

## The Winter Activity of the Endemic Lizard Species, *Anatololacerta danfordi* (Günther, 1876)

Hatice ÖZKAN<sup>1</sup>, Ufuk BÜLBÜL<sup>1\*</sup>

**ABSTRACT:** A winter activity of the Danford's lizard, *Anatololacerta danfordi* (Günther, 1876) has been observed during two winter seasons in Sütçüler and Aksu districts of Isparta province of Turkey. There is no information in the literature about the active season of this species. Our data showed that this lizard species may be active in winter. Activations of the adult individuals of the species mainly consisted of sunbathing on the rocks and preying.

**Keywords:** Danford's lizard, Isparta, hibernation, *Anatololacerta*, climate

### Endemik Kertenkele Türü, *Anatololacerta danfordi* (Günther, 1876)'nin Kış Aktivitesi

**ÖZET:** Türkiye'nin Isparta ilinin Sütçüler ve Aksu ilçelerinde Toros Kertenkelesi, *Anatololacerta danfordi* (Günther, 1876)'nin bir kış aktivitesi iki kış sezonu boyunca gözlenmiştir. Literatürde bu türün aktif sezonu hakkında herhangi bir bilgi yoktur. Verilerimiz, bu kertenkele türünün kış aylarında da aktif olabileceğini göstermiştir. Türün yetişkin bireylerinin faaliyetleri esas olarak kayaların üzerinde güneşlemekten ve avlanmaktan oluşmaktaydı.

**Anahtar Kelimeler:** Toros kertenkelesi, Isparta, kış uykusu, *Anatololacerta*, iklim

<sup>1</sup>Hatice ÖZKAN (Orcid ID: 0000-0002-7810-864X), Ufuk BÜLBÜL (Orcid ID: 0000-0001-6691-6968) Karadeniz Technical University, Faculty of Science, Department of Biology, Trabzon, Turkey

\*Sorumlu Yazar/Corresponding Author: Ufuk BÜLBÜL, e-mail: ufukb@ktu.edu.tr

## INTRODUCTION

The annual cycle of temperate zone squamates is divided into two main periods: 1) an active period, going from spring to autumn, in which animals move, feed, reproduce and molt; 2) a hibernation period, going from autumn to spring, in which they spend time within subterranean shelters in a latency status (Rugiero, 1995). The seasonal periods of low temperatures cause the hibernation of ectotherm animals in winter (Ultsch, 1989). Hibernation as a behavioral response to seasonal change is most likely a direct response to the cold temperatures and to the changes in the resource availability (Gregory, 1982; Vongrej et al., 2008).

Lizards are ectothermic organisms. Therefore, they often have limited climatic tolerance and are strongly dependent on climatic conditions (Buckley and Kingsolver Joel, 2012; Kıraç and Mert, 2018). Reptiles may have winter activity when the winters become milder because of some factors such as global warming and climate change (Corn, 2005; Zug et al., 2001; Zani et al., 2012). Researchers from different regions of the world reported winter activity for different species of lizards: *Darevskia rudis* (Koç et al., 2018), *Lacerta media* (Bülbül et al., 2019), *Lacerta viridis* (Vongrej et al., 2008), *Mediodactylus kotschy* (Mollov et al., 2015), *Ophisops elegans* (Franzen, 1986), *Podarcis erhardi* (Buresh and Tsonkov, 1933; Beshkov, 1977), *Podarcis muralis* (Rugiero, 1995; Beshkov and Nanev, 2002; Westerstrom, 2005; Tzankov et al., 2014), *Sceloporus jarrovi* (Tinkle and Hadlez, 1973) and *Zootoca vivipara* (Grenot et al., 2000).

It is a known fact that the members of family Lacertidae are hibernating species in the Northern Hemisphere (Smith, 1946). The Lacertid lizards usually hibernate from middle of October to early April in lowland populations (up to about 500 m a.s.l.). However, the hibernation periods may be changed from late September to early May in colder highland populations above 2000 m a.s.l. (Kurnaz et al., 2016).

*Anatololacerta danfordi* (Günther, 1876) is an endemic lizard species of the Lacertidae family in Turkish herpetofauna (İlgaz et al., 2019). This species is widespread in the southern Anatolia region, from the Burdur province to Adana province (Baran et al., 2012) and it is classified in the LC (Least Concern) category in the IUCN Red List (Tok et al., 2009). Although there is no information in the literature about the hibernation, period of *A. danfordi*, the individuals of *Anatololacerta pelasgiana* (Mertens, 1959), which is another species of *Anatololacerta* living in Turkey (Bellati et al., 2015), can be active in December and January months according to findings of Franzen (1986).

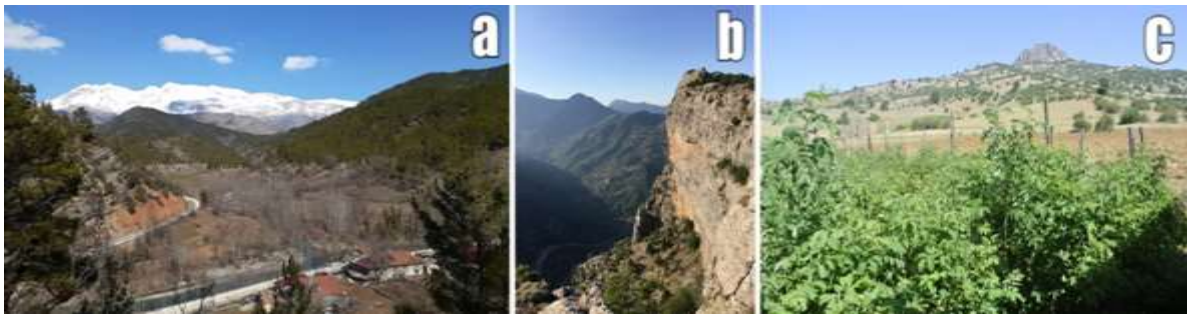
*Anatololacerta danfordi* lives on rocks and stone walls in wooded areas and forests not far from water (Baran et al., 2012). It prefers habitats with the bioclimate features including 12 mm of precipitation of driest month, 1-2°C for the mean temperature of wettest quarter, -4°C for minimum temperature of the coldest month, and 600 mm of annual precipitation (Kıraç and Mert, 2018).

The present study provides the first observation of winter activity for *A. danfordi* in the Isparta province of Turkey.

## MATERIALS AND METHODS

The individuals were observed in Sütçüler and Aksu districts of the province of Isparta during the day excursions in two winter seasons (2018 and 2019). Most of the observations were performed in sunny weather. The observation dates, air temperatures, coordinates, and altitudes of the localities were recorded. All photos of the habitats and individuals were taken by Hatice ÖZKAN with a digital camera (Canon D610). Then, the lizards were captured by hand for sex determination. The sex of the adult individuals was determined based on their primer sexual characters (presence of hemipenis in males). According to morphological and molecular findings of Eiselt and Schmidtler (1986) and Candan et al.

(2016), the individuals (living around Burdur and Isparta provinces) in the *Anatololacerta* genus are representatives of a lineage, which emerged from hybridization events, of *A. danfordi* species. In addition, Eiselt and Schmidtler (1986) reported that the lizards in Isparta province and its immediate surroundings belonged to the *Anatololacerta danfordi bileki* subspecies. The subspecies differs from the nominate subspecies in particular by the the coloration of throat ranging from red to white (not blue) in adult individuals and also due to lower average values for the femoral pores. Based on the morphological values determined in the study of Eiselt and Schmidtler (1986), we decided that the lizards in the studied populations belonged to *Anatololacerta danfordi bileki* subspecies according to the numbers of the plaques of circumanalia (with the number 17 in some male individuals) and gularia (not exceeding 25-29 in all individuals), white throat in all individuals, and the number of femoral pores (not exceeding 21-24 in all individuals). After sex determination and pholidolial examination, the lizards were released back their habitats.



**Figure 1.** General views of the habitats where the individuals were observed. (a) İbişler Küme Evler Village, Sütçüler District, (b) Kesme Village of Sütçüler District and (c) Yakaafşar Village of Aksu District

## RESULTS AND DISCUSSION

### January 2018

A female individual of *Anatololacerta danfordi* was observed in the İbişler Küme Evler Village, (Sütçüler District) on 28 January, 2018 during the field work at 11:45 a.m. (Figure 2a). The field work took two hours between 11:00 a.m. and 2:00 p.m. The observation site was located at the (37°32' 55" N; 31°14'59" E, 884 m a.s.l.). The habitat was consisted of a rock near the creek and an unused car road. There were sycamore, oak, willow and abundant rock rose plants in the region. We did not observe any other reptile species during the field work. The air temperature was 10°C in the observation time. The lizard was found in the hollow of a rock.

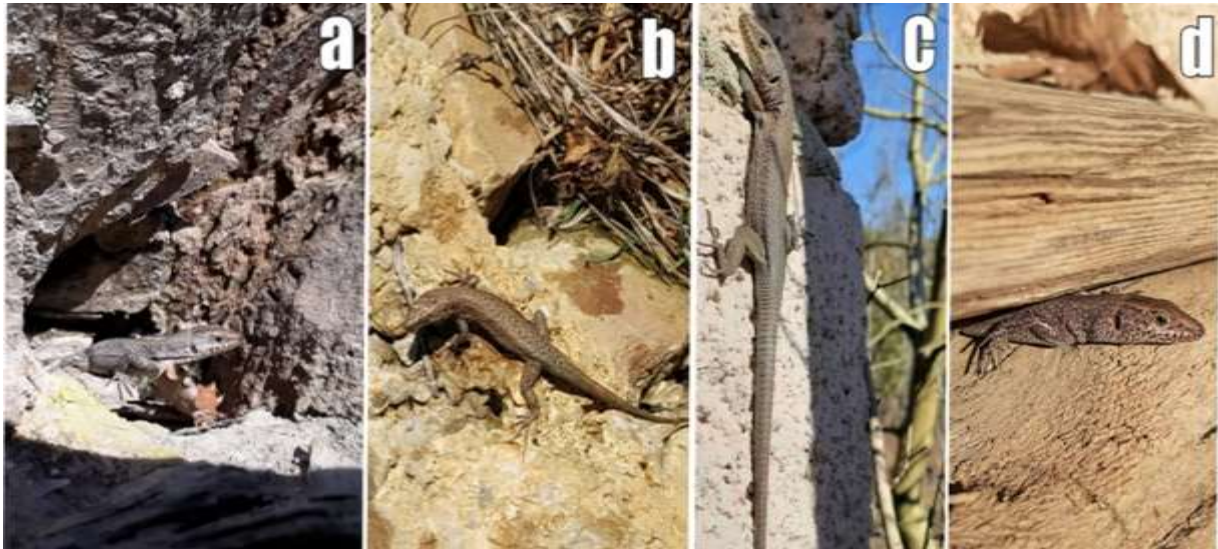
### February 2018

During a field visit on 4 February, 2018 at 12:30 p.m., a female (Figure 2b) individual of *A. danfordi* was observed in Kesme Village of Sütçüler District in a locality (37°28'06" N; 31°13'38" E, 1048 m a.s.l.). The habitat was consisted of a stony area outside the village, where the forest began. Juniper, oak, rock rose and cyclamen plants were seen in the region. We did not observe any other reptile species during the field work. The air temperature was 13°C in the observation time. Lizards were found at the bottom of a plant in the form of a bush.

### December 2019

Two male individuals of *A. danfordi* were observed on 16 December, 2020 in the İbişler Küme Evler Village of Sütçüler District (37°31'46" N; 31°15'00" E, 841 m a.s.l.) between 2:00 and 2:30 p.m. (Figure 2c and 2d). The field work took three hours between 1:00 and 4:00 p.m. The habitat was

consisted of a wooded area near the creek with abundant rocks and the stone walls (Figure 1). The lizards were observed on the concrete wall of a house and between the wooden wall of a barn. Sycamore, oak, cherry, plum plants were in the region. We did not observe any other reptile species during the field work. The air temperature was 21°C in the observation time.



**Figure 2.** (a) The observed female individual of *A. danfordi* from the İbişler Küme Evler Village, on 28 January, 2018, (b) a female individual observed in Kesme Village on 4 February, 2018 and (c) and (d) the observed two male individuals from İbişler Küme Evler Village, on 16 December, 2020

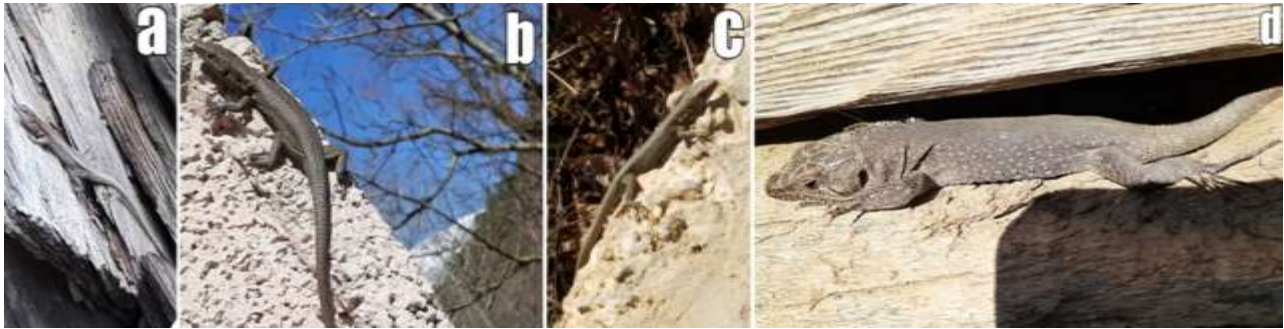
### January 2020

On 24 January, 2020, a male individual of *A. danfordi* was observed during a day excursion at 1:50 p.m. in İbişler Küme Evler Village of Sütçüler District (Figure 3a). The observation site was located at the 1000 m a.s.l. (37°33'09" N; 31°14'58" E, 905 m a.s.l.). The habitat was consisted of an area near the farmland and bushes with the stone walls and unused ruined houses. There were mulberry, pomegranate, apple, cherry, plum, sycamore, oak, willow and abundant rock rose plants in the region. The air temperature in the locality was 12°C in the observation time. The lizard was found on the wooden wall of a ruined straw warehouse.

### February 2020

During our field surveys in the February of 2020, the adult individuals of *A. danfordi* were observed from two different localities; Yakaafşar Village of Aksu District and İbişler Küme Evler Village of Sütçüler District. Firstly, a female individual was observed in Yakaafşar (37°44'33" N; 31°10'23" E, 1250 m a.s.l.) on 18 February, 2020 during a day excursion at 1:20 p.m. (Figure 3c). The habitat was consisted of an area near the irrigation canal with fields and the stone walls. Sycamore, oak, cherry, plum plants were in the region. There were plane trees, oak, apple, plum plants and many rose gardens in the region. The air temperature in the locality was 9°C in the observation time. The lizards were found on the concrete wall near the irrigation canal.

The second observation was performed on 19 February, 2020 in İbişler Küme Evler Village (37°31'46" N; 31°15'01" E, 840 m a.s.l.). Two male individuals of *A. danfordi* were observed during a day excursion between 1:40 and 2:00 p.m. (Figure 3b and d). The lizards were observed on the walls of a house. The air temperature was 13°C in the observation time.



**Figure 3.** (a) The observed male individual of *A. danfordi* from the İbişler Küme Evler Village, on 24 January, 2020, (b) a female individual observed in Yakaafşar Village, on 18 February, 2020 and (c) and (d) the observed male individuals from İbişler Küme Evler Village, on 19 February, 2020

During the last visits in İbişler Küme Evler Village (37°31'45" N; 31°15'04" E, 841 m a.s.l.), a male individual (Figure 4a) was observed basking on the house wall on 23 February, 2020 at 3:20 p.m. The weather was partly cloudy and the air temperature was 12°C in the observation time. One day later, a subadult individual and a female individual of *A. danfordi* were observed in a rock hollow during a day excursion at 3:20 p.m. (37°31'43" N; 31°14'59" E, 855 m a.s.l.) (Figure 4b). The weather was cloudy and the air temperature was 18°C. On 25 February, 2020, a female individual (Figure 4c) was observed on wooden Wall while basking hollow during a day excursion at 11:57 a.m. (37°31'46" N; 31°15'01" E, 840 m a.s.l.). The weather was sunny and the air temperature was 18°C. The habitat was consisted of an area near the creek with buildings, fields and the stone walls.



**Figure 4.** (a) The observed male individual of *A. danfordi* from the İbişler Küme Evler Village, on 23 February, 2020, (b) a subadult individual and a female individual of observed on 24 February, 2020 and (c) a female individual observed on 25 February, 2020

Warmer winter temperatures have been presumed to cause interruption of winter dormancy for reptile species (Gregory, 1982). Up to now, there has been no record on winter activity of *A. danfordi*, the endemic lizard species living in the South Anatolian region. Our results showed the winter activity of *A. danfordi*. Similar to our findings, Franzen (2000) reported the winter activity of *Anatololacerta pelasgiana* distributed in southwestern Anatolia and some islands of Greece. On the other hand, active periods have been reported previously for some lizards living in settlements in northern Anatolia during the winter months (Kurnaz et al., 2016; Koç et al., 2018; Bülbül et al., 2019). According to Franzen (2000), the activities of the lizards were restricted by heavy rain cycles in northern Anatolia in summer. That's why animals must compensate for the lack of sunbathe in this region in winter.

Certain vital activities (e.g. mobility, fertility, food availability and escaping behavior) of lizards mainly depend on air temperature and low temperatures can have negative effects on these activities (Adolph and Porter, 1993). In most studies, researchers reported that the lizards had winter activity on sunny days when the air temperature did not drop below 8 °C [8°C (Kurnaz et al., 2016), 8-10 °C (Vongrej et al., 2008), 10 °C (Koç et al., 2018), 11 °C (Rugiero, 1995), and 15 °C (Bülbül et al., 2019)]. Similar to these findings, we observed active individuals of *A. danfordi* at least at 9 °C during winter seasons of 2018-2020.

Based on our findings, we can say that individuals of *A. danfordi* can be active when the ambient temperatures do not decrease to eight degrees. *Anatololacerta danfordi* can be referred to as having a smaller body size than other lizard species from different altitudes (Beşer et al., 2020). Small sized lizards are able to warm rapidly by basking in the sun. Therefore, small size in lizards seems an advantageous factor aiding thermal regulation and favoring activity at low environmental temperatures as compared with larger species (Porter et al., 1973; Paulissen, 1988; Blázquez et al., 1996). Thus, differences in levels of winter activity occurred based on the size and thermoregulatory behavior of each species (Grant, 1990).

## CONCLUSION

Duration of the hibernation and seasonal activities of the lizards depends on air temperature. Our study showed preliminary results on a winter activity of the Danford's lizard. Long-term researches are needed to define the effects of climate change on hibernation and breeding of *Anatololacerta danfordi*.

## ACKNOWLEDGEMENTS

The authors thank to Songül ULUDAĞ, Recep DEMİRBAŞ, Hasan Ali ULUDAĞ, Osman YILDIZ and Keziban KORKMAZ for their help in the field.

## REFERENCES

- Adolph SC, Porter WP, 1993. Temperature, Activity, and Lizard Life Histories. *The American Naturalist*, 142 (2): 273-295.
- Baran İ, Ilgaz Ç, Avcı A, Kumlutaş Y, Olgun K, 2012. Türkiye Amfibi ve Sürüngenleri, 4. Baskı, Türkiye Bilimsel ve Teknolojik Araştırma Kurumu, Ankara.
- Bellati A, Carranza S, Garcia-Porta J, Fasola M, Sindaco R, 2015. Cryptic Diversity within the *Anatololacerta* Species Complex (Squamata: Lacertidae) in the Anatolian Peninsula: Evidence from a Multi-locus Approach. *Molecular Phylogenetics and Evolution*, 82: 219-233.
- Beshkov V, 1977. The Winter Lodgings of the Amphibians and the Reptiles. *Priroda Iznanie*, 28 (1): 9-11.
- Beshkov V, Nanev K, 2002. Amphibians and Reptiles in Bulgaria. Pensoft, Sofia-Moscow.
- Buckley LB, Kingsolver JG, 2012. Functional and Phylogenetic Approaches to Forecasting Species' Responses to Climate Change. *Annual Review of Ecology, Evolution and Systematics*, 43 (1): 205-226.
- Buresh I, Tsonkov Y, 1933. Untersuchungen Über die Verbreitung der Reptilien und Amphibien in Bulgarien und Auf der Balkanhalbinsel. I Teil: Schildkröten (Testudinata) und Eidechsen (Sauria). *Mitteilungen Aus den Königlichen Naturwissenschaftlichen Instituten in Sofia-Bulgarien*, 6: 150-207.
- Bülbül U, Koç H, Orhan Y, Odabaş Y, Kutrup B, 2019. Early Waking from Hibernation in Some Amphibian and Reptile Species from Gümüşhane Province of Turkey. *Sinop Üniversitesi Fen Bilimleri Dergisi*, 4 (1): 63-70.
- Candan K, Kankılıç T, Güçlü U, Kumlutaş Y, Durmuş SH, Lymberakis P, Poulakakis N, Ilgaz Ç, 2016. First assessment on the molecular phylogeny of *Anatololacerta* (Squamata, Lacertidae) distributed in Southern Anatolia: insights from mtDNA and nDNA markers. *Mitochondrial DNA Part A*, 27 (3): 2285-2292.
- Corn PS, 2005. Climate Change and Amphibians. *Animal Biodiversity and Conservation*, 28 (1): 59-67.
- Eiselt J, Schmidtler JF, 1986. Der *Lacerta danfordi* Komplex (Reptilia: Lacertidae). *Spixiana, München*, 9 (3): 1243-1252.

- Franzen M, 1986. Zur Winterlichen Aktivität Einiger Echsen in der Südlichen Türkei. *Herpetofauna*, 8 (45):6-10.
- Franzen M, 2000. Winteraktivität von *Darevskia*-Arten in der Nordost-Türkei. *Die Eidechse*, 11 (3): 77-81.
- Gregory PT, 1982. *Reptilian Hibernation*. Academic Press, pp. 53-154, New York.
- Grenot CJ, Garcin L, Dao J, Herold JP, Fahys B, Tsere-Pages H, 2000. How Does the European Common Lizard, *Lacerta vivipara*, Survive the Cold of Winter? *Comparative Biochemistry and Physiology Part A*, 127: 71-80.
- Ilgaz Ç, 2019. Türkiye Sürüngen Faunasının Endemizm Durumu. *Iğdır Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, 9 (3): 1243-1252.
- Kıraç A, Mert A, 2018. Will Danford's Lizard Become Extinct in the Future? *Polish Journal of Environmental Studies*, 28 (3): 1-9.
- Koç H, Bülbül U, Kutrup B, 2018. Is the Spiny-tailed Lizard *Darevskia rudis* (Bedriaga, 1886) Active All Year? *Ecologia Balkanica*, 10 (1): 47-51.
- Kurnaz M, Kutrup B, Bülbül U, 2016. An Exceptional Activity for *Darevskia derjugini* (Nikolsky, 1898) from Turkey. *Ecologica Balkanica*, 8 (2): 91-93.
- Mollov I, Georgiev D, Basheva S, 2015. Is the Kotschy's Gecko *Mediodactylus kotschy* (Steindachner, 1870) (Reptilia: Gekkonidae) Active During the Winter? *ZooNotes*, 84: 1-3.
- Rugiero L, 1995. Winter Activity of a Common Wall Lizard (*Podarcis muralis*) Population in Central Italy. *Russian Journal of Herpetology*, 2 (2): 148-152.
- Smith HM, 1946. *Handbook of Lizards: Lizards of the United States and of Canada*. Cornell University Press, USA.
- Tinkle DV, Hadley NF, 1973. Reproductive Effort and Winter Activity in the Viviparous Montane Lizard *Sceloporus jarrovi*. *Copeia*, 1973 (2): 272-277.
- Tok V, Uğurtaş İH, Sevinç M, Böhme W, Crochet PA, Kaska Y, Kumlutaş Y, Kaya U, Avcı A, Üzüm N, Yenyurt C, Akarsu F, 2009. *Anatololacerta danfordi* (errata version published in 2016). The IUCN Red List of Threatened Species 2009: e.T164744A86443842, <https://www.iucnredlist.org/species/164744/86443842> (Date of access: 19 February 2020).
- Tzankov N, Popgeorgiev G, Naumov B, Stojanov A, Kornilev Y, Petrov B, Dyugmedzhiev A, Vergilov V, Dragomirov R, Lukanov S, Westerström A, 2014. Identification Guide of the Amphibians and Reptiles in Vitosha Nature Park. Directorate of Vitosha Nature Park, Bulgaria.
- Ultsch GR, 1989. Ecology and Physiology of Hibernation and Overwintering Among Freshwater Fishes, Turtles and Snakes. *Biological Reviews*, 64 (4): 435-516.
- Vongrej V, Smolinský R, Bulánková E, Jandzik D, 2008. Extraordinary Winter Activity of the Green Lizard *Lacerta viridis* (Laurenti, 1768) in Southwestern Slovakia. *Herpetozoa*, 20 (3/4):173.
- Westerstrom A, 2005. Some Notes on the Herpetofauna in Western Bulgaria. In: Ananjeva N., Tsinenko O. (Eds.): *Herpetologia Petropolitana, Proceedings of the 12th Ordinary General Meeting of the Societas Europaea Herpetologica*, pp. 241-244, St. Petersburg.
- Zani PA, Irwin JT, Rollyson ME, Counihan JL, Healas SD, Lloyd EK, Kojanis, LC, Fried B, Sherma J, 2012. Glycogen, Not Dehydration or Lipids, Limits Winter Survival of Side-Blotched Lizards (*Uta stansburiana*). *The Journal of Experimental Biology*, 215: 3126-3134.
- Zug GR, Vitt LJ, Caldwell JP, 2001. *Herpetology, Second Edition: An Introductory Biology of Amphibians and Reptiles*. Academic Press, San Diego, USA.