermophilus xanthoprimum* is 2n=42, basic number of chromosomes is NF=81, the number of branches of autosomal chromosomes is NFa=78. Two pairs of autosomal chromosomes are metacentric, seven pairs are submetacentric, 10 pairs are subtelo-centric, one pair is acrocentric, X chromosome is middle-sized metacentric and Y chromosome is point like acrocentric (Figure 6).

As ectoparasite, adult female ticks *Hyalomma* sp. species belonging to *Ixodidae* family and *Argas* sp. species belonging to *Argasidae* family were found on these animals. (Figure 7).

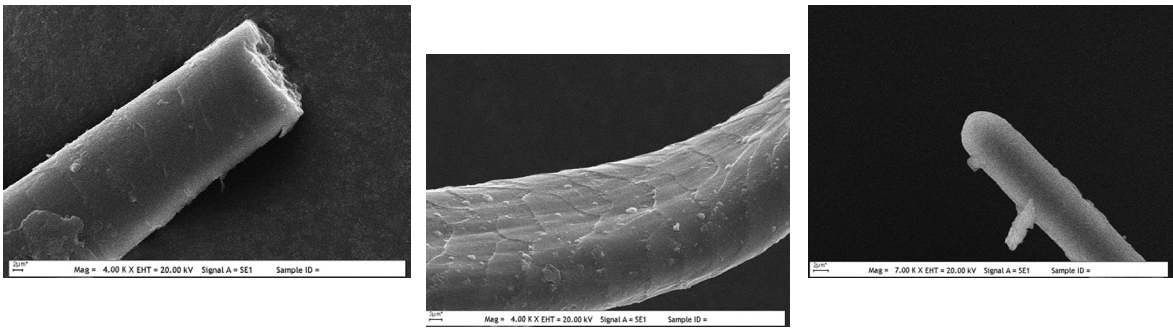


Figure 3. Base (A), shaft (B) tip (C).

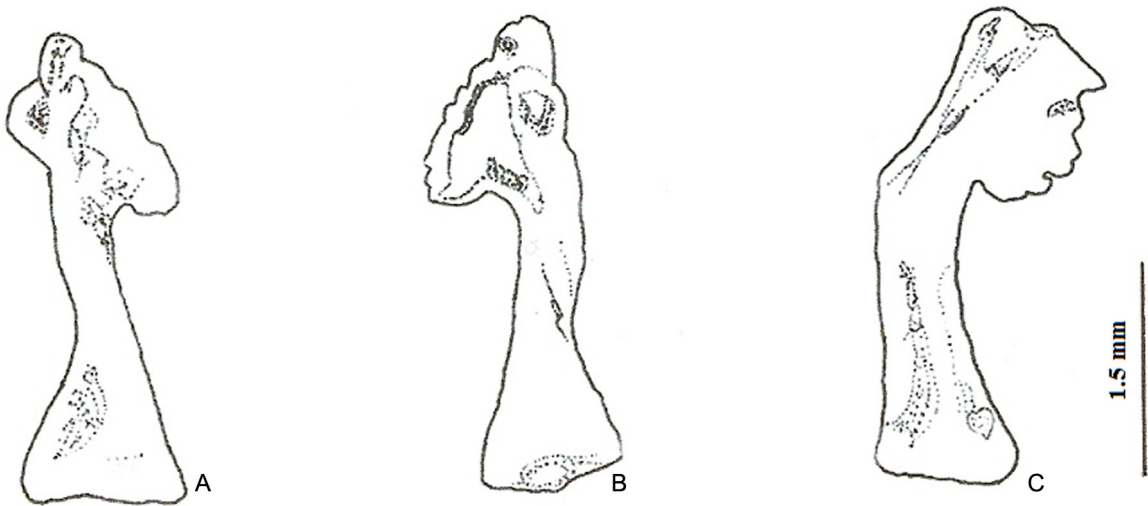


Figure 4. Dorsal (A), ventral (B) and lateral (C) view of baculum of an adult *Spermophilus xanthopyrnus*.

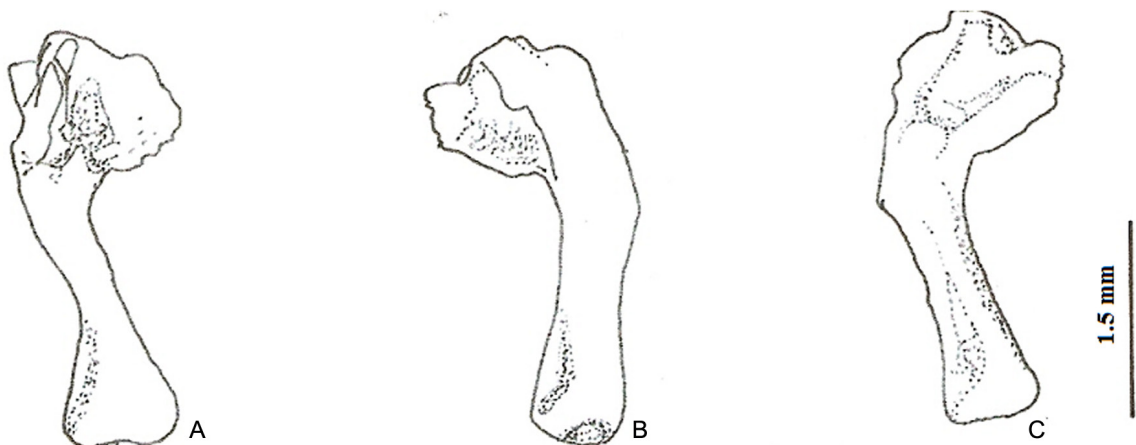


Figure 5. Dorsal (A), Ventral (B) and lateral (C) view of baculum of a young *Spermophilus xanthopyrnus*.

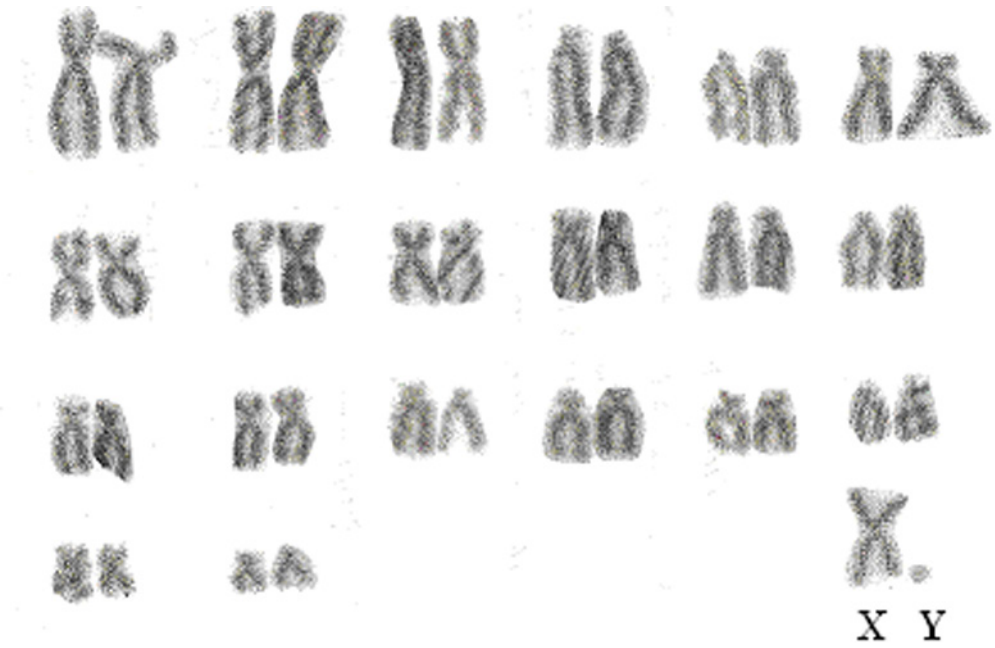


Figure 6. Karyotype of *Spermophilus xanthoprimum*.

RESULTS and DISCUSSION

Kaya and Şimşek (1986) stated the importance of baculum with regard to the separation of subspecies of *Spermophilus xanthoprimum* in Turkey; they suggest that *S. c. thracicus* in Thrace, *S. c. gelengius* in Central Anatolia and *S. c. xanthoprimum* in Erzurum can be differentiated with regard to baculum.

When the samples are compared to the literature data with regard to the shape and size of baculum, it was determined that *S. c. gelengius* is consistent with the data, but different than *S. xanthoprimum* and *S. c. thracicus*.

The first cardiological research on Anatolian ground squirrel were realized by Orlov et al. (1969) with the Armenian samples. The chromosome

number of *S. citellus* of the population in Thrace and Anatolia were determined as $2n=40$ and the chromosome number of *S. xanthoprimum* was determined as $2n=42$, $NFa=66$ and $FN=70$ by Voronkov et al. (1969). While Doğramacı et al. (1994) determined that the chromosome numbers of the samples from Bayburt, Çorum, Erzurum, Malatya and Sivas are $2n=42$, $NFa=64$ and $NF=67$, Özkurt et al. (2002) determined that they are $2n=42$, $NFa=78$ ve $FN=81$ in the samples from Ankara, Niğde and Erzurum. Özkurt et al. (2007) recorded the samples taken from Ankara, Niğde and Erzurum as a new species *Spermophilus torosensis*.

Arslan (2005) examined *S. xanthoprimum* caryologically and recorded as $2n=42$, $NF=81$ and $NFa=78$. Our karyologic findings are consistent with the findings of Arslan (2005).

In this study, a statistically important difference was determined with $P=0.05$ between male and females with regard to nasal width and upper jaw teeth row lengths (Parker, 1979).

Morphometric measurements of our samples were compared with the data from samples by Mursaloğlu (1964) from Kırklareli, Erzurum and Kars (Welch's T test). According to this, a statistically important difference was determined between

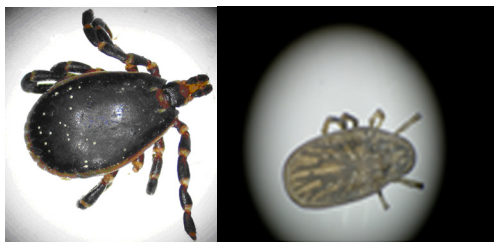


Figure 7. Hyalomma sp. (left) ve Argas sp. (right) specimens.

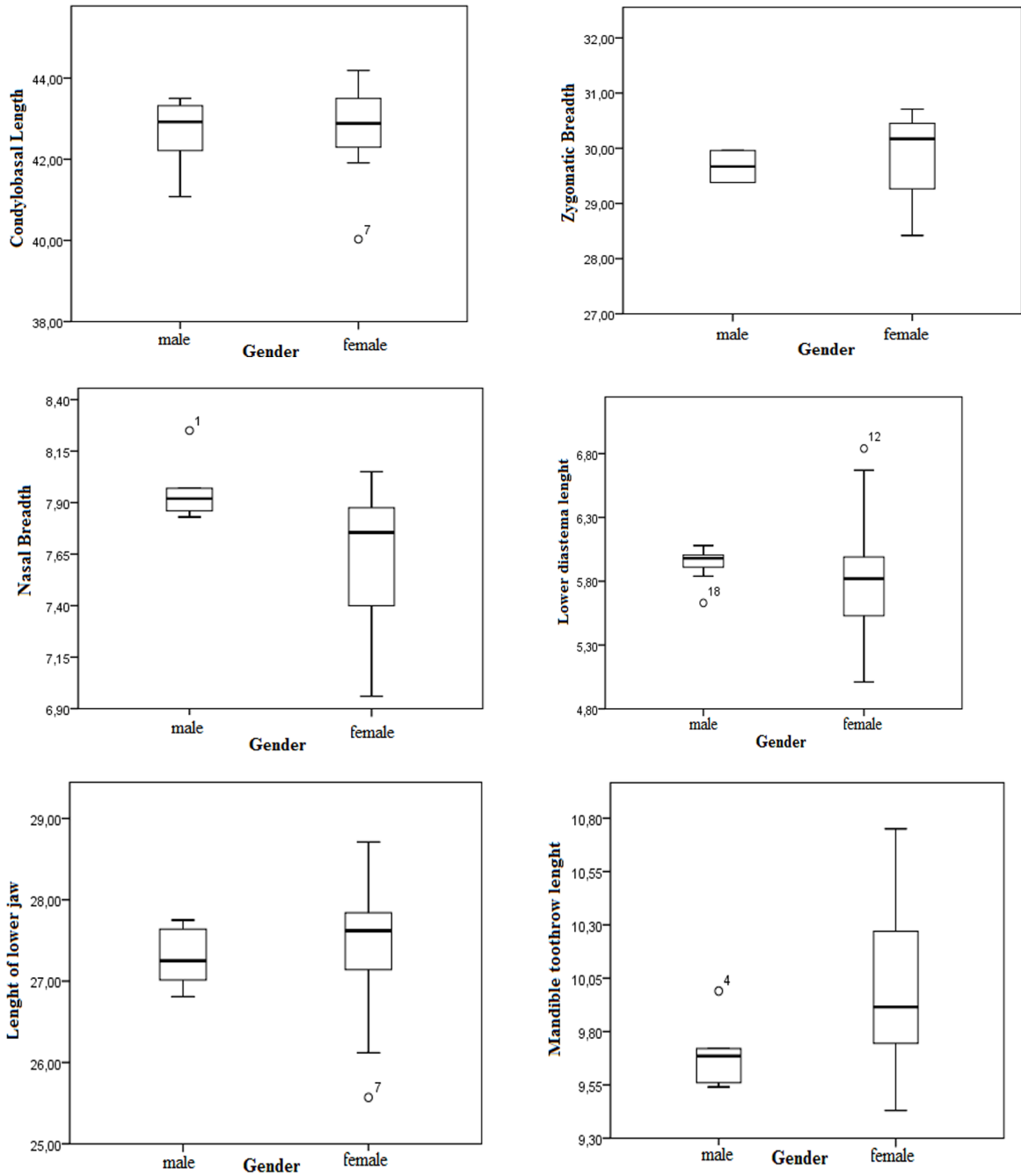


Figure 8. Some measurements of adult *S. xanthoprimum* with box plot.

Scheme 1. Measures (mm) of outer and inner characteristics of young and adult *Spermophilus xanthopyrmus*; sample number (N), top and bottom limits of variance (S), average (M), standard deviation (\pm SS).

Characters	Young						Adult					
	♀			♂			♀			♂		
	N	S	M	±SS	N	S	M	±SS	N	S	M	±SS
Length of body	3	217-240	231	12.1	7	235-274	253.2	13.8	12	210-270	242.3	20.4
Tail length	3	55-60	57	2.6	7	37-66	46.3	11.1	12	38-70	51.3	11.1
Hind foot length	3	34-41	38	3.8	7	34-44	39.9	3.6	12	35-46	39.7	3.3
Ear length	3	7-11	8.7	8.7	7	5-10	8	1.7	12	6-8	7.2	0.8
Condylbasal length	3	38.3-39.6	39	39	7	41.08-43.50	42.63	0.87	16	40.03-44.19	42.82	0.98
Zygomatic width	1	26.8	-	-	2	29.38-29.96	29.67	0.41	11	28.42-30.71	29.68	0.79
Interorbital width	3	8.2-9.4	8.9	8.9	-	-	-	-	-	-	-	-
Skull height	2	18.3-19.0	18.7	18.7	6	19.42-20.58	20.07	0.45	13	18.70-21.27	19.86	0.71
Brain capsule width	2	18.9-20.1	19.5	19.5	7	19.10-21.27	20.32	0.69	16	19.32-21.43	20.32	0.74
Occipital length	2	39.8-40.9	40.4	40.4	5	44.44-46.46	45.82	0.81	16	42.56-47.37	45.60	1.14
Upper diastema length	4	9.9-10.7	10.3	10.3	7	9.77-11.07	10.55	0.49	16	9.58-11.48	10.61	0.51
Basillar length	3	33.8-35.4	34.8	34.8	7	36.15-37.82	36.75	0.66	17	34.76-38.89	37.14	1.03
Nasal length	3	13.7-15.7	14.8	14.8	5	15.89-16.93	16.32	0.42	15	14.86-16.78	16.20	0.57
Nasal width	4	6.8-7.0	6.9	6.9	5	7.92-8.25	7.96	0.16	16	6.96-8.05	7.63	0.32
Palatal length	2	21.8-22.4	22.1	22.1	3	22.92-23.37	23.08	0.24	7	22.34-23.76	23.0	0.52
Palatal foramina length	4	2.1-2.6	2.3	2.3	7	2.01-3.11	2.58	0.42	17	2.05-3.3	2.68	0.36
Upper jaw tooththrow lengths	4	9.2-9.9	9.6	9.6	6	9.54-9.99	9.69	0.16	16	9.43-10.75	10.0	0.39
Lower diastema length	4	5.5-6.8	6.2	6.2	7	5.63-6.08	5.93	0.15	14	5.01-6.84	5.8	0.53
Mandible tooththrow length	4	8.9-9.5	9.2	9.2	7	9.42-10.31	9.87	0.32	14	9.24-10.14	9.82	0.26
Lower jaw length	4	26.7-28.1	27.7	27.7	7	26.81-27.75	27.30	0.38	17	25.57-28.71	27.48	0.82

Scheme 2. Sample Number (N), Median (M), Standart deviation (\pm S), T value (T), degree of free (D.F) and P value of some morphometric measurements of four adult species in Turkey.

Characters	<i>S. xanthopyrymus</i> Kırıkkale					<i>C.c.tharicus</i> Kırklareli					<i>C.c.xanthopyrymus</i> Erzurum					<i>C.c.xanthopyrymus</i> Kars									
	N	M	\pm S	T	D.F	P value	N	M	\pm S	T	D.F	P value	N	M	\pm S	T	D.F	P value	N	M	\pm S	T	D.F	P value	
♂																									
Condylobasal length	7	42.63	0.87	0.41	12	28.4	42.8	0.9	0.758814	13	0.461501	13	45	45.3	0.73	-6.137325	11	0.000110	4	45.3	1.24	-3.804482	5	0.019030	
Zygomatic width	2	29.67	0.41	0.56	12	28.4	28.4	0.56	3.826007	2	0.162752	2	31.2	31	0.83	-4.132988	3	0.0531857	4	31	1.04	-2.23395	4	0.111586	
Nasal width	5	7.96	0.16	0.16	12	14.6	14.6	0.68	-31.780401	13	0.000000	13	7.4	7.3	0.25	5.620357	12	0.000156	4	7.3	0.32	3.765593	4	0.019679	
Lower diastema length	7	5.93	0.15	0.34	12	6.2	6.2	0.34	-2.382059	16	0.029969	16	7.2	6.3	0.4	-10.193661	17	0.000000	4	6.3	0.62	-11.74075	3	0.325085	
Mandible toothrow length	7	27.3	0.38	0.66	12	32.5	32.5	0.66	-21.794063	17	0.000000	17	36.5	36	1.0	-29.465780	17	0.000000	4	36	1.64	-10.450659	3	0.001870	

Scheme 2. Sample Number (N), Median (M), Standart deviation (\pm S), T value (T), degree of free (D.F) and P value of some morphometric measurements of four adult species in Turkey.

Characters	<i>S.xanthopyrymus</i> Kırıkkale					<i>C.c.tharicus</i> Kırklareli					<i>C.c.xanthopyrymus</i> Erzurum					<i>C.c.xanthopyrymus</i> Kars									
	N	M	\pm S	T	D.F	P value	N	M	\pm S	T	D.F	P value	N	M	\pm S	T	D.F	P value	N	M	\pm S	T	D.F	P value	
♀																									
Condylobasal length	16	42.82	0.98	1.21	14	41.7	41.7	1.21	2.760568	25	0.010648	25	42.80	41.8	0.92	0.061128	31	0.91662	7	41.8	0.99	2.280565	11	0.043493	
Zygomatic width	11	29.68	0.79	0.76	14	27.9	27.9	0.76	5.686190	21	0.000012	21	29.40	28.40	0.84	0.893324	22	0.381352	6	28.40	1.20	2.349766	7	0.051105	
Nasal width	16	7.63	0.32	1.03	14	14.1	14.1	1.03	-22.569658	15	0.000000	15	6.9	6.70	0.33	6.542416	32	0.000000	8	6.70	0.40	5.723754	12	0.000133	
Lower diastema length	14	5.8	0.53	0.45	18	5.7	5.7	0.45	0.565104	26	0.577039	26	6.60	6	0.32	-4.985108	20	0.000071	8	6	0.49	-0.893741	16	0.385576	
Mandible toothrow length	17	27.48	0.82	0.81	14	31.9	31.9	0.81	-15.035646	28	0.000000	28	34.50	33.50	0.79	-25.766862	33	0.000000	7	33.50	0.74	-17.541145	12	0.000000	

male samples of Kırıkkale and *C.c. tharicus* from Kırıkkale with regard to lower diastema length. Also a statistically important difference was determined between male samples of *C.c. xanthoprymnus* from Kırıkkale and Erzurum with regard to condylobasal length and nasal width. Data of our samples were compared with the data of *C.c. xanthoprymnus* from Kars, and a statistically important difference was determined with regard to condylobasal length, nasal width and lower jaw length. The female samples from Kırıkkale were compared with the female samples from *C.c.tharicus* and a statistically important difference was determined with regard to condylobasal length and zygomatic width. Statistically important differences were determined with regard to the lower diastema length of the female samples of *C.c.xanthoprymnus*, and with regard to the condylobasal length and nasal width of the female *C.c.xanthoprymnus* samples.

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