North-Western Journal of Zoology Vol. 4, No. 1, 2008, pp.154-160
[Online: Vol.4, 2008: 19]

Notes on morphological anomalies observed in specimens of *Testudo hermanni boettgeri* Gmelin, 1789 (Reptilia: Chelonia: Testudinidae) from Southern Dobrudja, Romania

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Abstract. Two tortoises with mixed characters between *Testudo hermanni boettgeri* and *T. graeca ibera* were discovered during a trip in "Canaraua Fetii Forest" Mixed Nature Reserve (southern Dobrudja, Romania). A hybridization event was suspected. According to external qualitative morphological characters, our preliminary results suggest two morphologically anomalous *T. h. boettgeri*. The two specimens displayed mostly typical *T. h. boettgeri* morphological characters, but also anomalous characters, which are typical for *T. g. ibera* (e.g. the existence of horny spurs on the internal part of the thigh).

Key words: *Testudo hermanni boettgeri*, *T. graeca ibera*, mixed morphological characters, Canaraua Fetii Forest, Dobrudja, Romania

The Hermann's tortoise (*Testudo hermanni*) has an isolated distribution in continental Spain, France and Italy, and on Mallorca and Menorca (Balearic Islands), respectively in Corsica, Sardinia and Sicily. It inhabits most of the Balkan Peninsula in the eastern Mediterranean, while in the western Mediterranean it is confined to areas with a Mediterranean climate. However, on the Balkan Peninsula, it can be found in inland regions under the influence of continental climate such as in Bosnia-Herzegovina, Serbia and Montenegro, the Republic of Macedonia, Romania and Bulgaria (Cheylan 1999, Fritz et al. 2006b). In Romania the eastern Hermann's tortoise *T. h. boettgeri* (Mojsisovics, 1889) occurs in two distinct areas: in the south-western part of the country (e.g. Fuhn & Vancea 1961, Rozylowicz et al. 2003, Covaciu-Marcov et al. 2005) and in southern Dobrudja, were it was recently rediscovered (e.g. Iftime 2002, 2005, Sos & Daróczi 2008; see Fig.1). The presence of *T. hermanni* in Dobrudja was mentioned by several authors in the first part of twentieth century from different Dobrudjan areas. Later these findings were partly rejected or even unchecked (reviewed by Cheylan 1999).

In southern Dobrudja, *T. hermanni* is sympatric with one of the spur-thighed tortoise subspecies, *Testudo graeca ibera* Pallas, 1814 (Iftime 2002, 2005, Sos & Daróczi 2008 - see Fig.1). *T. g. ibera* inhabit all areas of Dobrudja, but it is partly missing from the central region due to probable negative results of human activities (Covaciu-Marcov et

al. 2006). Generally the spur-thighed tortoise has a broad distribution range; it can be found in northern Africa, in the Middle East, in south-eastern Europe and Asia (e.g. Buskirk et al. 1999, Kuyl et al. 2005).

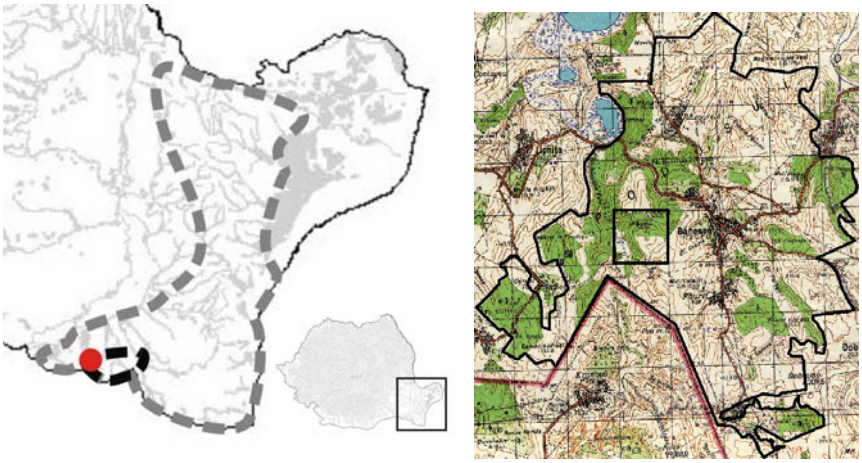

Figure 1. The first map **is** approximate the range limits of *Testudo hermanni boettgeri* (black) and *T. graeca ibera* (grey) in Dobrudja (after Fuhn & Vancea 1961, Iftime 2002, 2005, Covaciu-Marcov *et al.* 2006, own data). The red mark indicates the location of the area, in which we identified the turtles with mixed characters. On the second map, the quadrat shows the limits of study area in the territory of the Mixed Nature Reserve, "Canaraua Fetii Forest".

In august 2007, two tortoises with mixed characters (between *T. h. boettgeri* and *T. g. ibera*) were found during a trip in southern Dobrudja, in "Canaraua Fetii Forest" Mixed Nature Reserve (closest locality Băneasa, Constanța County). The habitat could be characterized as a transitional habitat between thermophilous oak forests (*Quercus cerris*, *Q. pedunculiflora* with *Tilia tomentosa*, *Acer* sp., etc.), cereal fields (wheat, barley and oat) and rocky (limestone) areas. We also found one subadult *T. h. boettgeri* and six adult *T. g. ibera* specimens. The two specimens were identified as anomalous, based on morphological details. A hybridization event was suspected. The analyses of external quailtative morphological characters proposed by Amiranashvili (2000) for an accurate identification of *T. h. boettgeri* and *T. g. ibera*, suggested two morphologically anomalous *T. h. boettgeri*. The majority of the morphological characters indicated that the specimens belonged to *T. h. boettgeri* (Tab.1, Fig.2). Both specimens displayed partially divided supracaudals. The most obvious character, which indicated possible hybridization, was the existence of the horny spurs on the internal part of the thigh, a characteristic of *T. g. ibera*. One specimen had twin, cylindrical elongat-

ed spurs on both sides, although none of them had typical *T. g. ibera* spurs. It is known that even the horny spurs of *T. graeca* show intraspecific variation (Türkozan et al. 2003). Another two characters which are typical of *T. g. ibera*, were also found in the two specimens: *i*. the maximum width of the vertebral scute V was almost equal to width of other vertebral scutes in one specimen, and *ii*. the femoro-anal sulcus crossed the medial line almost at a right angle in the second specimen (Tab.1, Fig.2).

In conclusion, the anomalous turtles displayed morphological traits, that can be interpreted as intermediate between the two species (towards *T. h. boettgeri*), but a hybridization event could not be confirmed, based only on external morphology. To determine the taxonomical status of the specimens we need further, mainly genetic investigations.

Table 1. The description of turtle specimens with mixed characters (using characters and descriptions proposed by Amiranashvili 2000). In normal fonts are listed the characters which are typical for *T. h. boettgeri*, in bold fonts the characters which are typical for *T. g. ibera* and in italics the ambiguous characters.

Characters	**Specimen 1**	**Specimen 2**
Supracaudal scute	*Less than 1/3 part of scute divided (a.4)*	*More than 2/3 part of scute divided (b.4)*
Horny nail	With (a.5, a.6)	With (b.5)
Horny tuber on the internal part of the thigh	**With two pairs in both sides (a.5, a.6)**	**With (b.5, b.6)**
The scales on the front limb	Partly with big scales, partly with small ones (a.3)	Partly with big scales, partly with small ones (b.3)
Width of vertebral scutes II, III and IV	Smaller than width of the pleural scutes (I, II and III; a.1)	Smaller than width of the pleural scutes (I, II and III; b.1)
Maximum width of the vertebral scute V	**Almost equal to width of other vertebral scutes (a.1)**	Greater than maximal width of other vertebral scute (b.1.)
Notch between first and second marginal scutes	Well manifested (a.1)	Well manifested (b.1)
Length of the sulcus between vertebral scutes IV and V	2 times smaller than medial length of the vertebral scute IV (a.1)	2 times smaller than medial length of the vertebral scute IV (b.1)
Femoro-anal sulcus	Crosse the medial line at the acute angel; it is practically straight (a.2)	**Crosse the medial line almost at right angle (b.2)**
Lateral portion of the femoro-anal sulcus	Does not curve forward (a.2)	Does not curve forward (b.2)
Medial length of anal scute	Greater than the medial length of femoral scute (a.2)	Greater than the medial length of femoral scute (b.2)

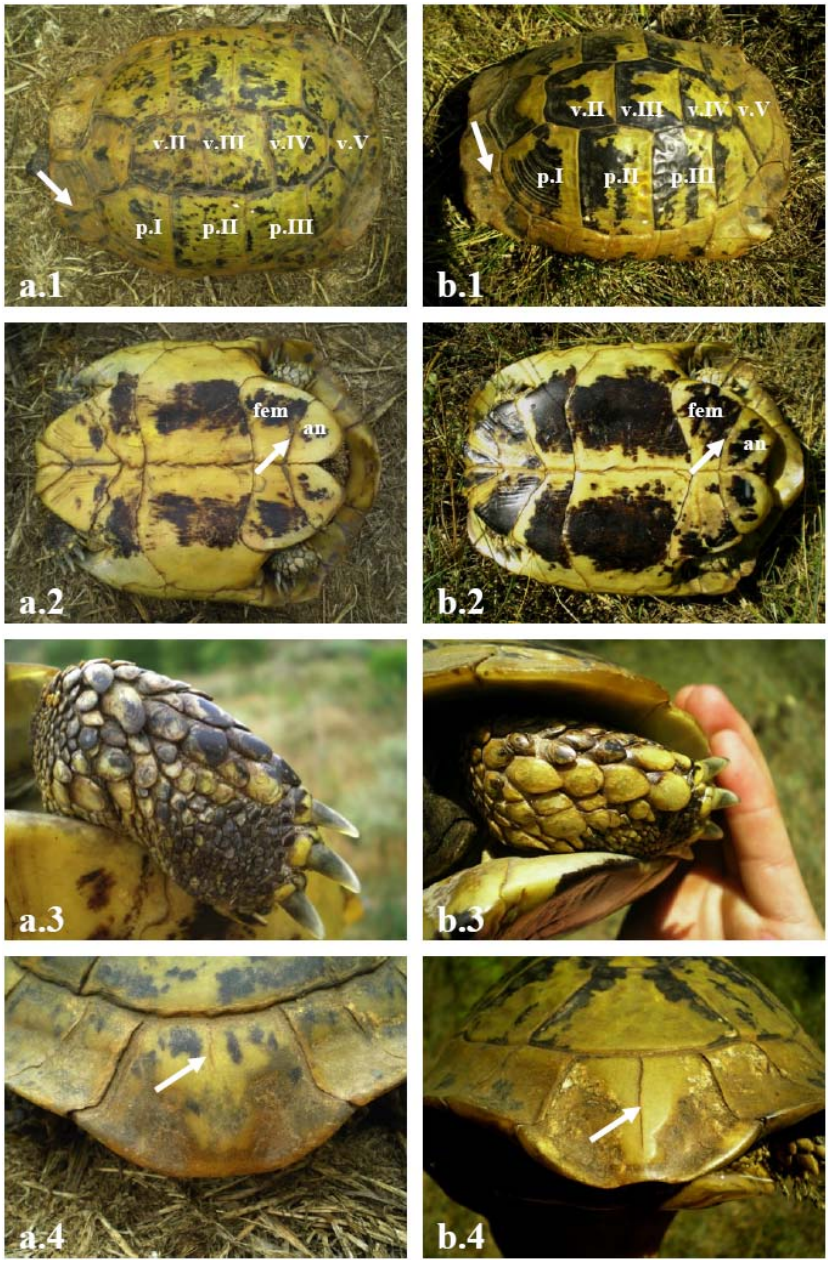

Figure 2.A. The two turtles with mixed characters (see comment in text).
Abbreviations: **carapace /a.1, b.1/**: *v.II-V*: vertebral scutes (II-V), *p.I-III*: pleural scutes (I-III), *with arrow*: the notch between first and second marginal scutes; **plastron /a.2, b.2/**: *fem*: femoral scute, *an*: anal scute, *with arrow*: the femoro-anal sulcus; **front limb /a.3, b.3/**; **supracaudals /a.4, b.4/**: *with arrow*: the fissure of supracaudals.

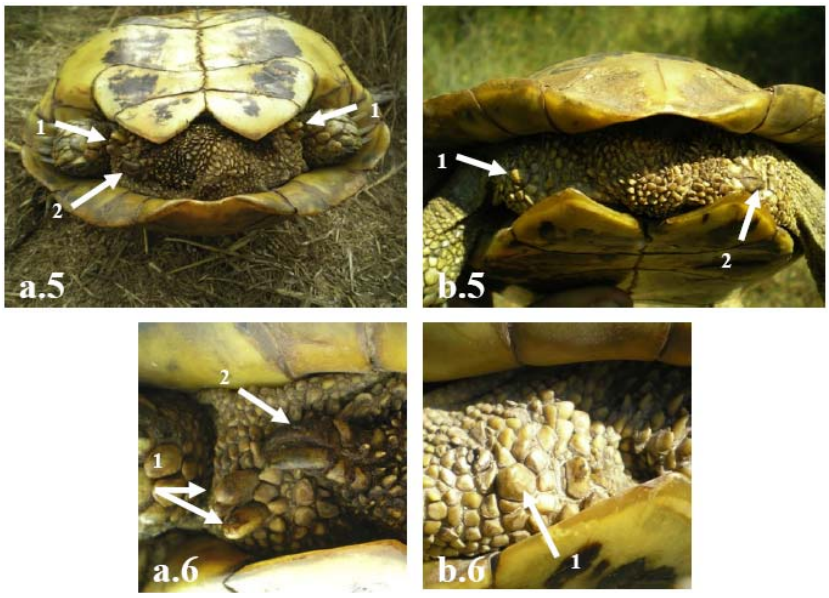

Figure 2.B. The two turtles with mixed characters (see comment in text).
Abbreviations: **posterior and thigh area /a.5,6, b.5,6/**: 1: horny tuber, 2: horny tail.

Intergenetic hybridization in chelonians is apparently uncommon; most reported instances have occurred under captive conditions (see in Fritz & Cheylan 2001). Similarly, in captivity hybrids were obtained from *T. g. graeca* and *T. h. hermanni* (e.g. Cheylan 1981) and *T. g. ibera* and *T. h. boettgeri* combinations (e.g. Mertens 1968). Thus, it is highly probable that unique specimens with "mosaic" features of both species can be found in nature, so hybridization between the two species is possible under natural conditions, if they occur in sympatry (Amiranashvili 2000).

Some authors described natural hybrids of *T. hermanni* and *T. graeca* from sympatric populations. These records were based only on one morphological character: the divided or undivided supracaudal(s) (Başoğlu & Baran 1977, Nöllert & Nöllert 1981, reviewed in Fritz & Cheylan 2001). This feature is normally used for the identification of the two species, *T. hermanni* and *T. graeca* but they do not have absolute reliability. Extensive research and field observations have shown that specimens of *T. hermanni* sometimes have an undivided supracaudal scute, and, respectively, *T. graeca* may have divided supracaudal scutes in nature (e.g. Amiranashvili 2000, Lapparent de Broin et al. 2006, Marian, T., Strugariu, Al. and Manci, C. O., pers. comm.). Thus, the divided/ undivided status of supracaudals can-

not be used for determining the exact taxonomy of these two tortoise species (e.g. Amiranashvili 2000) so it is not an eligible character for the identification of hybrids. However, a similarly anomalous tortoise, with transitional characters was described in north Dobrudja (Telița locality, Edirlen hill, Tulcea County; Oțel 1998). The specimen displayed horny spurs on the thighs (typical *T. ibera* characteristic) together with divided supracaudals and two cornificated and elongated "scales" (as described by Oțel 1998), which were assigned similar to the horny nail of *T. hermanni*. We suppose that this tortoise belonged to *T. graeca*, since, according to our previous investigations, a considerable number of *T. graeca* with 2 bigger and cornificated scales on the tail were found.

The distinction between the *T. hermanni* and *T. graeca* is easy when one focuses on correct characters, although similarities due to homoplasies or synapomorphies are numerous enough to induce a complete confusion even among herpetologists (Lapparent de Broin et al. 2006). This is probably the main reason why the occurrence of the *T. hermanni* in Dobrudja is only indicated by scarce and recent data (Iftime 2002, 2005, Sos & Daróczi 2008). A study based on analysis of 44 internal (bony elements) and external (horny elements) shell characters (Amiranashvili 2000) – and consequently qualitative morphological characters (see Fritz et al. 2006*a*), concluded that the two species could be accurately identified. We considered that these characters are eligible for identification of possible hybrids also, if the specimens displayed mixed characters (as highlighted in this work).

Acknowledgements. Alexandru Strugariu's and Marosi Béla's comments highly improved the article contents and language. The authors are indebted to Dr. Fritz Uwe, Alexandru Iftime, Tudor Marian and Sas István for providing some of the reference papers.

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Submitted: 06 January 2008
/ Accepted: 07 May 2008