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# The Natural History of the Egyptian Fruit Bat, *Rousettus aegyptiacus*, in Turkey (Mammalia: Chiroptera)

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**Abstract:** Aspects of the ecology, karyology, and taxonomic status of the Egyptian fruit bat, *Rousettus aegyptiacus*, in the Mediterranean region of Turkey were investigated based on 41 specimens obtained between 1977 and 2003. Distribution, external and cranial morphometrics, pelage coloration, baculum morphology, karyology, colony size, roosting and feeding ecology, and conservation and management issues were recorded. The fruit bat in Turkey is represented by the nominate subspecies, *R. a. aegyptiacus*. Sexual dimorphism was recorded in pelage coloration and morphometric data. The diploid number of chromosomes (2n) is 36. Records of feeding behavior were obtained from both field and laboratory studies. Seasonal changes in diet were recorded in both wild and cultivated fruits, including Persian lilac (*Melia azadirachta*), rubber tree (*Ficus elastica*), plum (*Prunus* sp.), loquat (*Eriobotrya japonica*), apple (*Malus* sp.), fig (*Ficus carica*), pomegranate (*Punica granatum*), grape (*Vitis viniferia*), persimmon (*Diosyros kaki*), date (*Phoenix dactylifera*), mulberry (*Morus* sp.), cherry (*Prunus* sp.), peach (*Prunus persica*), apricot (*Prunus* sp.), and *citrus* (*Citrus* sp.). It was determined that the fruit bats in Turkey reproduce in late August.

Key Words: Bioecology, karyotype, taxonomy, *Rousettus aegyptiacus*, Turkey

## Türkiye'deki Mısır Meyve Yarasasının Doğal Yaşamı (Mammalia: Chiroptera)

**Özet:** Türkiye'nin Akdeniz Bölgesinden 1977 ve 2003 yılları arasında elde edilen 41 örneğe dayanarak Mısır meyve yarasası, *Rousettus aegyptiacus*'un ekolojik ve karyolojik yönleri ile taksonomik durumu incelendi. Bu türde yayılış, dış ve kafatasının morfometrik değerleri, kürk rengi, baculum morfolojisi, karyoloji, koloni büyüklüğü, tünekleme, beslenme ekolojisi, koruma ve yönetim hususları kaydedildi. Türkiye'deki meyve yarasası, nominatif alt tür, *R. a. aegyptiacus* ile temsil edilmektedir. Kürk rengi ve morfometrik verilerde eşeysel dimorfizm kaydedildi. Türün diploid kromozom sayısı (2n) 36'dır. Beslenme ekolojisi ile ilgili kayıtlar hem arazi hem de laboratuar çalışmaları ile elde edildi. Diyetteki mevsimsel değişimler yalancı tespih ağacı meyvesi (*Melia azadirachta*), kauçuk ağacı meyvesi (*Ficus elastica*), erik (*Prunus* sp.), yeni dünya (*Eriobotrya japonica*), elma (*Malus* sp.), incir (*Ficus carica*), nar (*Punica granatum*), üzüm (*Vitis viniferia*), Trabzon hurması (*Diosyros kaki*), hurma (*Phoenix dactylifera*), dut (*Morus* sp.), kiraz (*Prunus* sp.), şeftali (*Prunus persica*), kayısı (*Prunus* sp.) ve narenciye (*Citrus* sp.), gibi hem yabani hem de kültür meyveleri itibariyle kaydedildi. Türkiye'deki meyve yarasalarının Ağustos sonuna doğru üredikleri saptandı.

Anahtar Sözcükler: Biyoekoloji, karyotip, taksonomi, *Rousettus aegyptiacus*, Türkiye

## Introduction

*Rousettus aegyptiacus* is the only bat species of the 32 recorded in Turkey that belongs to the suborder Megachiroptera. The Egyptian fruit bat, *R. aegyptiacus*, has been recorded by various researchers from the Turkish provinces of Hatay, Adana, Mersin, and Antalya (Şadoğlu, 1953; Koswig, 1955; Eisentraut, 1959; Kahmann and Çağlar, 1960; Osborn, 1963; Çağlar, 1965, 1968; Lehmann, 1966; Kumerloeve, 1975; Kinzelbach, 1986; Albayrak, 1990, 1993). Harrison (1964) and Harrison and Bates (1991) included Hatay province in the distribution map of this species. Bergmans (1994) concluded that this species may have migrated from Cyprus to Alanya. Benda and Horácek (1998) stated that the northern border of the global distribution of *R. aegyptiacus* is in Turkey.

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The aim of this study was to investigate the geographical distribution, taxonomic status at subspecies level, karyology, feeding, and roosting ecology of the Egyptian fruit bat in Turkey.

## Materials and Methods

Field studies were carried out between September 1999 and September 2003 in Hatay, Adana, Mersin, and Antalya, as well as the neighboring provinces with a Mediterranean climate. Of the 8 live specimens kept in captivity, 2 (Col. No: 1930, 22 April 2000; Col. No: 1769, 12 February 2002) were used for karyological analyses and 6 were kept in the laboratory in order to assess feeding preferences. In order to minimize the impact on the present population, only a few specimens were collected for this study. A total of 33 specimens collected between 1977 and 1987 were also included for the assessment of taxonomic status.

For about 1 year the captive bats were offered the full range of fruits seasonally available in the wild to determine which were preferred.

The preserved specimens were divided into 3 age groups (young, juvenile, and adult), in terms of the morphology of the sagittal and lambdoidal crests of the skull, degree of tooth wear, pelage coloration, external and cranial measurements (Anderson, 1917; Menzies, 1973; Young, 1975; Bagøe, 1977), and position of the projecting frontal bone (Figure 1). Only the data from adults were used in the analyses and subsequent comparisons. A test for significant differences between the means of the males and females was also carried out on the basis of morphometric values (Parker, 1979) (Student's t-test, P = 0.05).

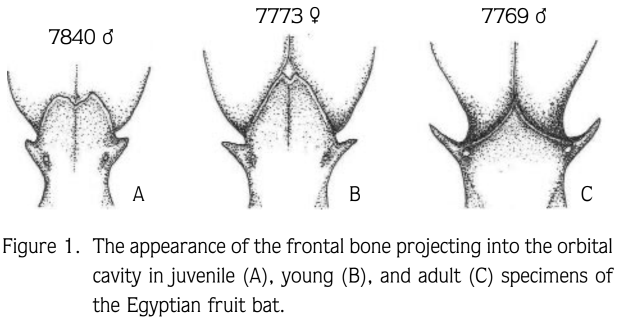


Figure 1. The appearance of the frontal bone projecting into the orbital cavity in juvenile (A), young (B), and adult (C) specimens of the Egyptian fruit bat.

The studies on pelage coloration, bacula, and karyology were carried out according to Ridgway (1886), Topal (1958), and Patton (1967), respectively. At least 10 slides were prepared from each specimen and approximately 25 well-stained metaphase spreads were examined from each slide; idiograms were subsequently prepared.

In order to count the number of fruit bats, entrances to roosts were made narrower by setting mist nests and the fruit bats were counted as they emerged. In other roost sites, the number of fruit bats was estimated by dividing the area of the roof of the cave occupied by the colony to the area occupied by a single fruit bat.

The localities and numbers of examined specimens were as follows (total = 41): Merkez district, Adana: in a hangar (1; Col. No: 1402) and a factory (5; Col. No: 1736, 1769, 1893, 1906, 1933); Kozan district: Anavarza Castle; Merkez district, Antalya: in a date palm tree; Alanya district: at a fruit breeding station; Finike district: in a city park; Harbiye town, Hatay: in a Persian lilac and in Harbiye Cave (30; Col. No: 7766-7782, 7829-7840, 8791); Serinyol town, Samandağı district, Merdiven Dibi (1; Col. No:1932): Hassa district, Demrek village: Dipsiz Cave; Karaağaç town, İskenderun district; Kırıkhan district; Erzin district; Say village, Tarsus district, Mersin: (4; Col. No: 1177, 1178, 1930, 1931); Erdemli, Alata (Figure 2).

All the specimens examined in this study are deposited in the Department of Biology, Faculty of Sciences and Arts, University of Kırıkkale.

## Results

The Egyptian fruit bat, *Rousettus aegyptiacus*, is the only species representing the suborder Megachiroptera in Turkey.

### Ecological Characteristics

The Egyptian fruit bat is distributed from Hatay to Antalya provinces in the Mediterranean region of Turkey. It roosts in caves, abandoned depots, and hangars. Depending on the season, this species feeds on both wild and commercially grown fruits. In the Mediterranean region, from March to November plum (*Prunus* sp.), loquat (*Eriobotrya japonica*), apple (*Malus* sp.), fig (*Ficus carica*), pomegranate (*Punica granatum*), grape (*Vitis viniferia*), persimmon (*Diosyros kaki*), date (*Phoenix*

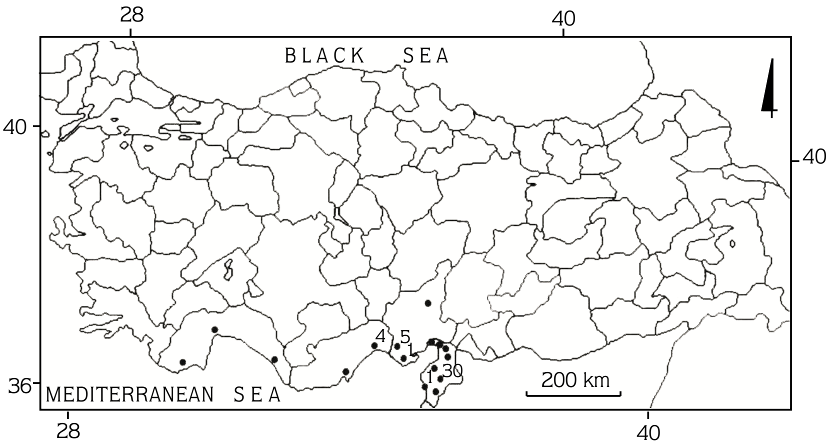


Figure 2. The localities where *Rousettus aegyptiacus* (●) was found (numbers indicate the number of specimens examined).

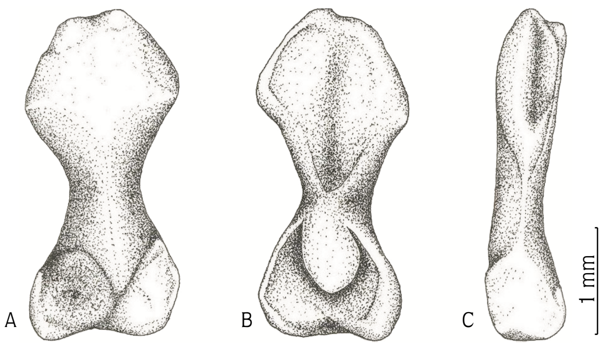


Figure 3. The baculum of *Rousettus aegyptiacus* from Turkey. Dorsal (A), ventral (B), and lateral views (C) (Col. No: 1930).

*dactylifera*), mulberry (*Morus* sp.), cherry (*Prunus* sp.), peach (*Prunus persica*), apricot (*Prunus* sp.), and citrus (*Citrus* sp.) are grown. It is apparent that bats make short-distance flights to fruiting trees, depending on when the fruits are ripe. Seasonal changes in the diet of the fruit bat are shown in Figure 4.

Some fruit bats left their roosts during May and returned in September, while others stayed at their roosts throughout the year. In this study it was determined that 2 wild fruits were important components of the seasonal diet. The fruit bats consumed rubber tree (*Ficus elastica*) from the end of October until the beginning of December. As soon as they emerged, they would seek these fruits. The Persian lilac (*Melia azadirachta*) is the other important fruit, which begins ripening in spring and remains on trees during the warm winter, although the plant loses its leaves in autumn, making the fruits easier to see.

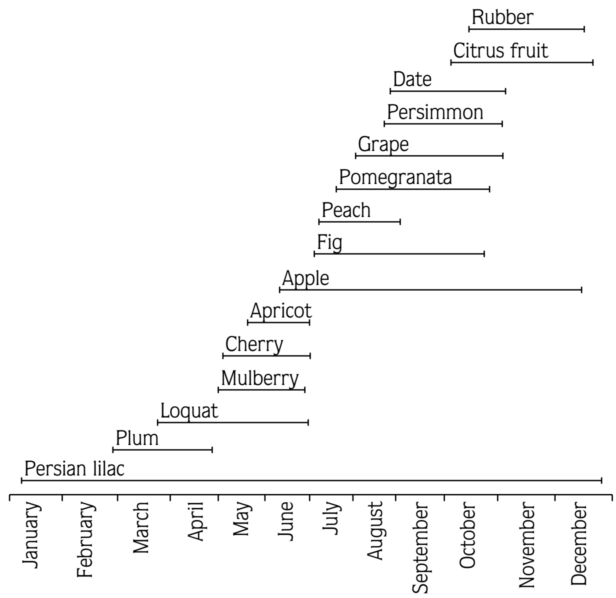


Figure 4. Seasonal changes in the diet of Egyptian fruit bats in Turkey.

It was observed that the fruit bats picked fruits from a tree and then carried them to either a cave or to another tree to eat. For example, we discovered loquat and Persian lilac seeds on the floor of a cave.

We were only able to determine roost size at 2 localities. There were approximately 800 individuals in a circular roost on the roof of a cave in April 2000 in the village of Say. In total, 1571 fruit bats were counted emerging from the empty depots of an abandoned factory towards evening in May 2001 in the central part of Adana province.

### Diagnostic Characters

Adult forearm length: 88.6-93.5 mm; greatest skull length: 42.7-44.8 mm; condylobasal length: 41.2-43.7 mm; zygomatic breadth: 25.9-28.7 mm; maxillary tooth row length: 16.1-17.1 mm; mandibular tooth row length: 17.1-18.8 mm; mandible length: 33.2-35.7 mm. The baculum has a slightly swollen tip, which is characteristic for this species (Figure 2). One baculum measured 0.86 × 0.20 mm.

### Measurements

External and cranial measurements, and the weights of 13 adult and 12 juvenile specimens were recorded (Table 1). Adult males had significantly greater values than did females, with regard to body weight, total length of head and body, hind foot, tibia, largest skull, maxillary and mandibular tooth row lengths, and rostrum and zygomatic breadths ($P < 0.05$). There were no statistically significant differences between male and female juveniles for any weights or measurements ($P > 0.05$). Adult males and females had significantly greater values than juveniles with regard to all weights and measurements, except for tail, ear, and upper and lower tooth row lengths ($P < 0.05$).

### Pelage Coloration

The dorsal coloration of adult males and females is gray-brown and the ventral coloration is dirty buff, but the glandular throat hairs of males are grayish. The bases of the dorsal hairs are light yellowish brown, and are light gray-brown ventrally and dirty yellow on the underside of male chins. The coloration of the hair tips matches the general dorsal and ventral colorations.

### Karyology

The diploid chromosome number (2n) of 1 male and 1 female *R. aegyptiacus* was 36, there are 66 autosomal arms (NFa), and the fundamental number (NF) in the female is 70. The chromosome set consisted of 12 pairs of metacentrics or submetacentrics, ranging in size from large to small, 4 pairs of medium-sized subtelocentrics, and 1 small acrocentric autosomal pair. The X chromosome is a medium-sized submetacentric, whereas the Y is the smallest acrocentric in the set (Figure 5).

Table 1. The body weight (g), and external and cranial measurements (mm) of juvenile, adult male, and female *Rousettus aegyptiacus* specimens from Turkey.

| Measurements | Adult (♂♂) | | | | Adult (♀♀) | | | | Juvenile (♀♀ + ♂♂) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | min-max | m | ±sd | n | min-max | m | ±sd | n | min-max | m | ±sd |
| Total length | 8 | 157-177 | 168.1 | 6.66 | 4 | 153-160 | 157.3 | 2.99 | 12 | 116-161 | 146.7 | 10.9 |
| Head and body length | 8 | 143-160 | 152.8 | 5.8 | 4 | 142-146 | 143.3 | 1.89 | 12 | 102-145 | 132.2 | 10.7 |
| Tail length | 9 | 13-17 | 15.2 | 1.48 | 4 | 11-17 | 14 | 2.94 | 12 | 12-17 | 14.5 | 1.45 |
| Hind foot length | 9 | 27-30 | 28.1 | 1.17 | 4 | 26-27 | 26.3 | 0.5 | 12 | 25-28 | 26.8 | 0.84 |
| Ear length | 9 | 22-27 | 25.2 | 1.39 | 4 | 25-26 | 25.3 | 0.5 | 12 | 23-26 | 24.9 | 0.9 |
| Weight | 8 | 120-140 | 131.5 | 7.05 | 4 | 105-130 | 113 | 11.46 | 12 | 70-115 | 90.8 | 11.22 |
| Forearm length | 7 | 88.6-93.5 | 90.8 | 1.59 | 2 | 91.1-91.6 | 91.4 | 0.35 | 9 | 76-86 | 81.1 | 3.16 |
| Tibia length | 7 | 38.1-41.9 | 39.3 | 1.39 | 2 | 35.3-37.8 | 36.6 | 1.77 | 7 | 28.5-36.3 | 32.5 | 2.68 |
| Greatest skull length | 8 | 43.1-44.8 | 44.1 | 0.54 | 3 | 42.7-43.3 | 43 | 0.31 | 6 | 40.1-41.6 | 41.1 | 0.68 |
| Total length of skull | 8 | 42.9-44.5 | 43.7 | 0.56 | 3 | 42.5-43.0 | 42.8 | 0.25 | 5 | 39.6-41.4 | 40.6 | 0.89 |
| Condylobasal length | 8 | 41.4-43.7 | 42.6 | 0.8 | 3 | 41.2-42.1 | 41.5 | 0.52 | 6 | 38.4-40.0 | 39.4 | 0.63 |
| Rostrum length | 9 | 14.1-15.5 | 15 | 0.48 | 4 | 14.0-14.7 | 14.4 | 0.38 | 8 | 10.2-13.7 | 13 | 1.19 |
| Zygomatic breadth | 9 | 26.2-28.7 | 27.3 | 0.89 | 4 | 25.9-26.3 | 26.2 | 0.19 | 8 | 23.2-25.6 | 24.3 | 0.87 |
| Interorbital constriction | 9 | 8.2-9.5 | 8.8 | 0.38 | 4 | 8.2-9.0 | 8.5 | 0.34 | 12 | 7.5-8.3 | 7.8 | 0.25 |
| Braincase breadth | 9 | 16.5-18.0 | 17 | 0.48 | 4 | 16.1-17.5 | 16.7 | 0.67 | 9 | 15.9-17.3 | 16.5 | 0.41 |
| Mastoid breadth | 9 | 16.7-18.7 | 17.2 | 0.7 | 4 | 16.0-16.7 | 116.4 | 0.34 | 10 | 15.1-16.3 | 15.7 | 0.42 |
| Skull height | 9 | 16.5-18.9 | 17.7 | 0.69 | 4 | 16.8-18.2 | 17.3 | 0.64 | 8 | 14.7-17.3 | 16.5 | 0.78 |
| Maxillary tooth row length | 9 | 16.4-17.1 | 16.8 | 0.28 | 3 | 16.1-16.4 | 16.3 | 0.17 | 11 | 15.2-16.4 | 15.9 | 0.32 |
| Upper molar tooth row length | 9 | 9.0-9.7 | 9.4 | 0.22 | 3 | 9.0-9.8 | 9.4 | 0.4 | 11 | 8.8-12.0 | 9.6 | 0.85 |
| Mandibular tooth row length | 8 | 17.7-18.8 | 18.5 | 0.36 | 4 | 17.1-17.9 | 17.6 | 0.36 | 12 | 16.7-18.3 | 17.4 | 0.41 |
| Lower molar tooth row length | 7 | 7.5-8.6 | 8.2 | 0.34 | 4 | 7.9-8.6 | 8.2 | 0.31 | 12 | 7.7-8.6 | 8.1 | 0.28 |
| Mandible length | 9 | 33.6-35.7 | 34.7 | 0.78 | 4 | 33.2-34.0 | 33.7 | 0.37 | 11 | 30.1-32.8 | 31.4 | 0.72 |

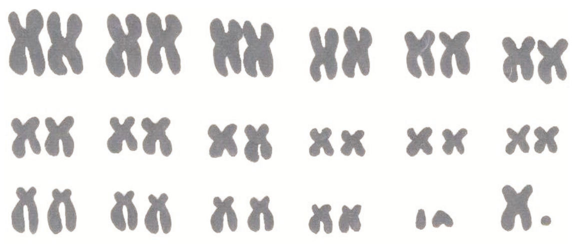


Figure 5. The karyotype of a male Turkish *Rousettus aegyptiacus*.

## Discussion

### Ecology

It has been reported that *Rousettus aegyptiacus* feeds on a variety of fruits, depending on what is locally available (Tuttle, 1984; Kinzelbach, 1986; Harrison and Bates, 1991). Izhaki et al. (1995) reported that in Israel *R. aegyptiacus* feeds on figs, bead tree fruits, date palm, mango, and banana, and that it is a potential seed disperser. They recorded that these bats immediately spat from their mouths the large seeds of carob, loquat, and jujube 25-400 m from the fruiting tree, whereas they swallowed the small seeds of fig, mulberry, and arbutus. They stated that because of the risk of hunting by people, fruit bats were forced to consume the fruit in situ. They observed that Egyptian fruit bats may use non-fruiting trees (e.g., pine) as a feeding roost. In the present study it was also observed that fruit bats consumed the fruits of Persian lilac in a pine tree, which was 30 m from the fruiting tree.

Korine et al. (1996) observed that in Israel fruit bats mostly feed on carob and bead tree fruits from the end of autumn through winter, on loquat and fig from the beginning of spring until summer, and on fig from the end of summer until the beginning of autumn. They also stated that in addition to the tropical and subtropical regions this species continues to exist in Egypt, Israel, Cyprus, and the southern part of Turkey, depending on the seasonal availability of fruit.

Korine et al. (1998) reported that they fed 2 female and 2 male bats fruits such as apple and banana in the laboratory and that the bats consumed approximately 150 g of apple per day. In addition, they reported that in Israel birds and bats did not show any preference for feeding on *Styrax officinalis*. According to Korine et al. (1999) fruit bats in Israel also feed on pear, apple, mandarin, and pomegranate.

In the present study, it was determined that in the Mediterranean region of Turkey the diet of the fruit bat consisted of plum, loquat, apple, fig, pomegranate, grape, persimmon, date, mulberry, cherry, peach, apricot, citrus fruits, Persian lilac, and rubber tree fruits. However, the only fruit that was eaten mostly in winter was Persian lilac (Figure 4). The laboratory bats were given various fruits throughout the year and they ate, in order of preference, banana, grape, apple, loquat, and Persian lilac. Mandarin was always given to the bats, but was only occasionally eaten with the other fruits after a while.

### Karyology

Salleh et al. (1999) stated that there were no karyological differences between 10 pteropodid bat species. We compared our karyological data to those obtained for *R. aegyptiacus* from Africa (Dulic and Mutere, 1973; Haiduk et al., 1981) (Table 2).

The karyology of *R. aegyptiacus* specimens in Turkey is similar to that recorded by Dulic and Mutere (1973), and Haiduk et al. (1981) with respect to diploid chromosome number, number of metacentric (24), submetacentric (8), and autosomal chromosomes, and 8 subtelocentric, 2 small acrocentric autosomes, and a submetacentric X chromosome. Unfortunately, the morphology of the Y chromosome was not established as the authors did not examine a male specimen. In our study the Y chromosome was the smallest acrocentric chromosome in the set.

Table 2. The karyology of *Rousettus aegyptiacus* from Africa and Turkey. M: metacentric; SM: submetacentric; ST: subtelocentric; A: acrocentric; X: X chromosome; Y: Y chromosome.

| Country | Sex | 2n | NF | M/SM | ST | A | X | Y |
|---|---|---|---|---|---|---|---|---|
| Africa (Dulic and Mutere, 1973) | ♀ | 36 | 68 | - | - | - | SM | - |
| South Africa (Haiduk et al., 1981) | ♀ | 36 | 66 | 24 | 8 | 2 | SM | - |
| Turkey | ♂,♀ | 36 | 66 | 24 | 8 | 2 | SM | A |

## Taxonomy

Andersen (1912) recorded *R. aegyptiacus*, *R. arabicus*, and *R. leachii* as species in the genus *Rousettus*. Miller (1912) and Ellermann and Morrison-Scott (1951) recognized *R. arabicus* as a valid species. Harrison (1964) stated that *R. aegyptiacus* is represented by the subspecies *R. a. aegyptiacus*, distributed in Israel, Lebanon, and Jordan (in the Arabian Peninsula), and *R. a. arabicus*, distributed in Oman and Aden. Corbet (1978) also stated that *R. a. aegyptiacus* is distributed in Egypt, Cyprus, Turkey, and Africa (south of the Sahara), whereas *R. a. arabicus* occurred from the south of Arabia to Pakistan. Harrison and Bates (1991) published a distribution map for *R. a. aegyptiacus* and *R. a. arabicus.* Qumsiyeh et al. (1992) stated that *R. aegyptiacus* is widespread in Africa and the cultivated areas of the Arabian Peninsula, and that its distribution extended to Turkey in the north and to Pakistan in the east. Bergmans (1994) regarded *R. aegyptiacus* as *R. egyptiacus* and accepted *R. e. egyptiacus*, *R. e. leachii*, *R. e. unicolor*, and *R. e. arabicus* as valid subspecies, stating that *R. e. egyptiacus* is distributed in Turkey. According to Benda and Horácek (1998), *R. a. aegyptiacus* is distributed from Turkey, the Levant, Cyprus, and Egypt to the middle of Arabia.

In the present study comparisons of the Turkish specimens to *R. a. aegyptiacus*, *R. a. arabicus*, *R. a. leachii*, and *R. a. unicolor* showed that they are most similar to *R. a. aegyptiacus* (Table 3).

Table 3. A comparison of external and cranial measurements (mm) and weights (g) of *Rousettus aegyptiacus* subspecies (Andersen, 1912; Harrison and Bates, 1991; Bergmans, 1994) to Turkish specimens.

| Measurements | *R. a. aegyptiacus* | | *R. a. arabicus* | | *R. a. leachii* | | *R. a. unicolor* | | Turkey | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n | min-max | n | min-max | n | min-max | n | min-max | n | min-max |
| Total body length | 16 | 126-167 | 28 | 101-153 | - | - | - | - | 12 | 153-177 |
| Tail length | 16 | 8.0-19.0 | 27 | 5.0-22.0 | - | - | - | - | 13 | 11-17 |
| Hind foot length | 20 | 19-26 | 28 | 17-24 | - | - | - | - | 15 | 26-38 |
| Ear length | 25 | 18.3-25.0 | 46 | 18-23 | 30 | 19.3-22.5 | 11 | 17.8-22.7 | 13 | 22.0-27.0 |
| Forearm length | 76 | 84-101.4 | 63 | 79.9-95 | 122 | 85.7-106.3 | 84 | 90.3-106.3 | 9 | 88.6-93.5 |
| Tibia length | 14 | 41.1-45.6 | 2 | 38.7-39.7 | 29 | 38.1-45.7 | 10 | 40.8-46.6 | 9 | 35.3-41.9 |
| Weight | 1 | 112.0 | 3 | 98.5-128.0 | 42 | 100.0-166.0 | 37 | 100.0-168.0 | 12 | 105.0-140.0 |
| 2nd digit metacarpal length | - | 40.0-44.0 | - | 37.0-42.7 | - | 36.2-43.7 | - | - | 9 | 41.3-44.7 |
| 3rd digit metacarpal length | - | 57.2-63.0 | - | 53.2-60.0 | - | 54.5-62.0 | - | - | 9 | 59.7-65.2 |
| 3rd digit 1st phalanx length | - | 39.0-44.0 | - | 37.0-39.8 | - | 38.2-42.2 | - | - | 9 | 38.7-43.0 |
| 3rd digit 2nd phalanx length | - | 53.0-61.5 | - | 50.5-56.5 | - | 50.5-60.0 | - | - | 9 | 53.0-60.7 |
| 4th digit metacarpal length | - | 54.0-61.0 | - | 50.8-58.7 | - | 54.2-61.0 | - | - | 11 | 55.0-62.3 |
| 4th digit 1st phalanx length | - | 30.0-34.5 | - | 28.0-31.0 | - | 29.0-33.8 | - | - | 11 | 30.0-33.7 |
| 4th digit 2nd phalanx length | - | 33.0-39.8 | - | 31.8-36.7 | - | 32.2-38.7 | - | - | 9 | 34.0-37.0 |
| 5th digit metacarpal length | - | 54.0-59.5 | - | 50.2-58.7 | - | 54.5-60.0 | - | - | 11 | 55.0-59.2 |
| 5th digit 1st phalanx length | - | 28.0-30.8 | - | 26.2-30.0 | - | 27.0-30.8 | - | - | 9 | 28.4-31.3 |
| 5th digit 2nd phalanx length | - | 25.0-31.8 | - | 24.2-28.8 | - | 25.0-28.5 | - | - | 11 | 26.0-28.5 |
| Greatest skull length | 37 | 41.2-46.2 | 54 | 37.8-42.7 | 79 | 38.3-45.7 | 47 | 39.7-45.6 | 13 | 41.4-44.8 |
| Rostrum breadth | 15 | 14.8-17.0 | 27 | 13.2-16.3 | 68 | 14.6-17.4 | 46 | 14.5-17.3 | 13 | 14.0-15.5 |
| Interorbital breadth | 15 | 8.0-9.9 | 27 | 7.2-8.2 | 71 | 7.4-9.1 | 47 | 7.2-9.5 | 12 | 8.2-9.5 |
| Condylobasal length | 16 | 39.6-43.3 | 20 | 36.1-41.3 | - | - | - | - | 13 | 39.8-43.7 |
| Zygomatic breadth | 31 | 23.6-29.2 | 48 | 21.2-26.1 | 7 | 24.0-28.9 | 44 | 23.6-28.6 | 13 | 25.9-28.7 |
| Braincase breadth | 16 | 16.2-17.8 | 20 | 15.4-16.8 | - | - | - | - | 13 | 16.1-18.0 |
| Postorbital breadth | 32 | 7.0-8.8 | 46 | 6.2-8.5 | 71 | 7.6-10.3 | 48 | 7.5-9.8 | 13 | 8.2-7.4 |
| Maxillary tooth row length | 30 | 15.6-18.8 | 44 | 14.6-16.7 | 75 | 14.4-18.8 | 44 | 15.1-18.2 | 14 | 15.8-17.1 |
| Mandibular tooth row length | 27 | 17.2-20.8 | 46 | 14.7-18.1 | 62 | 6.7-19.2 | 47 | 15.8-19.4 | 12 | 17.1-18.8 |
| Mandible length | 17 | 32.0-37.2 | 20 | 28.7-33.8 | - | - | - | - | 15 | 32.5-35.5 |

### Conservation and Management Issues

Harrison (1964) stated that the fruit bat is a pest of fruit crops in Israel. Qumsiyeh (1980) reported that the population of this species was gradually increasing in Jordan. In Israel, Makin and Mendelssohn (1987) reported that lindane (a kind of insecticide) was used for killing fruit bats. Harrison and Bates (1991) stated that farmers enclosed their commercial fruit in cages to protect their crops from depredation by *R. aegyptiacus*. However, Qumsiyeh et al. (1992) reported that fruit depredation by this species has not been scientifically examined in Jordan, but that it was already under threat as a result of the destruction of its roost sites. Kumerloeve (1975) pointed out that in Turkey this species existed in the Amanos Mountains and İskenderun. Spitzenberger (1979) reported that in Turkey and Israel roosting caves have been fumigated or their entrances walled up by fruit farmers.

Although the bats in the present study were indigenous, depending on their feeding habits they may change their roost sites. During this study it was observed that 11 of 15 roosts were destroyed by humans in an effort to exterminate the bats. The elimination of bat populations also included blocking cave entrances, asphyxiating bats by burning car tires, sulfur poisoning, and dynamiting roosting caves.

The impact of fruit bats on fruit crops may be considerable. Some farmers stated that in Hatay province fruit bats consumed 10%-15% of an approximately 10-t commercial harvest of loquat. Although this value may have been exaggerated, fruit bats are thought to be serious pests of commercial fruit crops. As a result they are frequently killed by various methods, and the destruction of roosting caves may eventually lead to a decline in this species as well as other microchiropteran bats that share these caves.


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