The Taxonomy and Ecology of *Meles Meles* (L., 1758) in Western Turkey*

Batı Türkiye'deki *Meles Meles* (L., 1758)'in Ekolojisi ve Taksonomisi

Research Article

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ABSTRACT

In this study 21 specimens were collected from various localities to investigate the ecology and taxonomy of *Meles meles* in Western Turkey. Apart from these 28 badger specimens obtained from various collections were also used in the study. It has been recorded that the badgers live mainly in agricultural areas as well as bushy and forest areas and woodlands. They were found to feed on both animal and herbal food. The age groups of the specimens were determined. The morphological features and meauserements of the baculum were given. The taxonomic data of the adult specimens were compared with the badger specimens recorded from the palaearctic region and it was found that the collected specimens represented in nominative form.

Key Words
Badger, *Meles meles*, Ecology, Taxonomy, Western Turkey

ÖZET

Bu çalışmada Batı Türkiye'deki *Meles meles*'in ekolojisini ve taksonomisini araştırmak için çeşitli bölgelerden 21 örnek toplanmıştır. Bunun dışında çeşitli koleksiyonlardan sağlanan 28 porsuğun verileri de bu araştırmada kullanılmıştır. Porsukların tarım alanları başta olmak üzere çalılık, ağaçlık ve ormanlık alanlarda yaşadığı kaydedilmiştir. Bitkisel ve hayvansal besinlerle beslendikleri tespit edilmiştir. Örneklerin yaş grubu belirlenmiştir. Bakulumun morfolojik özellikleri ve ölçüleri verilmiştir. Ergin örneklerin taksonomik verileri Palearktik bölgeden kaydedilen porsuk örnekleri ile karşılaştırılmış ve örneklerimizin nominatif formu temsil ettiği tespit edilmiştir.

Anahtar Kelimeler
Porsuk, *Meles meles*, Ekoloji, Taksonomi, Batı Türkiye

Article History: Received: May 5, 2014; Revised: Aug 20, 2014; Accepted: Oct 10, 2014; Available Online: Dec 27, 2014.

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*This study is a part of Nahit PAMUKOGLU of Ph. D. Thesis and it was supported by Scientific Research Funds (BAP) of Ankara University, Project No: 97–25-00-05.

INTRODUCTION

There are many records belonging to distribution and ecological features of *Meles meles* in Turkey [1-21].

Ellerman and Morrison-Scott gave the species described as *Meles canescens* by Blanford in Iran (Abadeh) as *Meles meles canescens* and the species defined as *Meles arcalus* by Miller in Crete *Meles meles arcalus* [4,22,23]. They also accepted *Meles meles minor* described by Satunin in Caucasia (Astrakhan), *Meles meles rhodius* described by Festa in Rhodos and *Meles meles ponticus* described by Blackler in Trabzon Blacksea region of Turkey and *Meles meles caucasicus* described by Ognev in Caucasia (near Ordzhonikidze) as valid subspecies[2,3,24,25].

Zimmermann described the subspecies as *Meles meles arcalus* as badgers of Rhodos and Crete Islands in Aegean which were formerly defined as *M. m. mediterraneus* by Bate in Crete and as *Meles arcalus* by Miller [5,26,27]. He noted that both these subspecies are more similar to small forms of Anatolia and Caucasia than those live in Central Europa.

Corbet acknowledged *Meles meles aberransi* described by Stronagov in Kazakhstan (Bogembai-Akmolinkaya) as the valid subspecies and made the others the synonym of the nominative species [28,29].

According to Wilson and Reeder, *Meles* genus is represented three species, *Meles meles, Meles leucurus* and *Meles anakuma* in the world [30].

There is not a detailed study on the taxonomy and ecology of badgers which live in a wide area in Western Turkey. Aim of this study is to suffice the lack of research regarding this subject.

MATERIAL and METHODS

There were 21 badger specimens collected in the field work carried out in the region located at the west of the line between Samsun and İskenderun. Also there were 49 badger specimens recorded from various collections including 23 specimens from İstanbul University, Zoology collection, 5 specimens from İstanbul University, Forestry Faculty collection.

The specimens were either caught alive with special traps or the ones killed by the hunters or traffic accident.

The specimens were skinned, stuffed and prepared as conventional museum type after the measuring the weight and taking four standard external measurements. Baculum specimens were prepared according to Lidicker [31]. Baculum is used as a criterion for age groups in Eurasian badger (*Meles meles* L.) [32-35]. In most of these studies the adult individuals were distinguished from the young.

The specimens were grouped in the age groups as young, subadult and adult according to the degree of teeth wear, whether the sagital and lambdoidal crest in the skull were apparent, the ratio between interorbital and postorbital breadth in the laboratory and embryo and milk gland activity and baculum structure [3,17,23,33,36]. There was no statistically significant difference between the adult and subadult ones. That was why the values are tabulated in the same table. The data obtained in the study were evaluated by the comparison with those in literature.

The analysis of the feces collected was carried out according to Kruuk and Parish [37]. The plant and animal pieces in the feces and the parasites such as fly, tick and flea were studied by the experts. The habitat conditions, setting types and footprints were recorded in the natural environment and the feeding behavior of the badger were observed in the laboratory. The specimens are deposited in the mammalian collection of the Biology Department of Science Faculty of Ankara University and Kırıkkale University.

RESULTS

This study was carried out with 21 badger specimens collected from western part of Turkey and 28 specimens were obtained from various collections.

Meles meles (Linnaeus 1758)

1758. *Ursus meles* Linnaeus, Systema naturae, 10th ed., 1:48

Type locality: Upsala, Sweden

1894. *Meles meles*, Die Heimat IV. p. 125

Diagnostic Characters: The hind foot length is 85-110 mm, the greatest skull length is 113.8-133.3 mm; condylobasal length is 108.3-127.7 mm; zygomatic breadth is 68.6-82.2 mm; interorbital breadth is 25.5-29.5 mm; maxillary tooth row length (excluding the incisors) is 36.4-44.4 mm; mandibular length is 76.7-88.8 mm; mandibular tooth row length (excluding the incisors) is 46.1-56.1 mm. Weigth is 5000-8700 g. The baculum weight and length of an adult individual were measured as 1.48 g and 72.18 mm; and the baculum weight and length of a young individual were measured as 0.80 g and 62.04 mm. The front tip of the baculum is fork likes, bended upwards and the edges of the fork were formed by blunt tuberculums. The hole located between the tuberculums in the young individuals were observed to closed in the adult ones. The shapless, thick and swollen mass located at the caudal edge was found to be four or five times bigger in adult badgers compared with young ones and there were three edges and three faces on the body of the baculum. Also in the baculum there was a very shallow groove on the ventral face (Figure 1).

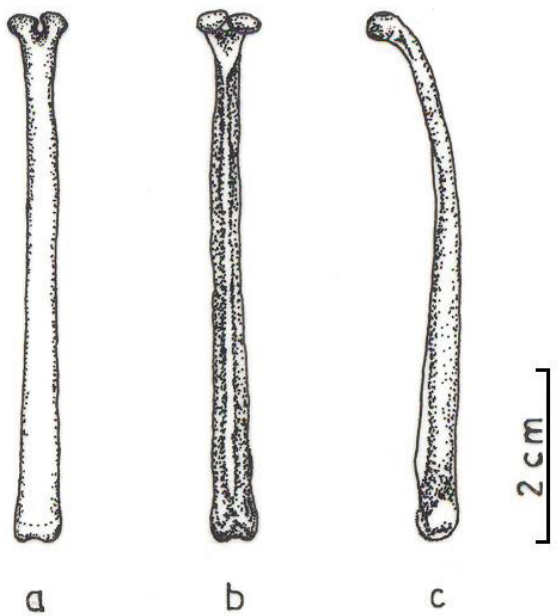

Figure 1. The dorsal (a), ventral (b) and lateral (c) views of the baculum belonging to a young badger (10 ♂♂).

Pelage colour: The colour of the dorsal and lateral parts of the adult individuals is blackish brown. The colour which is darker at the sides gets relatively lighter going to dorsal and becomes dark yellowish brown. The ventral side is in blackish dark brown. The summer fur is yellowish brown at the dorsal side and black in the ventral side while the winter fur is dark gray at the dorsal and black brown at the ventral side. The protective hairs in the winter fur are much denser and longer. In sub adult individuals the colour of the dorsal and lateral sides is dark brown and the ventral side is blackish brown. The hairs of the young are shorter and the colour changes from light gray to dark gray tones. The ventral colour is grayish brown.

Habitat: The badger was observed to live in agricultural lands and the regions near to agricultural area, rocky places, in forest formed by beech and oak. The analysis of the feces and stomach content revealed that the badger feeds on fruits such as apple (*Malus sylvestris*), pear (*Pyrus communis*), fig (*Ficus carica*), melon (*Cucumis melo*), water melon (*Citrullus lanatus*), cherry (*Cerasus avium*) and plump (*Prunus persica*). They were also observed to eat various agricultural products such as grape (*Vitis vinifera*), sugar beet (*Beta vulgaris*), lettuce (*Brassica oleracea*), cucumber (*Cucumis sativus*), pumpkin (*Cucurbita pepo*), chick pea (*Cicer anatolica*), wheat (*Triticum sativum*), barley (*Hordeum sp.*), lentil (*Lens culinaris*), horse bean (*Vicia faba*), bean (*Phaseolus vulgaris*), corn (*Zea mays*), peanut (*Arachis hypogaea*), sun flower (*Helianthus annuus*) and potato (*Solanum tuberosum*) and the roots of some plants . It was found that the badgers particulary prefer the fruits of wild berries (*Rubus idaeus*), desert rose (*Rosa canina*), barberry (*Berberis crataegina*) and oak (*Quercus coccifera*).

The badgers particularly like to eat the members of the family Carabidae, Curculionidae, Tenebrionidae, Silphidae of Coleoptera and Vespidae of Hymenotera and earthworms. They were found to eat the larvae of the wild bees and

their combs and various insects living in the feces of animals. They particularly prefer *Melolontha melolontha* belonging to Scarabaeidae and some rodents belonging to the genus *Apodemus* and *Microtus*. In addition, the feces analysis revealed that some badgers also eat soil.

The study showed that the badgers make their under the oak, beech, red pine and black pine trees and in the bush near the fields and at the edges or inside the fields in summer months. It was observed that *Meles meles,* do not prefer the steppe or open areas but rough parts of the plateaus at 1000-2000 m. In some parts there were badger setts in rocky parts and bushy regions covered with cherry, apple trees and black berries, wild rose and prickled bushes. In some region there are badger setts in rocky parts as well. Especially in Mediterranean Region there were their footprints and sett at an attitude of 2000 m.

The study revealed that *Meles meles* start to become active and leave their setts starting from March in Mediterranean, Aegean, Central Anatolia, Thrace and Western Black Sea regions. It was observed that they start their activity as early as February in some regions. There were many feces seen in front and around the setts in summer months in some regions. There were old feces buried into ground in some regions. Badgers were observed to remain in their setts in winter months and leave the sett when the temperature reaches above 10 °C.

The study showed that in some regions the badgers started to breeding behaviour at the end of May and start of June when the weather warms up. It was observed that the pubs who reached to a certain maturity played with each other near the sett. There were both the feces and footprints of the badgers in day time in summers. They were observed to rest inside the fields to protect themselves from the sun where there is rich plant formation. The badgers were observed to stay in the setts and do not come out very often in fall start from October and never leave the sett from the end of December to February in some regions.

The study showed that in some of the agricultural regions of Western Anatolia the natural habitat of the badgers was largely destroyed due to excessive distruction of forests over usage of fertilizers and pesticides. It was observed that the natural habitat of badgers in Aegean, Central Anatolia, West Black Sea and especially Thrace and Mediterranean Regions were heavily destroyed and many of them were killed due to uncontrolled hunting.

There were badger sett and their footprints at elevations up to 2000 m in especially in Antalya and Mersin, Adana and Karaman Provinces.

In western Anatolia the badgers were found to stay in their setts during day time and start their activity during the night. They usually walk around the fields, forests, bushy and rocky places. The badgers were observed to leave their setts and go to wine yards and fields when the corns and grapes start to mature. They were also observed to feed on members of the order Coleoptera, wild bees and their larvae, various plants as well as worms and some rodents. They are not as harmful as pigs to fields and orchards since they only eat enough to feed.

Measurements: The internal and external measurements of the specimens are tabulated below (Table 1).

Structure of the sett: The study revealed that the badgers make their sett in inclined or relatively rough regions or in the cavities of the rocks. Some setts are difficult to see since they are generally located in places covered with bushy. In some regions they also dig their setts at the bottom of oak, beech, red pine or black pine trees. In these regions there were 8-10 setts 5-6 meters apart from each other. Most of the setts were connected to each other and have more than one entrance. The badger was also observed to live in cave like small dens. There were fresh footprints in front of some setts but there are no footprints in others. In the region where the badgers' setts are located there are so many setts belonging to other rodents. The badgers use water barriers as a sett in summer months. They use to rest in 25-30 cm water barrier 5-6 m apart from each other. The setts prepared in summer months have

Table 1. Statistical data on weight, external and cranial measurements of adult *Meles meles* (+): number of individuals (n), range (min-max), mean (m), standard deviation (±SD).

Measurements	n	r	m	±SD
Head and body length	7	730-840	785	36.1
Total length	7	850-1050	942.8	69.2
Tail length	7	110-210	159.2	32.7
Hind foot length	7	85-110	101.1	9.7
Ear length	7	30-60	42.4	9.4
Greatest skull length	19	113.8-133.3	123.2	3.3
Condylobasal length	19	104.0-127.7	115.6	5.3
Condylonasal length	19	97.7-117.4	109.4	5.5
Zygomatic breadth	17	68.6-82.2	74.1	4.0
Mastoid breadth	20	53.5-61.7	56.6	2.6
Interorbital breadth	19	25.0-29.5	26.8	1.3
Postorbital breadth	19	21.1-25.1	23.0	1.2
Braincase breadth	20	43.1-50.2	47.2	2.1
Basilar length	19	96.8-116.4	108.1	6.6
Maxillary toothrow length	21	36.2-44.4	39.2	1.9
Skull heigth	18	45.3-53.7	49.7	2.9
Upper molar alveol length	20	29.0-36.3	31.3	1.6
Mandibular toothrow length	16	44.0-56.1	48.5	2.6
Mandibular premolar breadth	15	11.9-16.4	13.1	1.1
Lower molar alveol length	18	35.6-42.9	38.2	1.9
Mandible height	20	10.3-14.5	12.8	0.8
Mandible length	18	74.6-88.8	80.1	3.9

flat surfaces and are doing much deeper. The setts are made of 3-5 compartments and they are connected to each other with galleries. The compartments are usually covered with grass. There were 18-20 badger setts close to each other in this region.

In september one of the sett were dug to investigate its structure. It was observed that the sett was sloped downwards from the entrance. There was a right turn after two meters and after four meters it reaches to a 1.2 m high compartment filled with dry grass. The compartment was observed to be warmer than outside. After digging 2 more meters there was a second compartment filled with dry grass. There was a left turn afterwards and we reached to third and fourth departments filled with dry grass. There was a separate exit hole 16 meters from the entrance (Figure 2).

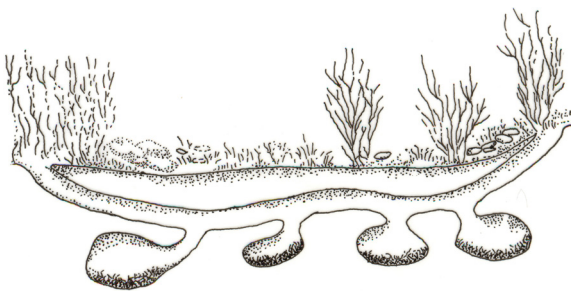

Figure 2. Schematic representation of a badger sett.

Localities and Specimens Examined (49): Balıkesir, Balya, Patlak village, 2; Gönen, 1; Edirne Centrum, 1; Keşan, Suluca village, 1; Karaman, Ermenek, Sarıvadi village, 3; Kılbasan, Körşü region, 3; Sarıveliler, 1; Antalya, Akseki, Çaltılıçukur village, 4; Susuz Şahap village 1; Çukurköy, Çayırlıyer region, 2; Muğla, Yerkesik, Karacaören region, 1; Niğde, Ulukışla, Maden, 3; Isparta, Şarkikaraağaç, Fakılar village, 1; Kastamonu, Araç, 1; Dırvana village, 5; Adapazarı, Sapanca, İstanbuldere, 1; Konya, Ereğli, 1; Adana, Eflak village, 1; Tellidere, 1; Seyhan dam lake, Kurttepe region, 1; Ankara, Kalecik, 1; Kırklareli, Demirköy, 1; Hatay, Altınözü,

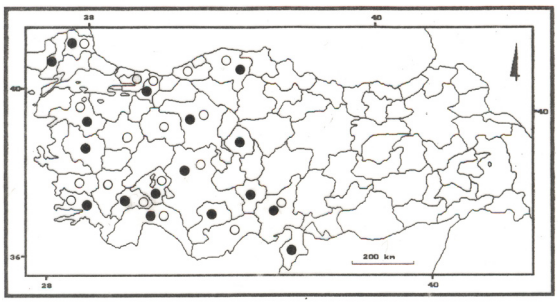

Figure 3. Distributional area of *Meles meles* in western Turkey; the previous records (O) and collection localities where *Meles meles* has been obtained in the study (●).

Kuser village, 1; Manisa, Akhisar, Çoban Hasan village, 1; Burdur, Pırnazpaşalı mountains, 1; Kırşehir, Seyfe lake region, 1; without locality, 8 (Figure 3).

DISCUSSION and CONCLUSION

Although the data obtained in this study showed some differences as regards to habitat and feeding behaviour of Turkish badgers they are generally similar with the studies of some autors [3, 10, 11, 12, 13, 15, 17, 38, 39, 40, 41, 42, 43, 44].

In contrary to Ognev, our field study showed that the badger does not store food in its sett [3]. According to Turan badgers cause harm to fields and orchards as much as pig [12]. However the field studies revealed that the harm caused by badgers to fields and orchards is limited.

Miller distinguished nominative form and *ponticus* and *marianensis* subspecies according to the length to breadth ratio of upper and lower molars [23]. Blackler claimed that although *Meles meles ponticus* is very similar to the nominative form as regards to colour it can be distinguished by its larger size, swollen bullea and the shape and size of the upper molars [2]. The ratio of the length to breadth of upper molars varies among the subspecies (in *M. m. ponticus* 1:1.27; in *M. m. marianensis* 1:1.22; in *M.m. meles* 1:1.18) [2].

Miller included 35 species obtained from different localities (2 from Ireland; 14 from England; 9 from Norway; 6 from Sweden; 1 from France; 2 from Germany; 1 from Italy) to the nominative subspecies and 7 species obtained from Spain to *M. m. marianensis* subspecies [27]. These two subspecies were distinguished from each other by the colour of their furs and average teeth size. He also included the four specimens obtained form Crete to *M. arcalus*. The sides of the ventral region in nominative form is not as whitish as in *marianensis*. In our specimens both these features are present together.

Ognev separated *Meles meles* into 8 subspecies [3]. He gave *M. m. meles* from Sweden, *M. m. marianensis* from Central Spain; *M. m. rhodius* from Rhodes; *M. m. tauricus* from Crimea; *M. m. caucasicus* from Caucasia; *M. m .minor* from Trans Caucasia; *M. m. ponticus* from Trabzon; *M. m. canescens* from Iran as the subspecies. He also investigated 42 specimens from Russia and evaluated them as nominative form. Our specimens have lower values as regards to condylobasal length, zygomatic breadth, interorbital breadth, braincase length, palate length, upper molar toothrow length and lower molar toothrow length. Ognev evaluated 12 species and he obtained from Caucasus as *M. m. caucacicus* [3]. They are observed to have higher values than the data obtained from our specimens. Corbet made *caucacicus* as the synonym of the nominative form [28]. The data obtained from our specimens are within the limits of the nominative form. Lehmann noted that the body size of the badgers gets smaller going from north to south [14]. According to it, it is apparent that our specimens represent the nominative form (Figure 4).

Zimmermann claimed that the mean of skull lengths of *M.m. minor* from Transcaucasia is 118 mm in 11 specimens [5]. The skull lengths of two specimens belonging to Anatolia in Berlin museum is 108 and 110 mm. The skull length of an old specimen obtained from Crete is 109 mm. The measurements of 2 Crete specimens of Miller and 3 Crete specimens of Zimmermann are very close to each other and upper alveol length is 13.5–13.9 mm [23, 5]. However he found this value surprisingly high in two specimens obtained from Rhodes as 15.5 and 14.5 mm. According to Zimmermann the Condylobasal length of an old badger obtained from Kalamata Peloponnes in Greece was 117 mm [5]. The lengths of the upper and lower molar are 17.0 and 16.8 mm. The fact

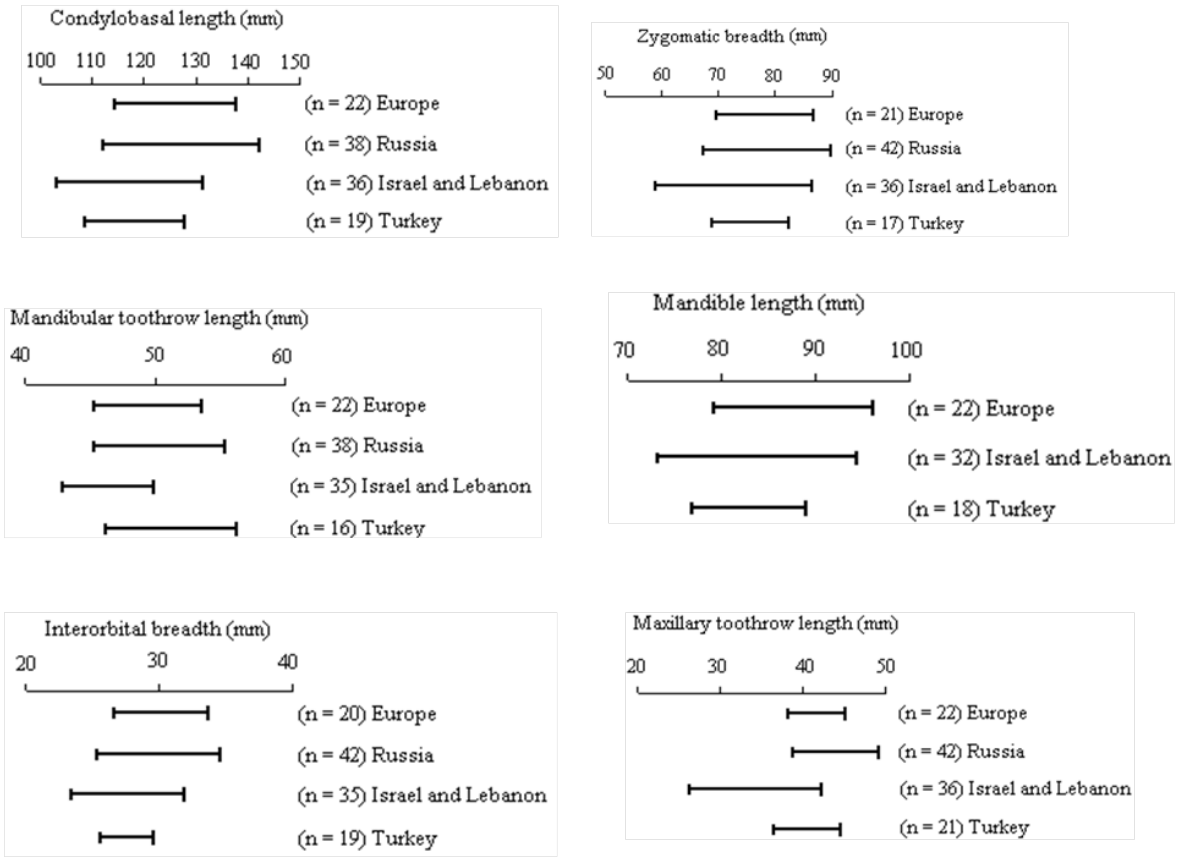

Figure 4. Comparison of some external and cranial measurements of *Meles meles* from Europe, Russia, Israel and Lebanon and Turkey (present study).

that upper molar length is bigger shows that Peloponnes badgers form a specific form. They can be temporarily included into nominative subspecies. The upper part of the Crete badgers is lighter in colour than the ones in Europe. However the Crete and Rhodes badgers may be very dark in colour [14].

Corbet made *marianensis* a synonym to the nominative form [28]. Harrison and Bates claimed that Arabian badgers are separated from the nominative form due to their smaller size, narrow and longer shape of the upper jaw first molars, the ratio of the highest width to diagonal length between 1:1.44 and 1:1.51 and light colours [17]. The researchers evaluated the specimens they obtained from Israel and Lebanon as *M.m. canescens*. Comparing those data with ours, our data remain within the values of the Israel and Lebanon badgers as regards to biggest skull length, condylobasal length, zygomatic breadth, braincase breadth, interorbital breadth and maxillary toothrow length. However our specimens have bigger values regarding the length of lower and upper jaw teeth rows and lower jaw length. It seems to be our specimens do not represent the *M.m. canescens*. The data obtained from our specimens are in good compliance with the ones recorded for the nominative form (Figure 4).

ACKNOWLEDGEMENT

This study is a part of Nahit PAMUKOĞLU of Ph. D. Thesis and it was supported by Scientific Research Funds (BAP) of Ankara University, Project No: 97-25-00-05.

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