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ARAŞTIRMA MAKALESİ **RESEARCH PAPER**

Unusual Winter Activity of Some Amphibian and Reptile Species Living in Bozcaada (Çanakkale, Türkiye)

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Abstract: Amphibian and reptile species, which are ectothermic animals, spend the winter months underground depending on the seasonal change in temperate regions. The availability of nutrients is also an important reason for the hibernation of these animal species. Ectothermic animals need higher air temperature and body temperature after hibernation to be able to perform their vital activities such as reproduction, feeding, escaping from predators. With the global climate change that is taking place, unusual winter activities can be observed in amphibian and reptile species. In addition, global warming has a significant impact on amphibians and reptiles, which leads to the fact that the species leaves hibernation earlier. As part of the research, field works were carried out in Bozcaada, Çanakkale on 19 and 20 February 2022. During the field studies, sampling was carried out for the detection of amphibian and reptile species, air temperature, coordinates of the observed individuals, habitat characteristics in which they lived, and sex characteristics were recorded. The captured specimens were subsequently released. In this study, *Lissotriton schmidtleri*, *Mauremys rivulata*, *Testudo graeca*, *Hemidactylus turcicus*, *Mediodactylus kotschyi*, *Ophisops elegans* and *Ablepharus kitaibelii* species in February and data on unusual winter activities were reported. Among the species, winter activity was found for the first time in relation to *Ablepharus kitaibelii*. Determining the unusual winter activity of ectothermal animals will contribute to the literature on the biology of species and the effects of climate change.

Keywords: Amphibia, bozcaada, climate, hibernation, reptilia, winter activity.

Bozcaada'da (Çanakkale, Türkiye) Yaşayan Bazı Amfibi ve Sürüngen Türlerinin Olağandışı Kış Aktivitesi

***Sorumlu yazar:**
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Öz: Ektotermik canlılar olan amfibi ve sürüngen türleri, ılıman bölgelerdeki mevsimsel değişime bağlı olarak kış aylarını yer altında geçirirler. Besin bulunabilirliği de bu hayvan türlerinin kış uykusuna yatması için önemli bir gerekçedir. Ektotermik hayvanlar hibernasyondan sonra üreme, beslenme, avcılardan kaçma gibi yaşamsal faaliyetlerini gerçekleştirebilmeleri için yüksek hava sıcaklığına ve vücut sıcaklığına ihtiyaç duyarlar. Yaşanmakta olan küresel iklim değişikliği ile birlikte amfibi ve sürüngen türlerinde olağandışı kış aktiviteleri gözlemlenebilmektedir. Bunun yanında küresel ısınma amfibiler ve sürüngenler üzerine oldukça etkilidir ve bu durum türlerin hibernasyondan daha erken çıkmasına neden olur. Araştırma kapsamında 19 ve 20 Şubat 2022 tarihlerinde Bozcaada, Çanakkale'de arazi çalışmaları gerçekleştirilmiştir. Arazi çalışmaları sırasında amfibi ve sürüngen türlerinin tespiti için örnekleme yapılmış, hava sıcaklığı, gözlemlenen bireylerin koordinatları, yaşadıkları habitat özellikleri ve cinsiyet özellikleri kaydedilmiştir. Yakalanan örnekler daha sonra serbest bırakılmıştır. Bu çalışmada *Lissotriton schmidtleri*, *Mauremys rivulata*, *Testudo graeca*, *Hemidactylus turcicus*, *Mediodactylus kotschyi*, *Ophisops elegans* ve *Ablepharus kitaibelii* türleri Şubat ayında tespit edilmiş olup, olağandışı kış aktivitelerine ilişkin veriler rapor edilmiştir. Türler arasında *Ablepharus kitaibelii* ile ilgili ilk kez kış aktivitesine rastlanmıştır. Ektoterm canlıların olağandışı kış aktivitesini belirlemek, türlerin biyolojisi ve iklim değişikliğinin etkileri hakkında literature katkı sağlayacaktır.

Anahtar kelimeler: Amfibi, bozcaada, hibernasyon, iklim, kış aktivitesi, reptil.

INTRODUCTION

Global warming and climate change have a significant impact on animal species, especially amphibians and reptiles (Corn, 2005; Hawkes et al., 2009; Bickford et al., 2010; Blaustein et al., 2010; Huey et al., 2012; Li et al., 2013; Le Galliard et al., 2012; Escobedo-Galvan, 2013; Jablonski, 2013; Kurnaz et al., 2016). Many of these effects have negative consequences for amphibian and reptile populations (Winter et al., 2016). Primarily, climatic changes affect the spring and winter activities of amphibians and reptiles (Zug et al., 2001). Poikilothermic animals, such as amphibians and reptiles, live depending on the thermal dynamics taking place in their micro and macro habitats (Vitt & Caldwell, 2013; Şahin, 2021).

Seasonal periods of low temperatures lead to the fact that these animals hibernate in the winters (Ultsch, 1989; Özkan & Bülbül, 2021). The beginning of next spring activity of hibernating species depends on climatic changes, as well as the photoperiod of the day, the gradual rise in temperature, changes in barometric pressure and the altitude of the habitat (Gregory, 1982; Vitt & Caldwell, 2009). Therefore, it is extremely rare to observe the winter activity of amphibians and reptiles which are usually hibernating, but it can happen under the influence of extraordinary environmental characteristics of the habitat, such as the phenomenon of thermal habitat (Covaciu–Marcov et al., 2010; Sas et al., 2012). Hibernation in amphibians and reptiles occurs as a behavioral response to seasonal change and is directly influenced by climate change (Gregory, 1982; Adolph & Porter, 1993).

The Turkish Smooth Newt, *Lissotriton schmidtleri* (Raxworthy, 1988), lives in shallow backwaters that see the sun in the spring, or in waters such as a slowly flowing pools, ditches, and lakesides (Baran et al., 2021). *L. schmidtleri* usually hibernates on land between November and March (Kowalewski, 1974; Juszczyk, 1987; Baruš & Oliva, 1992; Kaczmarek et al., 2018).

The Balkan Terrapin, *Mauremys rivulata* (Valenciennes, 1833) is found in habitats consisting of constant and slow-flowing waters such as swamps, lakes, ponds, dams, rivers, estuaries, and irrigation canals (Sidis & Gasith, 1985). They spend the hibernation period between the months of November and February under the mud at the bottom of the water (Ayaz & Çiçek, 2011; Bilgin, 2018).

Mediterranean Spur-Thighed Tortoise, *Testudo graeca* (Linnaeus, 1758) usually lives in damp, sandy and stony terrains. This tortoise species lives in forests, glades, roadsides, and watersides. *T. graeca* awakens from hibernation in March-April. Generally, the hibernation period begins in November (Başoğlu & Baran, 1977).

Mediterranean House Gecko, *Hemidactylus turcicus* (Linnaeus, 1758) lives in houses, on the outer walls of houses, ruins, forest edges, under stones and rock crevices and is a nocturnal species (Baran et al., 2021). The hibernation period of this species lasts from early December to mid-March (Wessels et al., 2018).

Kotsakiozi et al., (2018) studied the phylogenetic relationships of 174 specimens from 129 sampling sites that covering a significant part of the distribution of *Mediodactylus* species. It was established that the *M. kotschyi* lives in the mainland of Balkans, most of the Aegean islands and Italy. However, the species belonging to the *Mediodactylus* genus in our study area was uncertain according to Kotsakiozi et al., (2018). In recent studies (Gidiş & Başkale, 2020; Yıldız, 2020; IUCN, 2022), the species that is distributed in Turkey was identified as *M. kotschyi*, so this species was evaluated as *M. kotschyi* in our study. Kotschy's Gecko, *Mediodactylus kotschyi* (Steindachner, 1870) is a species that can be seen at night on house walls and lives in stony areas with few plants. And it was reported that the hibernation period of *M. kotschyi* lasts from the beginning of November to the middle of March (Stojanov et al., 2011).

Snake Eyed Lizard, *Ophisops elegans* (Ménétries, 1832), lives on stony and sandy ground in open areas with few plants. It was reported that *O. elegans* is in the hibernation period from November to mid-March (Arakelyan et al., 2011).

Snake-Eyed Skink, *Ablepharus kitaibelii* (Bibron & Bory de Saint-Vincent, 1833) lives in woodlands that has short plants, areas with maquis and sparse trees. Helmer et al., (1989) were determined that the hibernation period of *A. kitaibelii* was complete at late April-early May. Baran et al., (2021) were stated that this species is active in autumn and spring periods.

In this study, data on unusual winter activities of *L. schmidtleri*, *M. rivulata*, *T. graeca*, *H. turcicus*, *M. kotschyi*, *O. elegans* and *A. kitaibelii* species observed in February in Bozcaada are presented.

MATERIAL AND METHOD

Bozcaada is located in the northeast of the Aegean Sea, in the southwest of the Çanakkale (Figure 1). The city is located between 39º 47' 30"- 39º 50' 90" northern latitudes and 25º 57' 80"- 26º 05' 00" east longitudes about 6 kilometers away from the Aegean exit of the Dardanelles Strait. Bozcaada is the third largest island of Turkey with 36.03 km^2 surface area, after Gökçeada and Marmara Islands (Atalay, 1982; Hocaoğlu, 1988). The highest points of Bozcaada are Göztepe (194 m) and Yenikale (115 m).

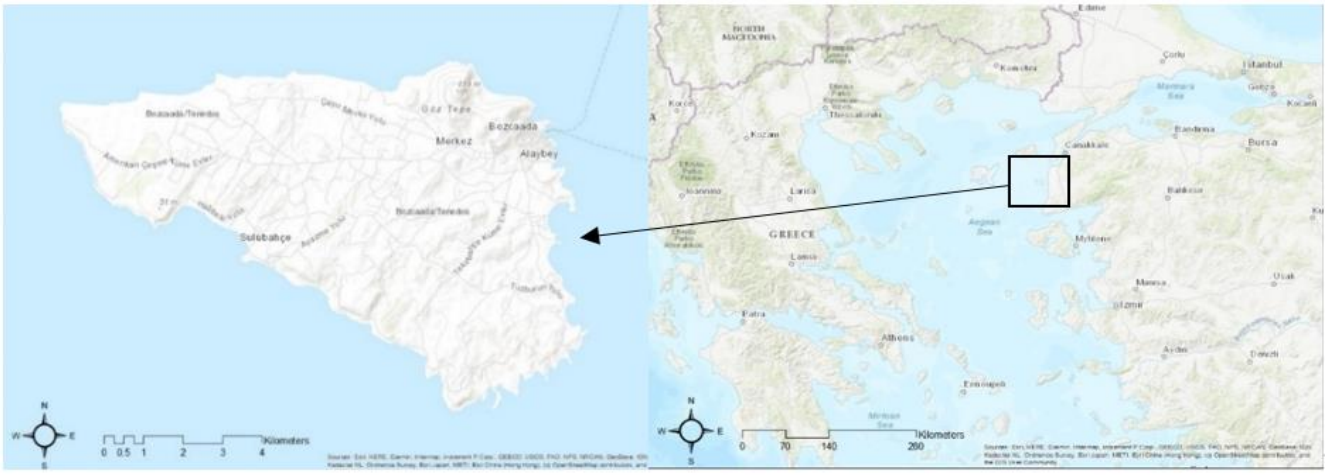

Figure 1. Study area.

The necessary permission was obtained from Ethics Committee of Animal Experiments of Çanakkale Onsekiz Mart University (Decision Number: 2021/01-04) for the studies carried out. All species were observed in the field study carried out on 19-20 February 2022, between 11:00 and 16:00, in Bozcaada, Çanakkale. The air temperature in the region was measured with digital thermometer as 12°C during the observations. The coordinates of the samples were recorded using GPS (Global Positioning System) device and photographs were taken with digital camera. The species were released back to their habitats after being captured by hand to determine their sex.

RESULTS

Two male *L. schmidtleri* individuals (Figure 2) were observed on 19 February 2022 at noon at a puddle that located on the roadside of Çayır location in the north of the island, at 2 m above sea level (39°50'10.62"N, 26°2'17.75"E). The parameters of water that the species found were measured; water temperature was 14.9ºC, pH was 6.46, and dissolved oxygen was 9.19 mg/L.

Figure 2. Observed *L. schmidtleri* species (A) and their habitat (B)

A juvenile *M. rivulata* individual (Figure 3) was observed in the Azmak River, the only water source of Bozcaada, at noon on 20 February 2022 (39°50'27.74"N, 26°2'13.22"E, 0 m a.s.l.). The parameters of water that the species found were measured; water temperature was 14.1ºC, pH was 7.30, and dissolved oxygen was 8.38 mg/L.

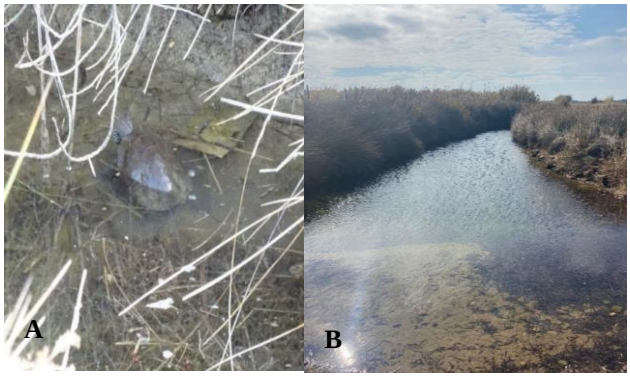

Figure 3. *M. rivulata* (A) and habitat (B).

Göztepe (194 m), where the species *T. graeca* has been identified, is the highest region of the island. This region has a stony-hilly type of habitat. A male *T. graeca* individual (Figure 4) was observed on 20 February 2022 before noon at 140 m a.s.l. (39°50’19.88”N, 26°3’6.30”E). The species was observed and photographed while sunbathing.

Figure 4. *T. graeca* (A) and habitat (B).

A female *H. turcicus* individual (Figure 5) was observed on 19 February 2022 at noon on a rock, at 81 m a.s.l. (39°50'11.03"N, 26°3'7.81"E).

Figure 5. *H. turcicus* (A) and the habitat in which it is observed (B).

A male *M. kotschyi* individual (Figure 6) was observed and photographed on 19 February 2022 between at noon under a rock, at 81 m a.s.l. (39°50'11.03"N, 26°3'7.81"E).

Figure 6. *M. kotschyi* (A) and habitat (B).

Sixteen *O. elegans* individuals (7 male, 9 female) were observed on 19-20 February 2022, between 11:00 and 16:00 and different altitudes in various habitats (39°49'48.35"K, 26°0'12.86"D, 53 m a.s.l.; 39°50'20.94"K, 26°3'8.98"D, 135 m a.s.l.; 39°50'10.62"K, 26° 2'17.75"D, 10m a.s.l.; 39°50'31.92"K, 26°1'57.00"D, 3m a.s.l) of Bozcaada. This species was mostly seen among scrubs or on stones and rocks (Figure 7).

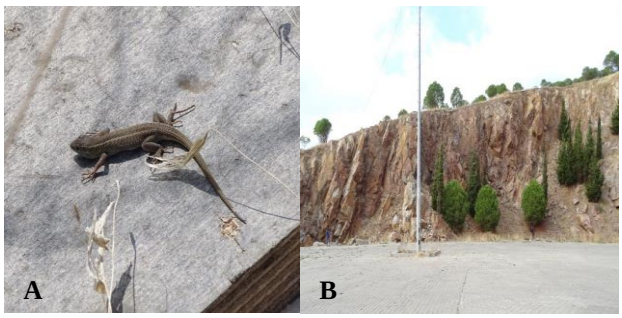

Figure 7. *O. elegans* (A) and their habitat (B).

Two *A. kitaibelii* individuals (1 male, 1 female) were observed on 20 February 2022 in the afternoon on a rock at 120 m a.s.l. (39°50'18.94"N, 26°3'7.45"E) (Figure 8).

Figure 8. *A. kitaibelii* (A) and habitat (B).

DISCUSSION AND CONCLUSION

Hibernation is a physiological condition that is carried out due to seasonal changes and disruption of many ecological activities in the environment in poikilothermic animals. Poikilothermic animals tend to protect themselves over the period until they find their reduced vital needs again in their microhabitats with hibernation. The seasonal activities of these animals are directly affected by climate changes (Zug et al., 2001, Bülbül et al., 2019). For this reason, when the temperature in their microhabitat increases, poikilothermic animals tend to wake up from hibernation independently from other ecological needs (nutrients, predators etc.) and they can return to their vital activities (Kurnaz & Şahin, 2021).

Since amphibians are poikilothermic animals, their body temperature is directly influenced by the environment (Moss, 2010). Especially in aquatic salamander species, the temperature of the water they live in directly affects their vital activities such as reproduction, food search and escaping from their predators (Bülbül & Koç, 2020). However, due to the inability to find enough nutrients in their micro-habitats, this species cannot be able to perform many other vital activities and as a result they will face the danger of death (Kurnaz & Şahin, 2021). The findings obtained from this study also indicate this risk for the *L. schmidtleri*. Although the water temperature is sufficient for this species to emerge from hibernation, it is thought that the lack of sufficient nutrients in February will negatively affect the species. Additionally, Kaczmarek et al., (2018) were observed the winter activity of *Lissotriton vulgaris* in the December and January months between 2014 and 2018 in their study. On 19 December 2014, they observed 6 *L. vulgaris* individuals and were reported that the air temperature was 11ºC during the observation. On 29 January 2018, 5 individuals were observed, and it was indicated that the air temperature was 9ºC. Kurnaz & Şahin (2021) were observed the *Triturus ivanbureschi* in their study conducted on 11 January 2021 in Şahinli, Çanakkale. During their observation, the air temperature was measured as 21ºC and the substrate temperature as 19ºC. In our study, the air temperature was measured as 12ºC, and the water

temperature was measured as 14.9ºC at the moment that we observed the *L. schmidtleri*.

Since turtles and tortoises can spend more than half of their lives in hibernation (Ultsch, 2006), it is important for successful conservation actions to have information about the activity and habitat of turtles during the winter months (Newton & Herman, 2009). According to Gül et al., (2014)'s study conducted in Bozcaada, *M. rivulata* was observed in March and air temperature was 26ºC during the observation. However, in our study, aquatic *M. rivulata* and terrestrial *T. graeca* species was observed on 20 February 2022 and the air temperature was measured as 12ºC. It was known that March-April months was the beginning of spring activity for both species. Rising of the air temperature in winter due to global climate change is important for showing that species which should be active in spring can also be active in winter months.

The cold environment is an influential factor on the hibernation of lizards. Certain vital activities of lizards (e.g., mobility, food availability and escaping behavior) depends mainly on air temperature, and low temperatures have a negative impact on these activities (Adolph & Porter, 1993). Gradual changes in air temperature can be the reason of emerging early from the hibernation in some lizard species (Kurnaz et al., 2016). Researchers from different parts of the world have reported winter activity for different lizard species: *Darevskia rudis* (Koç et al., 2018), *Lacerta media* (Bülbül et al., 2019), *Lacerta viridis* (Vongrej et al., 2008), *Hemidactylus turcicus* (Stone et al., 2021), *Mediodactylus kotschyi* (Mollov et al., 2015), *Ophisops elegans* (Franzen, 1986), *Podarcis erhardi* (Buresh & Tsonkov, 1933; Beshkov, 1977), *Podarcis muralis* (Rugiero, 1995; Beshkov & Nanev, 2002; Westerstrom, 2005; Tzankov et al., 2014), *Sceloporus jarrovi* (Tinkle & Hadley, 1973) and *Zootoca vivipara* (Grenot et al., 2000). In our study, in addition to these species studied before, we were detected unusual winter activity in *A. kitaibelii* species that has not found in previous studies. In their study, Stone et al., (2021) were stated that the *H. turcicus* species was active at different temperatures (18.89ºC, 13.89ºC, 8.89ºC, 15.56ºC) during January and February months between 2012 and 2017 on outside walls of the science building at the University of Central Oklahoma, Edmond, USA. Mollov et al., (2015) were reported that *M. k. rumelicus* was active on 18 January 2017 and *M. k. danilewskii* was active on 23 January 2015 in urban areas in Bulgaria. And they were explained this unusual gecko activity by the finding that cities and urban areas are 1-2ºC higher than the surroundings of the cities. According to Shterback & Golubev, (1986), the minimum temperature that geckos were observed was 12ºC. At the same time, small sizes of lizards play an advantageous role that helps with thermal regulation and promotes activity at low environmental temperatures compared to larger species (Porter et al. 1973). Therefore, differences in the levels of winter activity can occur depending on the size of each species and the thermoregulation behavior (Grant, 1990). The small size of all of the lizard species that we observed (*H. turcicus, M. kotschyi, O. elegans, A. kitaibelii*) may be one of the reasons why their seasonal activity begins in the early winter months by rising in the body temperatures.

In recent years because of global warming, it has been observed that amphibians and reptiles are active in the winter (Kaczmarek, 2018; Altunışık, 2019; Bülbül et al., 2019; Bülbül & Koç, 2020; Altunışık & Kara, 2021; Özkan & Bülbül, 2021; Kurnaz & Şahin, 2021). The identification of these unusual winter activities not only contributes to the biological knowledge of the species, but also provides important preliminary information for analyzing climate change models.

In conclusion, increasing temperatures due to global climate change have also affected amphibian and reptile species (*L. schmidtleri, M. rivulata, T. graeca, H. turcicus, M. kotschyi, O. elegans* and *A. kitaibelii*) living in Bozcaada, Çanakkale, causing them to wake up from hibernation earlier than normal spring activities.

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