

Scavenging behavior of an adult Hermann's Tortoise (*Testudo hermanni* Gmelin, 1789) (Reptilia: Testudinidae)

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Abstract. It is well known that the Hermann's Tortoise (*Testudo hermanni*) feeds primarily on plants. The species can also supplement its diet with different food sources, including carrion. Yet, few cases of scavenging behavior have been reported in the literature. Here we report on the consumption of a dead female Common Toad (*Bufo bufo*) by an adult female *T. hermanni*. The scavenging behavior observed can be related to the increased energy needs of females during the nesting season.

Key-words: diet, carrion, Bulgaria.

Introduction

Two species of tortoises inhabit the territory of Bulgaria: the Hermann's Tortoise – *Testudo hermanni* Gmelin, 1789 and the Spur-thighed Tortoise – *T. graeca* Linnaeus, 1758. They occur sympatrically in most parts of the country (Beshkov & Nanev 2002; Stojanov *et al.* 2011). The Hermann's Tortoise feeds predominantly on plants (Cheylan 2001; Petrov *et al.* 2004; Bertolero *et al.* 2011; Stojanov *et al.* 2011; Speybroeck *et al.* 2016), more than 130 species, which belong to 46 families (Bertolero *et al.* 2011). The ones with greater importance for the species are Fabaceae, Asteraceae, Rosaceae, Ranunculaceae, and Poaceae (Meek 1985; Lazarkevich-Stancheva 1997; Petrov *et al.* 2004; Bertolero *et al.* 2011).

Besides consuming plants, the Hermann's Tortoise can supplement its diet with fallen fruits, feces, invertebrates, mushrooms, algae, and cyanobacteria (Lazarkevich-Stancheva 1997; Undjian 2000; Cheylan 2001; Beshkov & Nanev 2002; Budó *et al.* 2009; Bertolero *et al.* 2011; Stojanov *et al.* 2011; Gagno *et al.* 2012; Speybroeck *et al.* 2016). Geophagy has also been observed (Sokol 1971; Gagno & Alotto 2010; Đorđević & Golubović 2013). Carrion could be an additional energy source (Cheylan 2001; Stojanov *et al.* 2011; Gagno *et al.* 2012; Speybroeck *et al.* 2016) for the Hermann's Tortoise, but it seems that the species rarely feeds on it (Petrov *et al.* 2004; Budó *et al.* 2009; Nikolić *et al.* 2016). Lazarkevich-Stancheva (1997) mentioned a case in which a Hermann's Tortoise had fed on a dead fish. Petrov *et al.* (2004) also mentioned that the species may occasionally consume a dead fish and ungulates. Budó *et al.* (2009) observed an individual, which was consuming a dead bird. Gagno *et al.* (2012) analyzed the content of the alimentary canal of 30 Hermann's Tortoises, all of which had died in a fire. They found animal remains in 22 specimens. A small proportion of the remains identified were of birds and mammals. Nikolić *et al.* (2016) observed an adult *T. hermanni*, which was feeding on the remains of a European Green Lizard, *Lacerta viridis* (Laurenti, 1768).

Here we report on the consumption of a dead female Common Toad, *Bufo bufo* (Linnaeus, 1758), by an adult female *T. hermanni*, and discuss some possible explanations for this behavior.

Materials and Methods

The observation took place in the northwestern foothills of the Pirin Mts., near the Nature Conservation Center Villa Fauna of the Fund for Wild Flora and Fauna (the village of Rakitna). The area has been visited at least 3–4 times per week since the reintroduction of the Griffon Vulture, *Gyps fulvus* (Hablizl, 1783), in 2010. The field observations have been intensified since 2021 when a study on the populations of the two species of tortoises in the area started.

Results and Discussion

A recently road-killed adult female *Bufo bufo* was found on 15 June 2022 (41.847937, 23.180612; 684 m a.s.l.; Fig. 1A). An adult female *T. hermanni* was observed eating that toad in the same place where it was found first 20 days later, on 5 July 2022 at 11:50 a.m. (Fig. 1B). The weather was calm and sunny – the cloud cover was about 10%. The air temperature was 30°C.

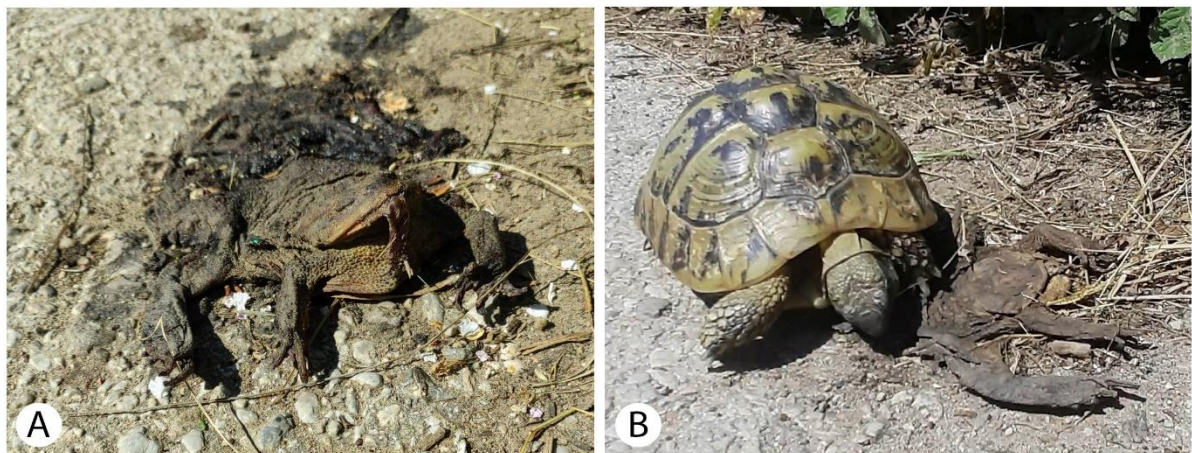


Fig. 1. The Common Toad found dead on a road (on the left) and the Hermann's Tortoise feeding on it at the same place about 20 days after its death.

As mentioned in the Introduction, the Hermann's Tortoise rarely feeds on carrion. This conclusion was confirmed by our previous study on the local population of the species in the northwestern foothills of the Pirin Mts. (Mitrevichin *et al.* in press). When feeding behavior was observed, the specimens never fed on carrion. They were consuming mostly herbaceous plants and sometimes fruits as well as dog feces (Mitrevichin *et al.* in press). This is the first case of scavenging behavior observed in the area.

This behavior can be due to the increased energy needs of females during the egg-laying period (Stubbs & Swingland 1985). Stubbs & Swingland (1985) found that during this period female Hermann's Tortoises move a considerable distance in search of suitable nesting sites. They noted that some of the females nested more than once in a season and the second clutch was occasionally laid about 500 m away from the first clutch. What is more, Stubbs & Swingland (1985) stated that some females tend to abandon the nest they have started digging. The same females were observed searching for a more appropriate nesting site sometimes up to 200 m away from the nest abandoned.

Díaz-Paniagua *et al.* (1995) also observed that female Spur-thighed Tortoises move greater distances during the nesting season. This increased activity and the larger sizes of

females lead to higher energy needs and thus may influence food selectivity making females more opportunistic than males. In Bulgaria, the egg-laying period is from June to July (Stojanov *et al.* 2011), which coincides with the scavenging behavior observed. Consequently, it can be assumed that this behavior may be associated with the higher energy needs of females during this part of the year.

Grozdanov *et al.* (2016) registered seven species of amphibians and ten species of reptiles in the northwestern foothills of the Pirin Mts. and the adjacent areas. The Common Toad was found to be one of the amphibians with high density (Grozdanov *et al.* 2016). This seems to be true as on 30 March 2022, between 11:00 a.m. and 2:00 p.m., we observed seven mating pairs. All of them were under a bush, probably trying to remain hidden from potential predators. The air temperature varied between 15 and 17°C. The weather was calm and there was no precipitation. The cloud cover was about 70%.

Since *Bufo bufo* population is stable in the area, it is not surprising that a specimen of the species was found dead on a road (Fig. 1A). Yet, it is interesting whether the toxic compounds in the skin of the toad have influenced the tortoise in some way. It is known that the skin of the toads contains different toxic compounds such as bufadienolides, which the toads use as a defense against predators (Deulofeu & Rùveda 1971; Meyer & Linde 1971; Krenn & Kopp 1998). However, the tortoise fed on the toad about 20 days after its death (Fig. 1B). It can be assumed that the weather conditions (e.g. high temperatures) may have influenced the toxic compounds in the skin of the toad, thus reducing or neutralizing the harmful effect on the tortoise.

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References

- Bertolero, A., Cheylan, M., Hailey, A., Livoreil, B. & Willemsen, R.E. (2011) *Testudo hermanni* (Gmelin 1789): Hermann's tortoise. In: Rhodin, A.G.J., Pritchard, P.C.H., van Dijk, P.P., Saumure, R.A., Buhlmann, K.A., Iverson, J.B., Mittermeier, R.A. (Eds.), *Conservation biology of freshwater turtles and tortoises: A compilation project of the IUCN/SSC tortoise and freshwater turtle specialist group*. Chelonian Research Monographs, pp. 059.1–059.20.
- Beshkov, V. & Nanev, K. (2002) Zemnovodni i vlechugi v Bulgaria. Pensoft Publishers, Sofia, pp. 120 (in Bulgarian).
- Budó, J., Capalleras, X., Fèlix, J. & Font, J. (2009) Aportacions sobre l'estudi de l'alimentació de la Tortuga mediterrània *Testudo hermanni hermanni* (Gmelin, 1789) a la serra de l'Albera (Catalunya). *Butlletí de la Societat Catalana d'Herpetologia*, 18: 109–115.
- Cheylan, M. (2001) *Testudo hermanni* Gmelin, 1798 – Griechische Landschildkröten. In: Fritz, U. (Ed.), *Handbuch der Reptilien und Amphibien Europas. Band 3/IIIa: Schildkröten (Testudines). I. (Bataguridae, Testudinidae, Emydidae)*. Wiebelsheim: Aula-Verlag, pp. 179–289.
- Deulofeu, V. & Rùveda, E. (1971) The basic constituents of toad venoms. In: Bücherl, W. & Buckley, E. (Eds.), *Venomous animals and their venoms*, Vol. 2. Academic Press, New York, pp. 475–495.
- Díaz-Paniagua, C., Keller, C. & Andreu, A. (1995) Annual variation of activity and daily distances moved in adult Spur-thighed tortoises, *Testudo graeca*, in southwestern Spain. *Herpetologica*, 51 (2): 225–233.
- Dorđević, S. & Golubović, A. (2013) Geophagy in the Hermann's tortoise, *Testudo hermanni*. Photo note *Hyla Herpetological Bulletin*, 1: 46–47.

- Gagno, S. & Alotto, C. (2010) Geophagy by Hermann's Tortoise, *Testudo hermanni* Gmelin, 1789 (Chelonii, Testudinidae) in the region of the Maures (Var, France). *Bulletin de la Société Herpétologique de France*, 135–136: 23–32 (In French, English Summary).
- Gagno, S., Chapelin-Viscardi, J.D. & Ponel, P. (2012) Revealing of predatory customs at Hermann's Tortoise, *Testudo hermanni* Gmelin, 1789 (Chelonii, Testudinidae), during the summer period in the region of the Maures (Var, France). *Bulletin de la Société Herpétologique de France*, 141: 47–61 (In French, English Summary).
- Grozdanov, A., Peshev, H., Stoynov, E., Vangelova, N., van Leest, M., Wielpstra, H. & Parvanov, D. (2016) Contribution to the faunistic research and conservation of the herpetofauna of northern Kresna Gorge and some adjacent areas. *Annuaire de l'Université de Sofia "St. Kliment Ohridski" Faculte de Biologie*, 101 (4): 44–54.
- Krenn, L. & Kopp, B. (1998) Bufadienolides from animal and plant sources. *Phytochemistry*, 48 (1): 1–29.
- Lazarkevich-Stancheva, I. (1997) Izsledvaniya varhu biologiyata na dvata vida suhozemni kostenurki – *Testudo graeca ibera* Pallas 1814 i *Testudo hermanni hermanni* Gmelin 1789 v rayona na gr. Kresna. *Master's thesis. SU "ST. Kliment Ohridski", Faculty of Biology*, 75 pp. (In Bulgarian).
- Meek, R. (1985) Aspects of the ecology of *Testudo hermanni* in southern Yugoslavia. *British Journal of Herpetology*, 6: 437–445.
- Meyer, K. & Linde, H. (1971) Collection of toad venom and chemistry of the toad venom steroids. In: Bücherl, W. & Buckley, E (Eds.), *Venomous animals and their venoms*, Vol 2. Academic Press, New York, pp. 521–556.
- Mitrevichin, E., Peshev, H., Stoynov, E., Grozdanov, A., Sakelarieva, L. & Pulev, A. (2022) A long-term study of some species traits and population characteristics of the Hermann's Tortoise (*Testudo hermanni*) and the Spur-thighed Tortoise (*T. graeca*) (Testudines: Testudinidae) in the northwestern foothills of the Pirin Mountains, Bulgaria. *Acta Zoologica Bulgarica*, in press.
- Nikolić, M., Savić, D., Ilić, M., Stojadinović, D. & Crnobrnja-Isailović, J. (2016) A note on scavenging behaviour of adult Hermann's tortoise (*Testudo hermanni*). *Biologica Nyssana*, 7 (1): 53–55.
- Petrov, B., Beshkov, V., Popgeorgiev, G. & Plachiyski, D. (2004) Plan za deystvie za opazvane na suhozemnite kostenurki v Bulgaria: 2005–2014. Plovdiv, BSPB-NMNHS-BBF, 58 pp. (In Bulgarian).
- Sokol, O. (1971) Lithophagy and Geophagy in Reptiles. *Journal of Herpetology*, 5 (1/2): 69–71.
- Speybroeck, J., Beukema, W., Bok, B. & Voort, J.V.D. (2016) Field guide to the Amphibians and Reptiles of Britain and Europe. Bloomsbury Publishing Plc., London, 432 pp.
- Stojanov, A., Tzankov, N. & Naumov, B. (2011) Die Amphibien und Reptilien Bulgariens. Chimaira, Frankfurt am Main, 588 pp.
- Stubbs, D. & Swingland, I. (1985) The ecology of a Mediterranean tortoise (*Testudo hermanni*): a declining population. *Canadian Journal of Zoology*, 63: 169–180.
- Undjian, E. (2000) Die Lurche und Kriechtiere des Lomtales und des Naturparkes „Russenski Lom“, Bezirke Russe und Rasgrad Nordostbulgariens. Russe, Bulgaria, NP Russenski Lom, 88 pp. (In Bulgarian, German summary).