Aestivation observed in *Testudo graeca ibera* PALLAS, 1814 in southern Anatolia (Turkey)

Testudo graeca LINNAEUS, 1758, the Spur-Thighed Tortoise, is distributed in North Africa, from Morocco to Libya, as well as in Europe, from southern Spain, the Balearic Islands, to Sardinia and Sicily; east of a gap in the Italian and western Balkan Peninsula, the range area continues from eastern Romania, Serbia, Bulgaria, Macedonia and Greece across most of Turkey, into the Transcaucasian countries, and as far as Lebanon, Israel, Syria, Jordan, Iraq and Iran in the Near East (BONIN et al. 2006; ANANJEVA et al. 2006).

Testudo graeca lives from sea level to about 2,700 m a.s.l. and occurs on dry open steppes, barren hillsides and wastelands, where vegetation varies from sea dune grasses to scrub thorn or dry woodlands (ERNST et al. 2010), but also in vineyards and gardens (BAŞOĞLU & BARAN 1977).

At least all higher altitude populations hibernate, but also lowland individuals such as the coastal populations in southwest Turkey. They do this from September-November through February-May (e.g. FUHN & VANCEA 1961; BANNIKOW et al. 1977; ALEKPEROW 1978; FRANZEN et al. 2008) depending on the intensity and extent of the cold season. On the other hand, this tortoise species was reported to aestivate during the hot months, hiding under bushes or in crevices (BONIN et al. 2006; ERNST et al. 2010). Aestivation was observed between June and September in Spain and Morocco (DÌAZ-PANIAGUA et al. 1995; PÉREZ et al. 1998; BAYLEY & HIGHFIELD 1996) and in hot years, from midsummer until October in southwest Turkey, where autumnal rainfall may end the aestivation phase (FRANZEN et al. 2008).

On July 22, 2010, at 12:00 midday, the authors observed an aestivating male *T. graeca ibera* PALLAS, 1814 (Fig. 1) in an arid open area (Fig. 2) at Yayladağı [Vilâyet Hatay (Antakya), Turkey (35°53.801'N, 36°5.292'E, 528 m a.s.l.)]. The straight carapace length of the individual was 26 cm. The tortoise was buried in the ground about 15-20 cm deep and covered with fodder (annual grasses - Poaceae, especially *Avena* sp. and *Hordeum* sp.). Maximum air temperature was recorded as being 38°C during the field study. The arid maquis vegetation cover of the aestivation area was *Quercus coccifera* dominated, with annual plants growing under shrub-like *Arbutus* sp., *Juniperus* sp., *Olea europea*, and *Quercus* sp. In addition, there were also agricultural areas in the surroundings. The sympatric lacertilian herpetofauna comprised *Trachylepis vittata* (OLIVIER, 1804), *Laudakia stellio stellio* (LINNAEUS, 1758), and *Ophisops elegans basoglui* BARAN & BUDAK, 1978.

Fig. 1: The partly uncovered aestivating male *Testudo graeca ibera* PALLAS, 1814 buried in the ground.

Fig. 2: The habitat at Yayladağı, Vilâyet Hatay (Antakya), Turkey where the aestivating tortoise was found on July 22, 2010.

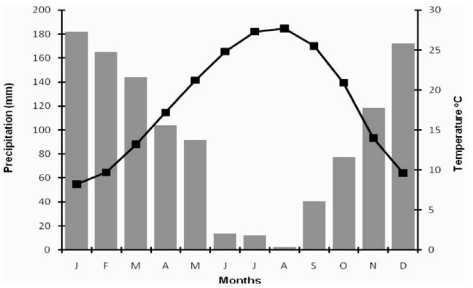

Fig. 3: Climate diagram of Vilâyet Hatay (Antakya). Data (1975-2008) obtained from the TURKISH STATE METEOROLOGICAL SERVICE (2010). Bars show mean monthly precipitation (mm), line shows mean monthly temperature (°C).

The Vilâyet of Hatay represents the southernmost part of Turkey, located near its border to Syria at the northeastern edge of the East Mediterranean Sea (Levantine region). Climatic conditions in this area are mainly Mediterranean, with a mean annual temperature of 18.1°C and mean annual rainfall of 1124 mm (Fig. 3). The highest mean temperatures are observed in July (27.2°C, range: 15.9°C-43.4°C) and August (27.6°C, range: 15.4°C-42.4°C) in Hatay (ATALAY 2002; TURKISH STATE METEOROLOGICAL SERVICE 2010).

In zoology, the term aestivation describes a facultative or obligatory longer lasting period of inactivity spent in sheltered places in order to overcome a season that is dry, short of food and usually hot. This physiologically controlled behavioral strategy evolved in a number of species inhabiting arid environments. Comparatively little is known about aestivation in reptiles, although it has been reported in several crocodilian, lizard, snake and chelonian species (GREGORY 1982; WINNIE et al. 2006; GLASS et al. 2009). Among the latter, aestivation behavior is observed both in terrestrial and aquatic forms, namely *Gopherus berlandieri* (AGASSIZ, 1857) (VOIGT & JOHNSON 1976), *Chelodina rugosa* OGILBY, 1890 (GRIGG et al. 1986), *Kinosternon* spp. (LIGON & PETERSON 2002), *T. graeca* (ERNST et al. 2010), and *Testudo horsfieldii* GRAY, 1844 (ANDERSON-COHEN 1994), and very likely occurs in the majority of chelonian species living in a seasonally or permanently arid environment.

In on-site observations of northwest African and west Turkish populations of *T. graeca* activity, relative to the influence of age and sex, air temperature and sunshine duration on the turtle's activity (LAMBERT 1981), turtles were active at temperatures above 18°C, while refuge from sunshine was taken during the middle of the day at temperatures above 28°C.

A systematic study regarding the aestivating behavior and features of the aestivating sites in south Anatolian populations is not available. Anecdotal observations, such as the present findings, form the current knowledge base.

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