

## Population estimate and body size of European pond turtles (*Emys orbicularis*) from Pazaragaç (Afyonkarahisar/Turkey)

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**Abstract:** Data on population size, adult sex ratio, body size and mass are provided for a population of the turtle *Emys orbicularis* near Pazaragaç (Afyonkarahisar/Turkey). Using the mark-recapture method (triple catch), a population size of 664 turtles was estimated (95% confidence interval, range 332–996), corresponding to a density of 83 turtles per hectare (range 41.5–124.5). The adult sex-ratio was significantly skewed in favor of males (2.02 males : 1 female;  $P < 0.001$ ). Almost all recorded specimens were adult (98.1%). Mean straight carapace length (SCL) and body mass (BM) of adult turtles were: SCL = 128.65 mm, BM = 345 g for males ( $n = 168$ ) and SCL = 135.37 mm, BM = 463 g for females ( $n = 83$ ).

**Key words:** *Emys orbicularis*; freshwater turtle; population size; body size; sex ratio; Turkey

### Introduction

The European pond turtle, *Emys orbicularis* (L., 1758), occupies a large range, spanning from North Africa in the west over most of Europe and the Middle East to as far east as the Aral Sea (Fritz 1998, 2001, 2003). The species is distributed in almost all regions of Turkey (Baran & Atatür 1998). While during the past twenty years studies on demography have been conducted for many European populations (see reviews in Fritz 2001, 2003), only few, mainly anecdotal data are available for Turkish populations (Baran et al. 1992; Taşkavak & Reimann 1998; Ayaz 2003). Until now, only one study focused on ecological aspects of a population in Turkey (western Asia Minor; Auer & Taşkavak 2004).

The European pond turtle is considered endangered in many parts of its range (Fritz & Andreas 2000). Associated with an intensification of agriculture and water management, the turtle becomes also in Turkey increasingly threatened by the loss of suitable habitats. Investigations screening local population size and structure are in dire need as such data constitute the prerequisite for any conservation measures. The current paper provides data on population size and density, adult sex ratio, body size and body mass for a pond turtle population in Afyonkarahisar Province, Turkey.

### Material and methods

Our study was carried out in Pazaragaç, (38°36' N, 30°51' E, 983 m a.s.l.) in Çay Township of Afyonkarahisar Province, Turkey. The study area is surrounded by Mt. Emirdağ in the north, Lake Eber in the east and the Sultan mountain range in the south. Climatic conditions in the study area are mainly continental, with a mean annual temperature of 11.2°C and annual rainfall of 455.4 mm (Turkish Ecology Foundation 1993). The study area covers an 8-hectare territory consisting of marshes and wetlands. Dominant vegetation consists of *Juncus litoralis* in marshes, *Typha angustifolia* and *Phragmites australis* in wetlands, and *Oenante pinpineloides* and *Eleocharis palustris* in water bodies.

For obtaining an estimation of population size, the annual season with the highest activity of turtles was chosen. Turtles were captured by four researchers on June 3, June 8 and June 13, 2005 between 09.00–12.00 a.m. and 14.00–17.00 p.m.. Various capture methods were applied to minimize any potential bias caused by the collection method (Kotenko 2000). Turtles were caught by net, hand or using fish traps set in eight different points early in the morning and checked three times until 17.00. Each captured turtle was individually marked by notching its marginal scutes (Gibbons 1990) before released. Each individual was measured (straight carapace length = SCL, and plastron length = PL) using a caliper to the nearest 0.1 mm, and body mass was recorded to the nearest 10 g using 1.5 kg Pesola scales. Sex was determined by secondary sex characteristics (Zuffi & Gariboldi 1995). The smallest turtle (a male) with

Table 1. Capture history of Pazarağaç population of *Emys orbicularis*.

	3 June			8 June			13 June		
	M	F	J	M	F	J	M	F	J
Captured				70 ( $n_2$ )	38 ( $n_2$ )	3 ( $n_2$ )	64 ( $n_3$ )	32 ( $n_3$ )	0 ( $n_3$ )
Day 1-marked				8 ( $m_{21}$ )	5 ( $m_{21}$ )	0 ( $m_{21}$ )	7 ( $m_{31}$ )	2 ( $m_{31}$ )	0 ( $m_{31}$ )
Day 2-marked							9 ( $m_{32}$ )	5 ( $m_{32}$ )	0 ( $m_{32}$ )
Released	58 ( $r_1$ )	25 ( $r_1$ )	2 ( $r_1$ )	70 ( $r_2$ )	38 ( $r_2$ )	3 ( $r_2$ )			

Key: M – males; F – females; J – juveniles;  $n_i$  – number of individuals caught on day  $i$ ;  $r_i$  – number of marked individuals released on day  $i$ ;  $m_{ij}$  – number of individuals caught on day  $i$  with a day  $j$  mark.

Table 2. Straight carapace length (SCL), plastron length (PL) and body mass (BM) of *Emys orbicularis* from Pazarağaç (mean, standard deviation, minimum and maximum).

	SCL (mm)		PL (mm)		BM (g)	
Juveniles ( $n = 5$ )	98.80 (6.42)	91.2–108.4	87.40 (3.78)	83.6–93.8	167 (20.8)	145–195
Males ( $n = 168$ )	128.65 (8.66)	111.3–153.2	111.34 (8.51)	93.4–134.5	345 (64.7)	145–515
Females ( $n = 83$ )	135.37 (6.62)	120.6–151.1	127.58 (5.97)	114.7–140.8	463 (61.5)	295–610

secondary sex characteristics measured 111.3 mm SCL and smaller specimens were considered juveniles.

We assumed that the population was closed (no births, deaths or migration), acknowledging the brief study period. Population size was estimated using the triple catch method and tested by Peterson's estimate (Begon 1979). Confidence Intervals (CI) of 95% were calculated according to Robson & Regier (1964); a  $t$ -test was applied to examine differences in SCL, PL and body mass (BM) between sexes.

## Results

A total of 256 turtles (168 males, 83 females and 5 juveniles) were marked and 36 individuals were recaptured (Table 1). According to these data, population size was estimated at  $642 \pm 154$  (95% CI, 321–963) on day 2. On day 3, population size was estimated at 685 (95% CI, 342.5–1027.5), resulting in an average of 664 (95% CI, 332–996; triple catch). This corresponds to 83 (41.5–124.5) individuals per hectare. Mean body mass is 384 g, leading to a biomass estimation of 32 (16–48) kg per hectare. We also used Peterson's estimator to calculate population sizes on days 2 and 3. The results were found to be very similar, with population sizes being 726 (363–1089) and 764 (382–1146) on days 2 and 3; respectively.

Distribution of size classes (Fig. 1) revealed that samples consisted mainly of adults (98.1%). The sex-ratio of all captured adult turtles was significantly skewed in favor of males (2.02 males : 1 female;  $\chi^2 = 28.78$ ,  $df = 1$ ,  $P < 0.001$ ). Females are bigger and heavier than males ( $t$ -test, for SCL:  $t = 6.20$ ,  $df = 249$ ,  $P < 0.001$ ; for PL:  $t = 14.90$ ,  $df = 249$ ,  $P < 0.001$ ; for BM:  $t = 12.54$ ,  $df = 249$ ,  $P < 0.001$ ; Table 2).

## Discussion

Despite the low percentage of juvenile turtles, our data suggest that at Pazarağaç a thriving local population

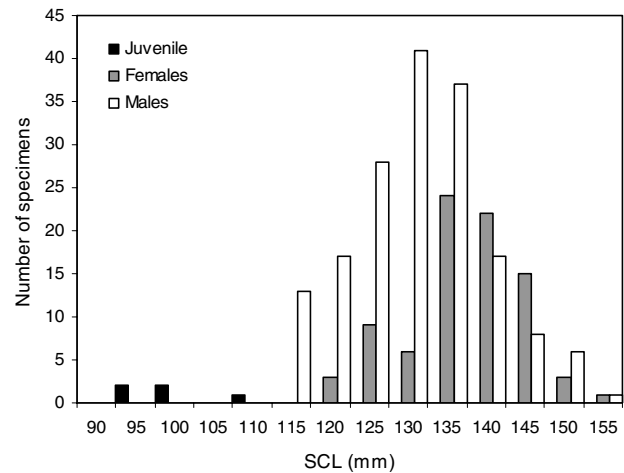


Fig. 1. Size distribution (SCL) of 256 *Emys orbicularis* specimens captured in Pazarağaç (not considering the recaptures).

lives. The recorded high individual densities could serve as an example for an intact, thriving population. The biased sex ratio suggests different survival rates of both sexes, perhaps correlated with a higher predation of nesting females. Also in another western Turkish pond turtle population a male-biased sex ratio was recorded (Auer & Taşkavak 2004), and in many other localities as reviewed in Fritz (2001, 2003).

We believe that the low rate of only 1.9% juveniles does not reflect the real percentage. In other studies distinctly higher percentages of juveniles were found, e.g., Doñana Reserve, Spain: approx. 20% (Keller 1997); Menorca, Spain: 12% (Braitmayer et al. 1998); two local populations in Brenne, France: 15% and 30% (Servan 1987, 1998). It is well-known that juvenile European pond turtles prefer small, shallow water bodies (e.g. puddles) with dense vegetation, where they can easily find food and protection from predators, and lead a more cryptic life compared to adults (e.g., Zuffi 2000;

Mosimann & Cadi 2004). Such water bodies were not the main target of the present study.

Adult body mass and size of the Pazarağaç population correspond with many other small-sized populations of the turtle in the south of the species' range (Fritz 2001, 2003). In Turkey a quite complicated pattern emerges, however, some populations from the Central Anatolian Plateau are large-sized, with maximum shell lengths of approximately 200 mm, while other Central Anatolian populations and populations along the Aegean and Mediterranean coasts reach at best maximum sizes resembling the Pazarağaç population (Fritz 2001, 2003; Taşkavak & Ayaz 2006). Further data are needed for a better understanding of the underlying pattern that could to be correlated with taxonomic differences and/or climatic factors. We also need additional investigations comparing ecological parameters of these morphologically distinct populations as different reproductive strategies are likely, considering the well-known correlation of body size with clutch size and frequency in *E. orbicularis* (Fritz 2001, 2003).

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#### References

Auer M. & Taşkavak E. 2004. Population structure of syntopic *Emys orbicularis* and *Mauremys rivulata* in western Turkey. *Biologia, Bratislava* **59**, Suppl. 14: 81–84.

Ayaz D. 2003. Investigations on the systematical states, morphologies, distributions, breeding and feeding biology of *Emys orbicularis* (Testudinata: Emydidae) and *Mauremys rivulata* (Testudinata: Bataguridae) from the Lakes District and eastern Mediterranean region. PhD. Thesis, Ege University, 239 pp.

Baran İ. & Atatür M.K. 1998. Türkiye Herpetofaunası. T.C. Çevre Bakanlığı Yayınları, Ankara, 214 pp.

Baran İ., Yılmaz İ., Kete R., Kumlutaş Y. & Durmuş S.H. 1992. Batı ve Orta Karadeniz Bölgesinin Herpetofaunası. *Turk. J. Zool.* **16**: 275–288.

Begon M. 1979. Investigating Animal Abundance: Capture-recapture for Biologists. University Park Press, Baltimore, 97 pp.

Braitmayer N., Fritz U., Mayol J. & Pieh A. 1998. Die Europäische Sumpfschildkröte (*Emys orbicularis*) Menorcas. *Elaphe* **4**: 57–60.

Fritz U. 1998. Introduction to zoogeography and subspecific differentiation in *Emys orbicularis* (Linnaeus, 1758). *Mertensiella* **10**: 1–27.

Fritz U. 2001. *Emys orbicularis* (Linnaeus, 1758) – Europäische Sumpfschildkröte, pp. 343–515. In: Fritz U. (ed.), *Handbuch der Reptilien und Amphibien Europas, Band 3/IIIA: Schildkröten I*, Aula, Wiebelsheim.

Fritz U. 2003. Die Europäische Sumpfschildkröte. *Laurenti, Bielefeld*, 224 pp.

Fritz U. & Andreas B. 2000. Distribution, variety of forms and conservation of the European Pond Turtle. *Chelonii* **2**: 23–27.

Gibbons J.W. 1990. Turtle studies at SREL: a research perspective, pp. 19–44. In: Gibbons J.W. (ed.), *Life History and Ecology of the Slider Turtle*, Smithsonian Institution Press, Washington, D. C.

Keller C. 1997. *Ecología de las poblaciones de Mauremys leprosa y Emys orbicularis del Parque Nacional de Doñana*. PhD. Thesis, Univ. Sevilla, 197 pp.

Kotenko T.I. 2000. The European pond turtle (*Emys orbicularis*) in the steppe zone of the Ukraine. *Stapfia* **69**: 87–106.

Mosimann D. & Cadi A. 2004. On the occurrence and viability of the European pond turtle (*Emys orbicularis*) in the Moulin-de-Vert (Geneva, Switzerland): 50 years after first introduction. *Biologia, Bratislava* **59**, Suppl. 14: 109–112.

Robson D.S. & Regier H.A. 1964. Sample size in Petersen mark recapture experiments. *Trans. Amer. Fish. Soc.* **93**: 215–226.

Servan J. 1987. Use of radiotelemetry in an ecological study of *Emys orbicularis* in France, first results, pp. 357–360. In: Van Gelder J.J. & Bergers P.J.M. (eds), *Proceedings of the 4<sup>th</sup> Ordinary General Meeting of the Societas Europaea Herpetologica*, Faculty of Sciences/SHE, Nijmegen.

Servan J. 1998. Ecological study of *Emys orbicularis* in Brenne (Central France). *Mertensiella* **10**: 245–255.

Taşkavak E. & Ayaz D. 2006. Some investigations on the taxonomic status of *Emys orbicularis* from the Aegean and Central Anatolian regions of Turkey. *Pakistan J. Biol. Sci.* **9**: 574–581.

Taşkavak E. & Reimann M. 1998. The present status of *Emys orbicularis* (Linnaeus, 1758) in southern Central Anatolia. *Mertensiella* **10**: 267–278.

Turkish Ecology Foundation. 1993. *Wetlands of Turkey*. Türkiye Çevre Vakfı Yayını, Önder Matbaası, Ankara, 225 pp.

Zuffi M.A.L. 2000. Conservation biology of the European pond turtle *Emys orbicularis* (L.) in Italy. *Stapfia* **69**: 219–228.

Zuffi M.A.L. & Gariboldi A. 1995. Sexual dimorphism in Italian populations of the European pond terrapin, *Emys orbicularis*, pp. 124–124. In: Lorente G.A., Montori A., Santos X. & Carretero M.A. (eds), *Scientia Herpetologica*, Proc. 7<sup>th</sup> Ord. Meet. SHE, SEH/AHE, Barcelona.

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