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## Contribution to the Taxonomical and Biological Characteristics of *Sciurus anomalus* in Turkey (Mammalia: Rodentia)

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**Abstract:** This study is based on 62 *Sciurus anomalus* specimens obtained from Konya, Karaman, Kütahya and Çorum provinces between 1997 and 2002. Some ecological and biological features of the species, including habitat, nest-sites, fur colour, baculum and phallus were investigated. In this species, the chromosome number (2n) is 40. For the taxonomical evaluation of *Sciurus anomalus*, morphometric data of the specimens were used. The specimens were discussed at the subspecies level, comparing to the relevant literature, and it was concluded that our specimens represent the nominate form.

**Key Words:** *Sciurus anomalus*, taxonomy, biology, Turkey

### Türkiye'deki *Sciurus anomalus*'un Taksonomik ve Biyolojik Özelliklerine Katkılar (Mammalia: Rodentia)

**Özet:** Bu araştırma 1997 ve 2002 yılları arasında Konya, Karaman, Kütahya ve Çorum'dan toplanan 62 *Sciurus anomalus* örneğine dayanmaktadır. Türün bazı ekolojik ve biyolojik özellikleri ile ilgili olarak habitat, yuva yeri, kürk rengi, baculum ve phallus'u incelendi. Bu türde kromozom sayısı (2n) 40 olarak bulundu. *Sciurus anomalus*'un taksonomik değerlendirmesi için örneklerin morfometrik verileri kullanıldı. Örnekler, ilgili literatürle karşılaştırılarak alttür seviyesinde tartışıldı ve örneklerimizin nominatif alttürü temsil ettiği sonucuna varıldı.

**Anahtar Sözcükler:** *Sciurus anomalus*, taksonomi, biyoloji, Türkiye

### Introduction

Squirrels are often considered harmful because they eat or collect some fruits and seeds in residential areas. They may even gnaw and remove the bark of some trees such as the pine, spruce, fir and beech in rural areas. The damage they cause to seeds and seedlings might be sometimes remarkably high in agricultural areas. However, squirrels also play an important role in plant distribution (Alkan, 1965). In Turkey, 2 tree squirrel species of the genus *Sciurus* occur: the Persian squirrel (*Sciurus anomalus* Gldenstaedt, 1785) and the Eurasian red squirrel (*Sciurus vulgaris* Linnaeus, 1758).

Misonne (1857) reported *S. anomalus* in Urfa province, and Ellermann (1948) recorded *S. a. anomalus* from İzmir, Çanakkale, Mersin and Trabzon provinces.

Brink (1956) included Turkish Thrace in the distribution area of *S. vulgaris*, while Bobrinski et al. (1965) gave a record of *S. vulgaris* from Northeast Anatolia. *S. anomalus* was also recorded in Glnar (Mersin), Manavgat (Antalya), Bozdağ (Konya), Sapanca (Adapazarı), Abant Lake (Bolu), Kurdikan (Diyarbakır) and Ardanuç (Artvin) (Osborn, 1964). Mursaloğlu (1973) reported *S. anomalus* from the whole of Turkey and she stated that *S. vulgaris* lived only in Kırklareli province in Turkish Thrace and the uplands of Artvin and Erzurum provinces in Anatolia. Felten et al. (1977) also recorded *S. a. anomalus* from Dzce and Kocaeli and *S. a. syriacus* Ehrenberg, 1867 from Muğla, Antalya, Isparta and Burdur provinces. Corbet (1978) reported only *S. anomalus* from Turkey and he also concluded that *S. a. syriacus* and *S. a. pallescens* (Gray, 1867) were the only

valid subspecies in the Palaearctic Region. In recent works, Hoffmann et al. (1993) and Galvish and Gurnell (1999) described a *S. anomalus* distribution that included Turkey, and Özkan (1999) also recorded *S. anomalus* from Gökçeada (Imbros), one of the Turkish Aegean Islands.

This study aims to obtain some information about biological and taxonomical characteristics of *S. anomalus* from Turkey.

### Materials and Methods

This study is based on 62 squirrel specimens obtained from west Anatolia (Konya, Karaman, Kütahya and Çorum provinces) from 1997 to 2002 (Figure 1).

The specimens were shot, skinned, stuffed and prepared as a conventional museum type in the field after taking 4 standard measurements and weights. All measurements were taken using dial calipers to an accuracy of 0.1 mm. The specimens were divided into 3 age groups, young, juvenile or adult, according to the skull structure, tooth wear, fur colour and the field notes on the activity of mammary glands.

Diagnostic, karyological and biological characteristics of *S. anomalus* were recorded. Karyological analysis was performed according to Patton (1967). The phallus and baculum were prepared according to Lidicker (1968). A t-test for significant differences between the means of the males and females was carried out on some morphometric data.

Specimens examined (62) and localities: Çorum (9): Ahmetoğlan village 9; Karaman (1): Ermenek, 1; Konya (29): Akören, May town, 5; Bozkır, Karacaören, 1; Kızılcaorman, 2; Kızılin, 3; Hadim, 2; Fakılar village, 4; Kalınağıl town, 1; Hüyük, Kireli town, 1; Çavuşlu town, 1; Seydişehir, Karacaören village, 4; Savak, 1; Taşkent, 1; Meram, Tavusbaba, 3; Kütahya (23): Merkez district, 2; Simav, 1; Domaniç, 2; Emet, 2; Gediz, 3; Tavşanlı, 13 (Figure 1).

All specimens are deposited at the University of Kırıkkale, Faculty of Sciences and Arts, Department of Biology.

### Results

The squirrels were often encountered in fruit gardens during the study.

*Sciurus anomalus* Gldenstaedt, 1785

1785. *Sciurus anomalus* Gldenstaedt, Schreber Sugeth. 4: 781.

Type locality: Sabeka, 25 km south-west of Kutais, Georgia.

### Diagnostic Characters

In adults, condylobasal length, 41.1-44.9; zygomatic breadth, 28.5-32.6; upper toothrow length, 9.7-11.9; lower toothrow length, 10.1-11.7; mandible length, 29.7-33.7 mm. The distal part of the phallus is slightly bent. The phallus length is 44 mm in a specimen examined. The distal part of the baculum is widened and

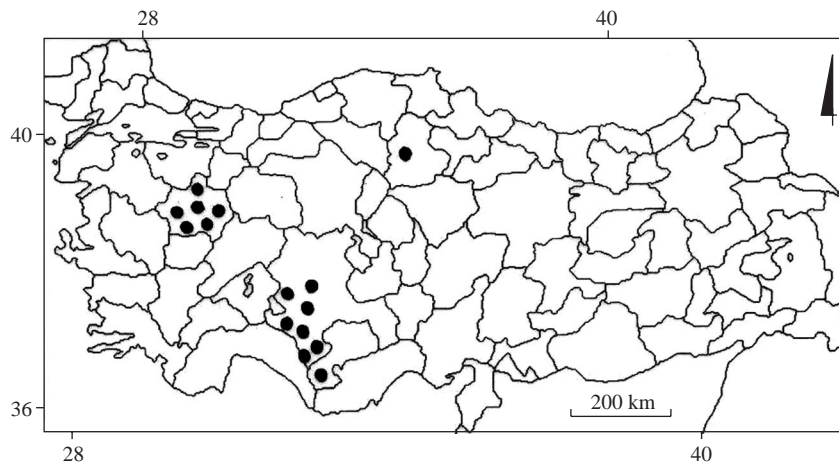


Figure 1. Collection localities (•) of *Sciurus anomalus*.

flattened like a shovel. The proximal part is also somewhat widened and markedly forked (Figure 2).

#### Ecological and biological features

Persian squirrels build their nests in some tree hollows such as the oak (*Quercus trojana*), walnut (*Junglans regia*), juniper (*Juniperus excelsa*) and willow (*Salix alba*), and under rocks, inside heaps of stones, in graveyards and in abandoned buildings for cattle. The dominant tree and shrub species in the habitats used by the squirrels are *Quercus trojana* (oak), *Juniperus excelsa* (juniper), *Junglans regia* (walnut), *Pinus nigra* (pine), *Salix alba* (willow), *Pyrus elaeagnifolia* (wild pear), *Crateagus aronia* (yellow hawthorn), *Pyrus domestica* (plum), *Pyrus syriaca* (pear), *Pyrus malus* (apple), *Crateagus monogyna* (hawthorn), and *Rosa canina* (dog rose).

The dorsal fur colour of the adults in winter varies from pale blackish grey to pale reddish buff. The ventral colour varies from light pale yellowish buff to light reddish buff. In summer, the dorsal colour varies from very light reddish grey to pale blackish grey. The ventral colour varies from reddish yellow tinged light dirty white to light buff tinged reddish tone. The head, forefeet, flanks and tail are deep rush coloured and somewhat reddish tinged.

The forefoot is 4-fingered because the thumb is vestigial. The hindfoot is 5-fingered. Each toe has a callus and each foot has 5 pads. There may be some projecting parts like callus on the soles.

There are 4 pairs of breasts in females and the teats are dark brown during or after lactation. Immature specimens have the same number of breasts but the teats are small and white. Average testicle length and width in mature squirrels are 16 mm and 8 mm, respectively. The sagittal crest gradually appears well from juvenile to adult due to fusion. In addition, the degree of tooth wear also increases from young to adult. The dental formula is  $i\ 1/1, pm\ 1/1, m\ 3/3 = 20$ .

A male and female *S. anomalus* were karyotyped and it was determined that the diploid number is 40, the number of autosomal arms (NFa) 76 and the fundamental number (FN) 80. The chromosome set consists of 19 pairs including 5 metacentric and 14 submetacentric pairs. The X is medium submetacentric and the Y is small submetacentric (Figure 3).

Two ectoparasites, *Ceratophyllus sciurorum* (Schrank, 1803), a flea, and *Ixodes* sp., an acarid, occurred on the 6 specimens examined.

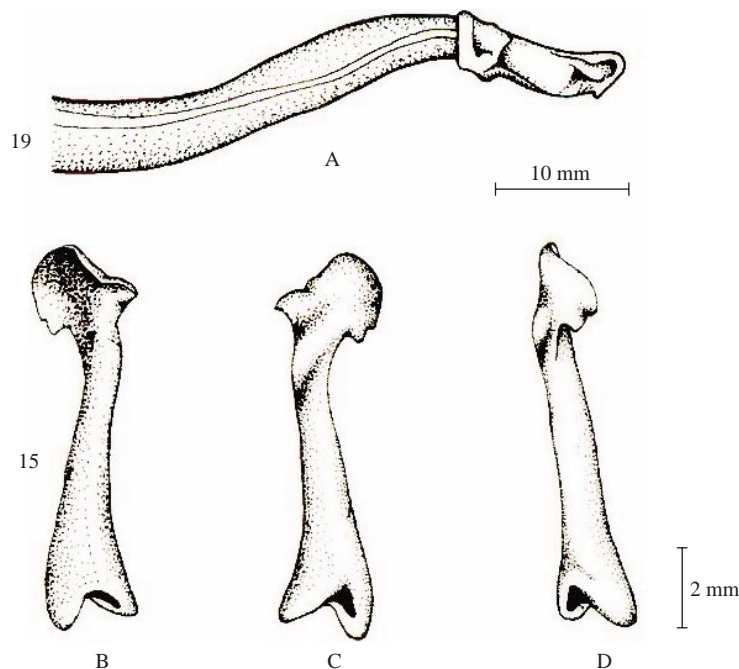


Figure 2. Phallus (A) and the dorsal (B), ventral (C) and lateral (D) view of the baculum in *Sciurus anomalus* (Each specimen number is given on the left hand side of each figure).

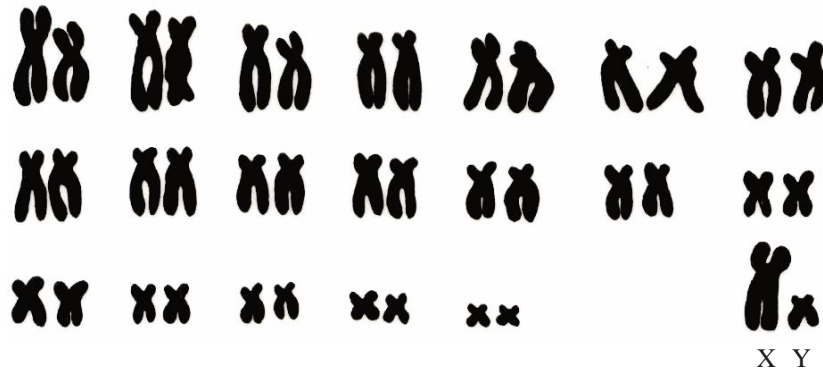


Figure 3. A male karyotype of Turkish *Sciurus anomalus*.

Statistically significant differences were detected among the adult females and males with respect to mandible length (Table 1).

**Discussion**

The 2 species of the genus *Sciurus* in the Palearctic Region, *S. anomalus* and *S. vulgaris*, have been separated from each other by some authors using the existence of tufts on the ears. Corbet (1978) gave the absence of the tufts on the ears as a diagnostic character for the species

*S. anomalus*. Mursaloğlu (1973) stated that *S. anomalus* has not got any tufts on the ears at any time of the year but *S. vulgaris* has got tufts on the ears in winter.

In our specimens, tufts on the ears are present in some specimens caught from late November to late April. Of 25 specimens, 16 (64%) have ear tufts and 9 (36%) do not. In the 13 specimens (100%) caught from April to November, tufts are absent (we do not have any specimen caught in September and October). Harrison and Bates (1991) indicated that the dorsal colour in *S. anomalus*

Table 1. External and cranial measurements (mm) and weights of adult male and female specimens of *S. anomalus* from west Anatolia (n: number of specimen, r: range, m: mean, sd: standard deviations, t: t test, P: probability of significance).

| Characters                | Male |           |       |       | Female |           |       |       | t      | P     |
|---------------------------|------|-----------|-------|-------|--------|-----------|-------|-------|--------|-------|
|                           | n    | r         | k     | sd    | n      | r         | k     | sd    |        |       |
| Head and body length      | 19   | 192-248   | 216.4 | 13.17 | 23     | 198-235   | 213.2 | 9.94  | 1.773  | 0.084 |
| Total length              | 16   | 315-381   | 357.0 | 15.29 | 23     | 328-388   | 360.1 | 13.82 | -0.653 | 0.518 |
| Tail length               | 16   | 120-157   | 142.8 | 9.11  | 23     | 120-162   | 146.9 | 9.99  | -1.306 | 0.200 |
| Hind foot length          | 21   | 54-62     | 9.0   | 1.96  | 26     | 56-64     | 59.6  | 1.69  | -1.210 | 0.233 |
| Ear length                | 14   | 20-29     | 26.4  | 2.34  | 10     | 24-28     | 25.8  | 1.48  | 0.746  | 0.463 |
| Codylobasal length        | 16   | 41.4-44.6 | 43.1  | 1.08  | 20     | 42.3-44.9 | 43.6  | 0.79  | -1.813 | 0.079 |
| Nasal length              | 16   | 14.7-17.2 | 5.7   | 0.60  | 19     | 15.1-17.4 | 16.1  | 0.75  | -1.605 | 0.118 |
| Occipitonasal length      | 13   | 49.1-53.2 | 50.9  | 1.18  | 16     | 50.1-53.5 | 51.5  | 1.00  | -1.579 | 0.126 |
| Diastema length           | 19   | 13.1-15.8 | 14.5  | 0.74  | 23     | 13.3-15.5 | 14.8  | 0.63  | -1.341 | 0.187 |
| Zygomatic breadth         | 16   | 28.5-31.5 | 30.4  | 0.78  | 18     | 29.0-32.7 | 30.8  | 0.95  | -1.384 | 0.176 |
| Interorbital constriction | 18   | 15.2-17.9 | 16.3  | 0.72  | 22     | 15.5-18.1 | 16.7  | 0.69  | -1.784 | 0.082 |
| Greatest skull length     | 15   | 20.7-23.4 | 21.8  | 0.74  | 20     | 20.2-23.4 | 21.9  | 0.80  | -0.350 | 0.728 |
| Braincase breadth         | 15   | 21.1-24.8 | 23.5  | 1.01  | 18     | 22.5-24.9 | 23.8  | 0.55  | -1.074 | 0.291 |
| Upper toothrow length     | 19   | 9.8-11.8  | 10.4  | 0.43  | 23     | 9.7-12.0  | 10.4  | 0.52  | -0.065 | 0.948 |
| Lower toothrow length     | 19   | 10.1-11.4 | 10.9  | 0.41  | 22     | 10.3-11.7 | 11.0  | 0.37  | -0.850 | 0.400 |
| Mandible length           | 18   | 30.7-33.3 | 31.9  | 0.73  | 22     | 31.2-33.7 | 32.4  | 0.67  | -2.097 | 0.043 |
| Weight                    | 21   | 250-401   | 335.7 | 44.40 | 26     | 274-410   | 349.0 | 31.80 | 1.192  | 0.091 |

*pallescens* is “pale iron grey with a silvery grizzled effect” and the ventral colour is “white or variably washed with pale orange buff”. The dorsal colour in *S. anomalus syriacus* is “blackish, grizzled with light grey tips” and ventral colour is “a rich orange colour”.

Our specimens seem to be similar to *S. a. pallescens* with respect to both dorsal and ventral colour except for the grizzled effect, and differ from *S. a. syriacus* in terms of ventral colour and a silvery grizzled effect of dorsal colour.

Compared with the data quoted from Harrison and Bates (1991) (their specimens are all regarded as adults), it seems that our specimens differ from Iraq, Jordan and Lebanon populations in terms of total length, hindfoot length and zygomatic breadth measurements (Table 2).

Our analyses of a relatively large sample showed that fur colour was more variable than previously described, and, for the moment, our specimens seem to agree with

those of the nominate form in terms of their measurement and pelage colour.

Mursaloğlu (1964) indicated that *S. anomalus* was preyed upon by wild carnivores due to the fact that our forests became short of food resources. Squirrel populations in Turkey are threatened with lethal extinction due mainly to habitat loss and fragmentation and by the various types of pollution. The current state of the squirrel populations should be investigated in more detail in order to take effective conservation measures.

### Acknowledgements

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Table 2. The comparison of some external and cranial measurements (mm) of *S. anomalus* from Iraq, Jordan and Lebanon (Harrison and Bates, 1991) and Turkey (n: number of specimen, r: range, m: mean, sd: standard deviations, t: t test, P: probability of significance).

| Measurements              | Turkey (West Anatolia) |           |       |       | Iraq, Jordan and Lebanon |           |       |      |       |       |
|---------------------------|------------------------|-----------|-------|-------|--------------------------|-----------|-------|------|-------|-------|
|                           | n                      | r         | k     | sd    | n                        | r         | k     | sd   | t     | P     |
| Total length              | 44                     | 315-390   | 361.2 | 15.60 | 6                        | 332-358   | 345.0 | 13.5 | 2.70  | 0.010 |
| Tail length               | 44                     | 120-172   | 147.6 | 11.40 | 6                        | 135-143   | 139.8 | 2.6  | 1.71  | 0.094 |
| Hind foot length          | 53                     | 54-64     | 59.4  | 1.79  | 14                       | 46-60     | 53.1  | 3.4  | 10.34 | 0.000 |
| Ear length                | 30                     | 20-32     | 26.9  | 2.40  | 10                       | 23-31     | 28.5  | 2.5  | -1.58 | 0.122 |
| Codylobasal length        | 43                     | 41.4-44.9 | 43.5  | 0.93  | 3                        | 42.4-45.2 | 44.2  | 1.5  | -0.79 | 0.436 |
| Zygomatic breadth         | 41                     | 28.5-32.6 | 30.6  | 0.88  | 4                        | 26.2-30.0 | 28.7  | 1.7  | 4.52  | 0.000 |
| Interorbital constriction | 49                     | 15.2-18.1 | 16.6  | 0.69  | 4                        | 14.6-17.1 | 23.3  | 0.8  | 1.66  | 0.103 |
| Braincase breadth         | 40                     | 21.1-24.9 | 23.7  | 0.73  | 4                        | 22.2-23.8 | 16.1  | 1.2  | 1.38  | 0.174 |
| Mandible length           | 50                     | 29.7-33.7 | 32.1  | 0.88  | 4                        | 30.8-34.2 | 33.0  | 1.6  | -1.44 | 0.156 |

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