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The distribution, habitat and conservation status of the Turkish spiny mouse, *Acomys cilicicus* Spitzenberger, 1978

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Abstract

The present study examined the distribution of Turkey *Acomys cilicicus*, Spitzenberger, 1978, the properties of its habitat and, because it is under pressure in its distribution area, its prospects for the future. The present study confirmed that *A. cilicicus* endemic species exists only in Turkey near Silifke, and like other *Acomys* species it generally lives in block calcareous rock fields. Although vegetation in this habitat was poor, *A. cilicicus* was an omnivore and will readily exploit animal food sources. This endangered species is restricted to a small and narrow distribution area along the coastline of southern Turkey, and if necessary measures are not taken, it is likely to become extinct in the wild in the near future.

Keywords: *Acomys cilicicus*, conservation, distribution, habitat, spiny mouse

1. Introduction

The genus *Acomys* is represented by 19 species that are distributed in the Palearctic Region. *Acomys* species, which are commonly known as spiny mice due to their stiff guard hairs, are small rodents that are generally confined to rock and arid field habitats as a result of competition from other rodents^[1].

Acomys cilicicus is endemic to a region near Silifke, Turkey and lives in calcareous rock fields. Recently, the *A. cilicicus* (Silifke-Turkey) *A. nesiotetes* (Cyprus) and *A. minous* (Crete) species from *Acomys* genus, distributed in the northern parts are placed into the *cahirinus-dimidiatus* clade in phylogenetic studies^[2, 3, 4]. The evolution of these species has been explained by Barome *et al.*^[3]; *A. cilicicus* was carried by humans throughout the Mediterranean, reaching the Cyprus islands and the south coast of Anatolia, where it separated into three isolated populations and then diverged over time. These populations have been evaluated in some studies as sub-species of *A. cahirinus*^[5, 6], but in other studies as independent species^[7, 8], i.e. *A. cilicicus* Spitzenberger, 1978a^[9], *A. minous* Bate 1903a^[10] and *A. nesiotetes* Bate, 1903b^[11]. Although there are studies on the taxonomy and the biology of reproduction of *A. cilicicus*^[4, 12-18], there is little information about its distribution, habitat and conservation status. Therefore the present study was undertaken between 1995 and 2009 to examine these issues in detail and to elucidate the future of *A. cilicicus* in Turkey.

2. Material and Methods

In the present study of *Acomys* species, we evaluated data collected from field surveys between 1995 and 2009, together with laboratory observations of live specimens carried out between 2003 and 2009.

2.1 Field Surveys (1995 – 2009)

Thirty-four (34) research specimens were collected from six localities using dead traps (Table 1); 11 specimens, which were appropriate to examine their stomach materials, were taken into a liquid environment on petri dishes in order to evaluate. Arthropod material recovered from the stomachs of sampled mice was investigated under loop and identified to the family level (Table 2). We attempted to determine the habitat for this species by a comprehensive search of the Mediterranean region to specify its distribution field; traps were set in some places where *Acomys* species are known. Such localities were considered as research stations for subsequent studies, and their locations were marked on satellite images and their coordinates given in

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Table 1. Data were collected about the distribution and habitat of this species towards the end of the study period. The habitat was determined by the identification of plant

communities in the areas where specimens were caught (Table 3).

Table 1: The coordinates, altitudes and number of specimens caught in each year.

Localities (= Stations)	Coordinates (WGS 84 coordinating system)	Altitude (m)	Number and Year of Specimens
1. Station (bound of Silifke-Mersin approximately 5. km.)	36°23'12"N 33°59'85"E	68 m	n = 1 (2004)
2. Station (opposite of Altun Orfe Hotel)	36°25'65"N 34°05'93"E	50 m	n = 1 (2004)
3. Station (bound of Silifke-Mersin approximately 18. km.)	36°27'26"N 34°06'58"E; 36°27'10"N 34°06'99"E; 36°27'26"N 34°07'00"E	30 m 70 m 99 m	n = 2 (2003) n = 2 (2004)
4. Station (bound of Silifke-Mersin approximately 20. km.)	36°27'20"N 34°07'24"E	43 m	n = 16 (1995) n = 5 (2003)
5. Station (bound of Silifke-Mersin approximately 21. km.)	36°27'26"N 34°07'48"E	35 m	n = 2 (2003) n = 3 (2005)
6. Station (Ancient ruins)	36°28'18"N 34°09'13"E	13 m	n = 2 (2004)

Table 2. The stomach contents of field specimens.

Phylum	Classis	Ordo	Familia	Nutrition type	Number of specimens
	Insecta	Orthoptera	-	Eye and antenna	2
	Insecta	Coleoptera	-	Leg	2
	Insecta	Hymenoptera	Formicidae	whole ants and body parts	7
Arthropoda					
				Ant's egg (23 pieces)	2
	Insecta	Lepidoptera	-	Caterpillar	1
	Chilopoda			Mouth parts	3
	-			Whole leaves	1

2.2 Laboratory Studies (2003 – 2009)

Two female and two male animals caught using live traps during the field survey of 2003 were brought to the vertebrates research laboratory at the Ankara University Biology Department. These animals were held in wire cages (80 x 60 x 60 cm or 60 x 60 x 60 cm) and all observations were recorded; nine interconnected cages with folding entries were used. The laboratory temperature was between +18 °C and +32 °C depending on the season. Humidity was in the range of 30-80% so it has been benefitted from daylight. Nests were established in the cages using various boxes and tubes. These nests were similar to the holes used by *Acomys* species in their natural habitat and should therefore be less stressful to the animals. Diet was assessed by providing a range of different foods (including apple, orange, fresh green vegetables, corn, sunflower seeds, pellet feed, pieces of meat, insects) for animals in the laboratory. The two female and two male animals originally sampled ultimately gave rise to 1404 offspring between 2003 and 2009; these were used for the laboratory research described here.

3. Results

Acomys cilicicus Spitzenberger, 1978 (Turkish Spiny Mouse)

3.1 Type locality

20 km east of Silifke, Mersin, Turkey.

The distribution area of the species: In order to determine the distribution area of the species, the suitable habitat environment was researched by studying in lots of the Mediterranean region. At the end of the field surveys, certain borders of the distribution area of the species were determined (Fig. 1 and Table 1). It is stated that the species individuals have only lived in coastal strip, between 5 and 25 km of Silifke – Mersin highway at the present time; they have been found up to approximately 100 m in the some rocky regions in the coastal regions which was destroyed due to the settling and the operating stone pits.



Fig 1: A satellite image showing the species range of the Turkish spiny mouse. The marked points show the localities of individuals identified during field surveys.

On the other hand, it was determined that the species samples disappeared from these areas because of the road construction which had been done near the 2nd station between 2004 and 2005. At the end of the field surveys and the observations, it was reported that the settling has been gradually increased at the 3rd, 4th, 5th stations and the living space has been gradually reduced due to the destruction of the two stone pits. In addition to this, it was determined that animals like the cats and dogs which have been living around the area discomfited the species individuals, also the destruction of the natural plant communities affected the living conditions of the species in a negative way. It is concluded that the endemic species will disappear in the near future, if necessary precautions are not taken.

3.2 Habitat

The fragmented block form of calcareous rock comprising the spiny mouse habitat is rather poorly populated by plant species, but includes maquis, pine, olive tree, locust bean and oak trees (Fig. 2 and Table 3). Individual spiny mice were found in slits, fractures and deep perforations within the rocks. We caught a number of animals in traps in the 7-8 cm diameter holes very close to rock fractures or deep fissures, suggesting that individuals climbed from within the rock and

used these spaces for nesting. Spiny mice did not make nests under laboratory conditions, but instead used the boxes provided as shelter; their remarkable climbing ability was also apparent in the laboratory.

Observations in both the field and the laboratory indicated that the Turkish spiny mouse does not store food. When we investigated the contents of the stomachs of animals taken from the field, we typically found unidentified plant material together with many insect body parts and eggs and centipede (Chilopoda) mouth pieces (Table 2). In the field, we also found a large quantity of mollusc shells where spiny mouse individuals consume their food. In the laboratory, captive mice were mostly fed a vegetable diet for technical reasons, but they would also eat animal food (ants, raw meat etc.) and exhibited cannibalistic and infanticide behavior [18]. Thus, the combined results of field data and laboratory testing show that

the spiny mouse is omnivorous, but the preponderance of digested animal parts, rather than vegetable materials, in the stomachs of field samples suggest that it has a preference for feeding on animal material.



Fig 2: The habitat of *A. cilicicus*.

Table 3: The flora of the habitat

Scientific Name of Plant	Turkish Name [19]	Name of Plant [20]	Type of Plant
<i>Phillyrea latifolia</i>	Akçakesme	Jasmine Box	Bush
<i>Calycatome villosa</i>	Keçiboğan	Calicatome	Bush
<i>Phlomis sp.</i>	Çalba	Jerusalem Sage	Herbaceous
<i>Micromeria myrtifolia</i>	Boğumluçay	Micromeria	Herbaceous
<i>Styrax officinalis</i>	Ayıfındığı	Styrax	Bush
<i>Euphorbia sp.</i>	Sütleğen	Spurge	Herbaceous
<i>Echium sp.</i>	Engerekotu	Vipers Bugloss	Herbaceous
<i>Inula heterolepis</i>	Ak Andızotu	Flea-Bane	Herbaceous
<i>Pistacia lentiscus</i>	Sakız Ağacı	Mastiche	Bush
<i>Papaver sp.</i>	Gelincik	Poppy	Herbaceous
<i>Medicago sp.</i>	Karayonca	Alfalfa	Herbaceous
<i>Lathyrus sp.</i>	Mürdümük	Sweat Pea	Herbaceous
<i>Daphne sericea</i>	Tavukbüzüğü	Spurge Laurel	Bush
<i>Paliurus spina-christii</i>	Karaçalı	Blackthorn	Bush
<i>Salvia viridis</i>	Zarif Şalba	Sage	Herbaceous
<i>Olea europea var. oleaster</i>	Zeytin	Olive	Tree - Bush
<i>Drimia maritima</i>	Kum Örümcekotu	Urgenia	Herbaceous
<i>Trifolium sp.</i>	Yonca	Clover	Herbaceous
<i>Malva sylvestris</i>	Ebegümece	Musk Mallow	Herbaceous
<i>Bromus sp.</i>	Ibubukekini	Brome Grass	Herbaceous
<i>Galium sp.</i>	Yapışkanotu	Gallium	Herbaceous
<i>Pinpinella sp.</i>	Anason	Anise	Herbaceous
<i>Hieracium sp.</i>	Şahinotu	Mouse-Ear	Herbaceous
<i>Minuartia sp.</i>	Tıstısotu	Minuartia	Herbaceous
<i>Quercus coccifera</i>	Kermes Meşesi	Kermes Oak	Bush
<i>Ceratonia siliqua</i>	Keçiboynuzu	Carop- Bean	Tree – Bush
<i>Pinus brutia</i>	Kızılçam	Red Pine	Tree

4. Discussion

Lehmann [12], did the first record of *Acomys* species in Anatolia according to specimens caught in a house near Silifke. Later, in 1969, Lehmann [13] identified specimens taken from the same place as *A. nesiotis*. In 1978, Spitzenberger [9] described *Acomys* specimens taken from calcareous rock between 17 and 20 km from Silifke as a new species (*A. cilicicus*); at that time, the rock fields from which she collected specimens were already being destroyed by human activity. Spitzenberger [18] found that the rocks from which he took the specimens started to wear down and that there were no trace of *Acomys* species in the Nur Mountains and that the species which is closest to the species found in Anatolia was found in the south of Lebanon. All samples used by subsequent researchers [4, 15-18, 21] were taken from a rock field near Silifke. In this study, we established that *A. cilicicus* is only found near Silifke.

Following Spitzenberger's observations in 1978 that the rock fields near Silifke were under threat, Krystufek and Vohralik [16] reported that, during their field survey of the distribution of *A. cilicicus* in 2004, the habitat was divided in two by road works and that it was encroached upon by human settlements. These data conform with our research results and our conclusions that this species' distribution area is shrinking and is being degraded.

Mitchell [22] established that *Acomys* is widely distributed in Cyprus; these mice are found in hanging gardens, in hilly terrain and in a lowland valley in Limmasol, where they live in riddled, in slits and in hollows; they were also found in Agios Konstantinos at an elevation of 4000 feet. Spitzenberger [9] reported that *Acomys* live in various blocks of calcareous rock at an elevation of 600 feet in Cyprus, where plant communities include such species as maquis, locust bean (*Ceratonia siliqua*), gum (*Pistacia lentiscus*),

cypress (*Cupressus sempervirens*) and juniper (*Juniperus phoenicea*).

Zimmermann ^[23] described the Cretan *Acomys* (*A. minous*) as a rock animal whose diet probably includes snails, as evidenced by the mollusc shells found in their eating places. Dieterlen ^[24] stated that *A. minous* prefers a rock biotope and that this species enters gardens and houses in phrygana and has the ability to climb along escarpments and live in slits and fractures in rocks; they do not make nests.

Hoogstraal, Wassif and Kaiser ^[25] recorded that *A. dimidiatus* inhabited the rocks with simple vegetation and houses. Porter *et al.* ^[26] stated that *Acomys* use other rodents' nests rather than make their own. More recently, Nowak ^[27] reported that *Acomys* in the Middle East and in Africa live in rocky and dry land, in semi-desert areas and in savanna; Frynta ^[4] reached similar conclusions.

It was determined in this study that when *A. cilicicus* was compared with the similar species in the same clad (i.e. *A. nesiototes*, *A. minous*, *A. dimidiatus*), it shows great similarities with respect to distribution, habitat and diet.

According to IUCN (International Union for Conservation of Nature) ^[28] data, if the necessary measures are not taken urgently for this species, which is on the 1996 "Critically Endangered" list, i.e. if the rock fields where *A. cilicicus* lives are not given special protection status, this endemic species will inevitably soon be under the threat of extinction.

5. Conclusion

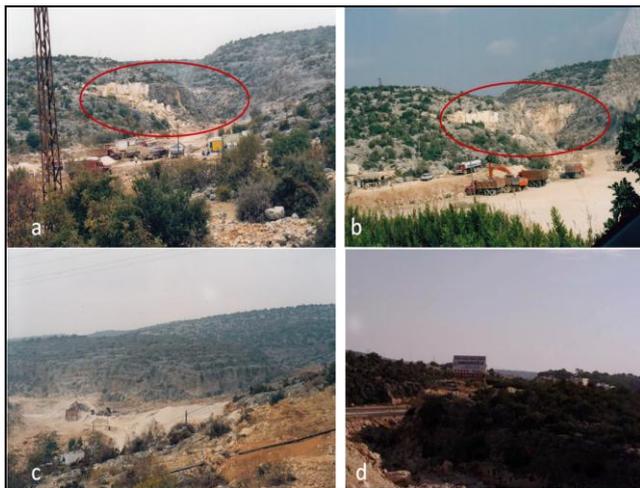


Fig 3: Photo of stone pit I in 2003 (a) and in 2007 (b), stone pit II (c), and the hotel in the habitat of *A. cilicicus* (d).

Invaluable information about the Turkish spiny mouse has been obtained following about eight years of laboratory studies and about 15 years of intermittent field surveys. The present study data, together with the results of the literature, provoke extreme concern for the future of this species, which is only distributed in a small area in the Silifke region of southern Turkey. The Turkish spiny mouse is under severe pressure in its current distribution area due to commercial activities such as road building, quarrying, the hotel and leisure trades, and shopping centers etc. built along the coast. The destruction of rock fields to allow the building of homes and farms, which continues today, together with the spoliation of the natural flora in rocky areas by grazing, cutting or burning, reduces the available living area for this vulnerable species and poses a significant and ongoing threat to its future (Fig. 3).

The disappearance of this species will be a major loss for the fauna of Turkey and for the world of science.

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