Bioecology of the Wild Boar (*Sus scrofa* Linnaeus 1758) in Kırıkkale Province, Turkey

Kırıkkale (Türkiye) İlindeki Yaban Domuzunun (*Sus scrofa* Linnaeus 1758) Biyoekolojisi

Research Article

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ABSTRACT

The bioecology of the wild boar *Sus scrofa* was studied in the Turkish province of Kırıkkale using field observations and examination of 21 specimens collected from 2001 to 2003. Habitat, some breeding features, and morphometric data were recorded. The wild boar in Kırıkkale occurs mainly in forests, marshy areas and dense scrub. It selects scrub areas near hill tops as daytime resting sites. It feeds on some agricultural products in summer and is often hunted to prevent such damage. It produces its young in April and May. Morphometric data from specimens examined were consistent with the Turkish wild boar belonging to the nominate subspecies *Sus scrofa scrofa* but its taxonomy does merit further investigation.

Key Words
Wild boar, Suidae, ecology, taxonomy, Turkey

ÖZET

Yaban domuzu, *Sus scrofa*'nın biyoekolojisi Türkiye'nin Kırıkkale ilinde yapılan arazi gözlemleri ve 2001 ila 2003 yıllarında toplanan 21 örneğin incelenmesi ile araştırıldı. Habitat, bazı üreme özellikleri ve morfometrik veri kaydedildi. Kırıkkale'deki yaban domuzu ormanlarda, bataklık alanlarda ve yoğun çalılıklarda bulunur. Yaban domuzu gündüz dinlenme yeri olarak tepelerin zirvesine yakın çalılık bölgeleri seçer. Kırıkkale'deki yaban domuzu yazın bazı tarım ürünleriyle beslenir ve bu gibi zararları önlemek için sık sık avlanır. Yaban domuzu nisan ve mayıs ayında yavru verir. İncelenen örneklerden elde edilen morfometrik veriler Türkiye yaban domuzunun ait olduğu nominatif alttür, *Sus scrofa scrofa*'ya uygunluk göstermekte, fakat yaban domuzunun taksonomisi için daha fazla araştırmaya gerek vardır.

Anahtar Sözcükler
Yaban domuzu, Suidae, ekoloji, taksonomi, Türkiye

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INTRODUCTION

The wild boar *Sus scrofa* is distributed in Europe, Asia and North-West Africa, and as an introduced species in South Africa, Australia, New Zealand, United States and Argentina (Corbet and Southern, 1977; Lever, 1985; Dardaillon, 1987; Oliver and Brisbin, 1993; Genov, 1999). Up to 26 subspecies have been described (Ellerman and Morrison-Scott, 1951; Epstein, 1971; Groves, 1981; Mayer and Brisbin, 1991; Oliver, 1995). However, Genov (1999) recognised only four subspecies as valid; *Sus scrofa scrofa, S.* s. *ussuricus, S.* s. *cristatus* and *S.* s. *vittatus,* and grouped those found in Turkey with the nominate subspecies as *S. s. scrofa*.

The wild boar is the only member of the Suidae present in Turkey and was first reported by Gray (1868). There are limited records available concerning the distribution, ecology, biology and taxonomy of the species in Turkey (Tunçok, 1935; Ellerman and Morrison-Scott, 1951; Mohr, 1960; Huş, 1967; Groves, 1981; Turan, 1984; Mayer and Brisbin, 1991; Genov, 1999). However, wild boar are an important game species in Turkey (Eroğlu, 1995) and have the potential to cause damage to agricultural crops (Andrzejewski and Jezierski, 1978; Genov, 1981; Schley and Roper, 2003; Wilson, 2004). They are therefore of interest both economically and ecologically.

The present study aims to reveal for the first time some biological and ecological characteristics of *Sus scrofa* in Turkey and to help clarify its taxonomic status.

MATERIALS AND METHODS

Study area

Kırıkkale province is located in the central Anatolian region (33°31′-E, 39°50′-N) and occupies an area of 4615 km^2. It is surrounded by Koçudağı mountain (1778 m) lying NW-SE, Dinek mountain chain (1742 m) S-SE and Küre mountain (1450 m) NE-SW. Mean altitude of the province is 700 m. The total estimated forest area is 49530 ha (approx 11% total area), composed of a mixture of oak (*Quercus* sp.) and pine (*Pinus* sp.) forest. The remainder of the area is dominated by farmland and open steppes (grass steppes and tragacanthic steppes). *Quercus* spp. Fabaceae, Asteraceae and Poaceae are the dominant vegetation types in the area. A detalied description of the vegatation is given by Dönmez (2002). Crops plants grown include wheat *Triticum aestivum,* barley *Hordeum vulgare,* sunflower *Helianthus annus,* and beet *Beta vulgaris*.

In addition to wild boar, the other large mammals inhabiting the area include red fox *Vulpes vulpes,* badger *Meles meles* and wolf *Canis lupus*.

Kırıkkale has a terrestrial climate, with mean annual tempature 12.5°C and precipitation 354 mm/year. The coldest month is January (average -3°C) and hottest month is July (average 27.6°C).

Field observations

Field studies were concentrated in the wildlife areas of Sulakyurt, Balişeyh and Delice district, which contain almost 70 percent of the total forest area in Kırıkkale. Ecological data were obtained from direct observations of animals in the field, animals shot, winter tracking and rooting damage to grassland or damage to crops. Boar damage was identified from feeding and snout marks, faeces, live sightings and farmer complaints. Observations were made periodically, at night between 23:00 and 08:00 h for direct observation of the animals to record habitat use, group size and composition, and in daylight, between 08:00 and 15:00 h, primarily to inspect for damage, field signs and record home range characteristics and habitat use. Field observations were made from March 2001 to october 2003. Nighttime and daytime observations were made at two hours intervals. The time and frequency of direct observations were recorded according to the habitat type and season in which the animals were seen.

Taxonomic data

Specimens of wild boar were obtained from animals shot dead by hunters or caught alive during the field studies from 2001 to 2003. The animals were divided into three age-groups; infant, juvenile and adult, depending on their cranial and dental structure, coat colour body size and field notes. Where possible, live-weight,

Table 1. A list of species recorded in the habitat of the wild boar in Kırıkkale, Turkey (Plant specimens were identified using the Flora of Turkey (Davis, 1965-1985; Davis et al, 1988; Güner et al, 2000).

ANIMALS

Vertebrates
Pisces
Barbus plebejus
Capoeta tinca
Chondrostoma narus
Esox lucius
Leuciscus cephalus
Silurus glanis
Sander lucioperca
Tinca tinca
Amphibia
Bufo bufo
Rana ridibunda
Reptilia
Lacerta sp.
Mauremys caspica
Natrix sp.
Testuda graeca
Aves
Accipiter nisus
Falco **sp.**
Perdix perdix
Coturnix coturnix
Passer **sp.**
Oriolus oriolus
Fringilla coelebs
Phalacrocorax carbo
Sturnus vulgaris
Parus ater
P. major
Buteo buteo
Ciconia ciconia
Fulica atra
Egretta garzetta
Anas sp.
Actitis sp.
Ardea cinerea
Tadorna ferruginea
Mammalia
Insectivora
Erinaceus concolor
Crocidura leucodon
Lagomorpha
Lepus europaeus
Rodentia
Sciurus anomalus
Spermophilus xanthoprymnus
Cricetulus migratorius
Microtus hartingi
Microtus rossiaemeridionalis
Meriones tristrami
Nannospalax leucodon
Apodemus mystacinus
Apodemus sylvaticus
Allactaga williamsi
Carnivora
Canis lupus
Vulpes vulpes
Mustela nivalis
Martes foina
Meles meles
Lutra lutra
Invertabrates
Potamon sp.
Helix pomatia
Lumbricus terrestris

PLANTS

Wild Plants
Apiaceae
Astrodaucus orientalis
Echinophora tournefortii
Eryngium campestre
Asteraceae
Achillea setacea
Anthemis sp.
Centaurea solstitialis
C. virgata
Cichorium intybus
Cirsium arvense
Echinops sp.
Senecio vernalis
Berberidaceae
Berberis crataegina
Boraginaceae
Anchusa sp.
Heliotropium lasiocarpum
Brassicaceae
Brassica elongata
Caryophyllaceae
Cerastium dichotomum
Dianthus zonatus
Chenopodiaceae
Atriplex sp.
Chenopodium album
Salsola ruthenica
Convolvulaceae
Convolvulus holosericeus
Cruciferae
Alyssum hirsutum
Capsella bursa pastoris
Cupressaceae
Juniperus oxycedrus
Cuscutaceae
Cuscuta planiflora
Cyperaceae
Bolboschoenus maritimus
Elaeagnaceae
Elaeagnus angustifolia
Ephedraceae
Ephedra major
Euphorbiaceae
Euphorbia arvalis
E. macroclada
Fabaceae
Astragalus hamosus
A. densifolius
A. plumosa
A. microcephalus
Melilotus officinalis
Ononis spinosa
Trifolium arvens

four standard external measurements (Moretti, 1995), 15 cranial and 6 dental measurements were recorded according to Mayer and Brisbin (1991), Harrison and Bates (1991) and Genov (1999). In addition, the shape of the lacrimal bone and the rear margin of the palatum durum were evaluated according to Genov (1999).

Specimens were either prepared as a complete skeleton, preserved as embryos in 70% alcohol, or were skulls only. Skull measurements were made using a pair of callipers (accuracy 0.02 mm).

A test for significant differences between the measurements of our adult specimens and those recorded in the literature from other parts of the wild boar's range was carried out using a Student's-t test.

RESULTS

In the study area, wild boar were observed 15 times as large groups and 13 times as solitary individuals. All the solitary individuals observed were adult males.

Table 2. Number of times wild boar were observed per habitat type and season.

Habitat Type	Spring (Mar-May)	Summer (Jun-Aug)	Autumn (Sept-Nov)	Winter (Dec-Feb)	All seasons
Oak Forest	7	3	4	3	17
Pine forest	2	1	4	3	10
Scrub	2	1	1	2	6
Farmland	6	3	2	4	15
All Habitat Type	17	8	11	12	48

Animals in groups included adult females, juveniles and piglets. For animals seen in groups, mean group size and standard deviation were found to be 21.73 ±10.95 (range 11 to 42). Wild boar were most commonly observed in forests dominated by oak trees (*Quercus pubescens*) or pine trees (*Pinus nigra*) (Table 1). They were also recorded in dense scrub and in partly wooded agricultural areas in river valleys. More than 58 animal and 122 plant species were recorded in the habitat of the wild boar (Table 2).

Wild boar in Kırıkkale were most often active and observed at night (80% of all observations). They are less active during the day and dig shallow pits amongst bushes near small hill tops where they shelter and rest during this time. Of the total of 36 such bedding sites found during the study, 21 were found in summer and 15 in winter. Of the bedding sites found in summer 66.67% (14) occured on north-facing slopes while of those found in winter 66.67% (10) were on south-facing slopes.

Wild boar damage to farm crops was recorded in all seasons of the year but mainly from spring to autumn. Fruit and vegetables were mainly consumed in summer, but damage to cornfields was also recorded in winter (Table 3).

Four direct observations of litter size were made; one of 5 embryos in a female wild boar killed by hunters in March 2002 one of two newly-born piglets seen in April 2003, a sow seen with six piglets in May 2002 and a sow seen with eight piglets in April 2003.

A total of 21 wild boars collected between November 2001 and August 2003 was examined (Table 4; Figure 1). Standard cranial and dental measurements for adult wild boar were compared with other published data (Table 5).

DISCUSSION

Wild boar habitat in Kırıkkale is very variable and rich in plant and animal species including both natural/semi-natural and agricultural habitats. Wild boar can damage agricultural crops and grassland by rooting or directly feeding on crops such as maize, cereals or potatoes (Genov, 1981; Dardaillon 1986; Wilson, 2004). Wilson (2004) reported that most wild boar damage caused by a feral population in England was rooting of grassland in January, February and March, whereas in our study the greatest damage reported was to wheat, maize and chickpeas in June, July and August. Wild boar are hunted in

Table 3. Records of feeding signs (S; not considered significant damage) /damage (D; where crop yield considered to be affected) per season for each crop type.

Crop type	Spring (Mar-May)	Summer (Jun-Aug)	Autumn (Sept-Nov)	Winter (Dec-Feb)
Cornfields	D	-	D	D,S
Chickpea	D	D	S	-
Wheat	D	D	D,S	-
Grape	D	D	S	-
Barley	D	D	S,D	-
Beetroot	D	D,S	S,D	-

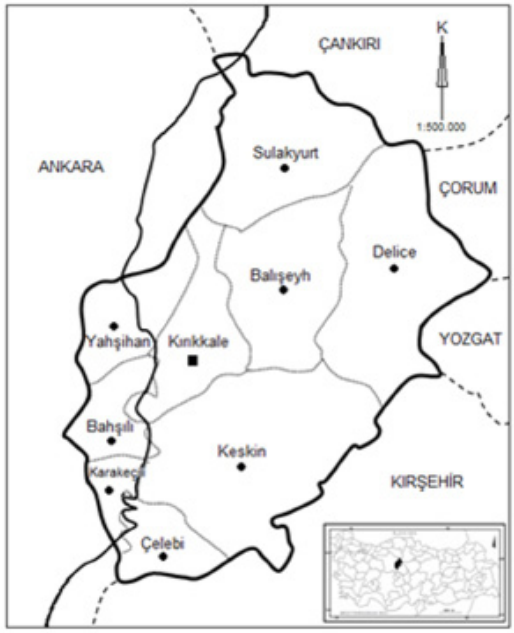

Figure 1. Localities of ***Sus scrofa*** in the province of Kırıkkale.

the study area to prevent such damage, though also, but rarely, for their meat. Hunting is a major pressure on wild boar in this province because they are the target of hunters throughout year.

Although wild boar mainly use forest and scrub during daylight, they use farmland at night and the damage they cause in farmlands is the main reason that they are hunted in Turkey (Tunçok, 1935; Erençin, 1979). Bodenheimer (1936) gave similar records of damage specifically on fruits and vegetables and Harrison and Bates (1991) on grains. In this study, our results also showed the damage caused by the wild boar on vegetables, fruits and other farm crops during winter and summer, and were thus in accordance with those found elsewhere.

Previous studies record that the wild boar occupies habitats such as dense forests, bushes and swamps near lakes or rivers (Tunçok, 1935; Erençin, 1977; Huş, 1967; Turan, 1984). Harrison and Bates (1991) reported that the wild boar lives in wooded areas, reedy fields, swamps areas and semi desert areas. Spitz (1999) stated that wild boars live in muson forests and vegetations near rivers. In our study, habitats of the wild boar in Kırıkkale show similarities with information given in the literature, except for the use of semi-desert areas.

The wild boar feeds on plant foods such as beech, acorns, chestnut, wild herbs and roots, cereals, legumes, corn, potato, beetroot, jerusalem artichoke, marrow, tomato, lentil, chickpea, hazelnut, walnut, cornelian cherry, mulberry, strawberry, grape, turnip and with animal foods such as earthworms, birds and bird eggs, snails, grasshopper eggs, small mammals, mouse, snakes and carrion (Tunçok,1935; Huş, 1967; Turan, 1984). Harrison and Bates (1991) recorded that the wild boar feeds on insect larvae, small vertebrates, swamp plants, aquatic tubers, cherries, strawberries and garden plants.

It was determined that the wild boar in this study area feeds on acorn, plant root under snow layer and almond seed in winter and on fruit and vegetables in summer, and it prefers more plant foods for feeding.

Gray (1868) described *Sus libycus* on the basis of a skull recorded from southwest Anatolia, near Günek (Xanthus-Muğla) by Fellow. The skull, examined at the British Museum, was found to be quite different from other recorded specimens and was therefore suggested to be representative of a new species (Gray, 1868). Subsequently, Ellerman and Morrison Scott (1951) regarded *S. scrofa libycus* as a subspecies of *S. scrofa*. Similarly, Mohr (1960) and Mursaloğlu (1964) recorded the wild boar as *S. scrofa libycus* without reporting any specimen in Turkey. Groves (1981) and Mayer and Brisbin (1991) determined that the Turkish wild boar is *S.* s. *libycus,* based on Harrison's data (1973) and eight specimens (three without any localities) respectively.

When our skull measurements are compared with those by Gray (1868) our samples display lower values only as regards skull length and skull height. Compared with nine skull measurements quoted by Harrison and Bates (1991), Mayer and Brisbin (1991), our samples displayed lower values as regard skull length, zygomatic breadth, mandibular toothrow length and mandible length, but had higher values as regards condylobasal length and braincase length. The values of the samples from Iraq, Syria and Israel compared with those of Kırıkkale showed a difference only between the condylobasal lenght ($p \leq 0.001$) of the adult females. However, the limited number of the samples compared does not give a

Table 4. Wild boar specimens examined in Kırıkkale.

Location	Date	Adult	Juvenile	Infant	Live Weight	Notes
Bardakçı District in Sulakyurt	04/11/01		1 female		not recorded	
Geçitpınar District in Sulakyurt	06/02/02	1 male 1 sex unknown			not recorded	Skull only Skull only
Battalobası Village in Balışeyh	30/03/02	1 female			67.5	+5(3♂♂ 2♀♀) embriyos
Çoraklı District in Delice	31/03/02	1 female			not recorded	Skull only
Killik District in Delice	06/04/02		1 female		37	
Ören District in Delice	06/04/02		1 male		48	
Kalekışla Village in Sulakyurt	11/04/02	1 female			not recorded	Skull only
Seyidim District in Sulakyurt	11/07/02	1 male			63	
Tütünna District in Keskin	18/07/02	1 male			not recorded	Skull only
Ada District in Sulakyurt	22/08/02		1 male	1 male	not recorded 17	
Kağnıçayı District in Sulakyurt	14/04/03			1 male 1 female*	12.5 27.5	released
Yayla District in Sulakyurt	12/07/03	1 female			not recorded	Skull only
Keklikkaya District in Keskin	12/07/03	1 female			not recorded	Skull only

*of the 21 wild boars, one was released to the nature.

Table 5. Comparison of seven cranial and two dental measurements of *Sus scrofa* from Iraq, Syria and Israel (Harrison and Bates, 1991), Turkey, Syria and Israel (Mayer and Brisbin, 1991) and Kırıkkale.

Measurement	*S. scrofa* Iraq, Syria, Israel					*S. s. libycus* Turkey, Israel, Syria				Turkey (This study)				
	Sex	n	r	M	±SD	n	R	M	SD	n	R	m	±SD	p- Value
Greatest skull length	♂	7	394-460	435.7	23					3	404- 411	409.0	4.3	0.026
	♀	5	381-409	396.2	13.4					3	393-398	396.4	2.6	0.976
Conylobasal length	♂	7	348-390	378.4	15.3	6	340-401	362.7	-	3	395-401	399.0	2.6	0.014
	♀	4	339-360	354.5	6.1	2	320-355	340.7	-	3	385-389	386.5	2.3	0.001
Nasal length	♂					6	194-250	215.8	-	3	208-209	208.6	0.5	-
	♀					2	175-195	186.7	-	3	198-203	201.3	2.8	-
Zygomatic breadth	♂	6	163 -174	168.3	4.4	6	145-160	157.0	-	3	136-152	142.6	8.5	0.039
	♀	4	147-157	153.8	2.8	2	136-157	148.0	-	3	137-148	143.1	5.5	0.091
Braincase breadth	♂	3	86-96	89.7	5.5		-	-		3	98-102	100.5	1.5	0.082
	♀	4	77-87	84.0	5		-	-		3	93-98	96.1	2.6	0.014
Interorbital breadth	♂	7	80- 97	90.0	6.1		-	-		3	84-89	87.1	3	0.348
	♀	4	74-82	81.0	4.8		-	-		3	77-82	80.9	3.6	0.976
Maxillary toothrow length	♂	7	164-185	170.1	7.1		-	-		3	160-165	163.6	3.2	0.086
	♀	5	153-166	159.2	4.7		-	-		3	152-159	155.1	3.8	0.235
Mandibulary toothrow length	♂	7	168-195	183.1	9.9		-	-		3	175-177	176.6	0.5	0.134
	♀	5	168-178	170.4	4.5		-	-		3	159-169	164.2	5.1	0.181
Mandible length	♂	6	315-360	335.8	17.9	6	282-323	297.3	-	3	317-320	319.0	2	0.072
	♀	5	273-323	310.8	21.5	2	253-279	266.3	-	3	293-298	295.8	2.5	0.198

conclusive comparison according to Harrison and Bates (1991) and Mayer and Brisbin (1991).

Genov (1999) used different taxonomic characters to describe and review subspecies of wild boar. He concluded that the Turkish wild boar beloged to the nominal subspecies *Sus scrofa scrofa*. Genov (1999) described the nominal subspecies *S. s. scrofa* as having the concavity of cranium profile for males 5.48-20.00; ratio between the height of lacrimal bone at the orbit and lower suture length 0.58-0.79 for males and 0.60-0.86 for females; form of the lacrimal bone rectangular and trapezoid; combination of the shapes of the lacrimal bone and rear end of the palatum durum of the male specimens 1/1 3/1, 1/3, 3/3 and female 1/1, 1/3, 2/1, 3/1, 3/3. Our specimens measurements are 17.20-18.50; 0.58-0.75 and 0.61-0.70; 3/1, 1/3 and 3/1,3/3, respectively. Thus there appears to be a similarity between our material and descriptive measurement quoted from Genov (1999). Our results are consistent with Genov's placing of the Turkish wild boar in the nominate subspecies *Sus scrofa scrofa*.

Limited observations of litters or embryos in our study are indicated that Kırıkkale Province young wild boar are born in April or May, suggesting oestrus takes place in November or December and mating in December or January.

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