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## No one ever noticed: First report of *Zootoca vivipara* (Lichtenstein, 1823) in Greece

Ilias Strachinis<sup>1,\*</sup>, Korina M. Karagianni<sup>1</sup>, Martin Stanchev<sup>2</sup>, and Nikola Stanchev<sup>3</sup>

The Viviparous Lizard, *Zootoca vivipara* (Lichtenstein, 1823), is a relatively small, ground-dwelling lizard belonging to the family Lacertidae. It is the terrestrial reptile with the largest range in the world, extending from Ireland in the west, to Japan (Hokkaido Islands) in the east, and from Bulgaria in the south to the Barents Sea in the north (Kupriyanova et al., 2017; Horreo et al., 2018). As a highly cold-adapted species (Recknagel et al., 2018) the Viviparous Lizard can be found up to 350km north of the Arctic Circle (Arnold and Ovenden, 2002) and up to 2900 m a.s.l. (Agasyan et al., 2010). It occurs in a variety of habitats with rich vegetation and adequate humidity, however, in the south margin of its range it is restricted to high elevation open landscapes, above the tree line (Speybroeck et al., 2016). *Zootoca vivipara* constitutes one of the four representatives of the Order Squamata that present both viviparous and oviparous populations (Rodriguez-Prieto et al., 2017). It has been recently revealed that oviparous populations are genetically distinct from those using viviparity as a reproduction strategy (Cornetti et al., 2015), while several distinct lineages have been recognized based on taxonomic studies on karyology and molecular genetics (Kupriyanova et al., 2017; Rodriguez-Prieto et al., 2017).

Although the Viviparous Lizard is listed as “Least Concern” in the IUCN Red List in view of its wide distribution and can be locally abundant, there are populations in parts of its range that have dangerously

declined and in some cases almost gone extinct (e.g. lowland populations in Italy; Agasyan et al., 2010). The current population trend is decreasing and the major threat that can occur locally is habitat loss resulting from agricultural intensification, urbanization and tourism facilities development (Agasyan et al., 2010). The species is protected under the Bern Convention (Annex II) and listed on Annex IV of the European Union Habitat and Species Directive (Agasyan et al., 2010).

In the Balkans the species’ distribution appears scattered (Fig. 1A) as the suitable habitats are mostly limited in higher altitudes, isolated by lowlands and river valleys (Crnobrnja-Isailovic et al., 2015). To date, the southernmost known edge of the species’ range lies in Sovatya mt (location “Perelik”) in the western Rhodopes, Bulgaria (41.6103° N, 24.5963° E; Petrov et al., 2006). In the past, several herpetological expeditions, both in the Bulgarian and Greek Rhodopes, failed to prove the species’ occurrence south of the Perelik area (Petrov et al., 2006). In this report we present a new discovered population of *Z. vivipara* in the Greek Rhodopes, about 7.3 km SW of the Perelik (Fig. 1).

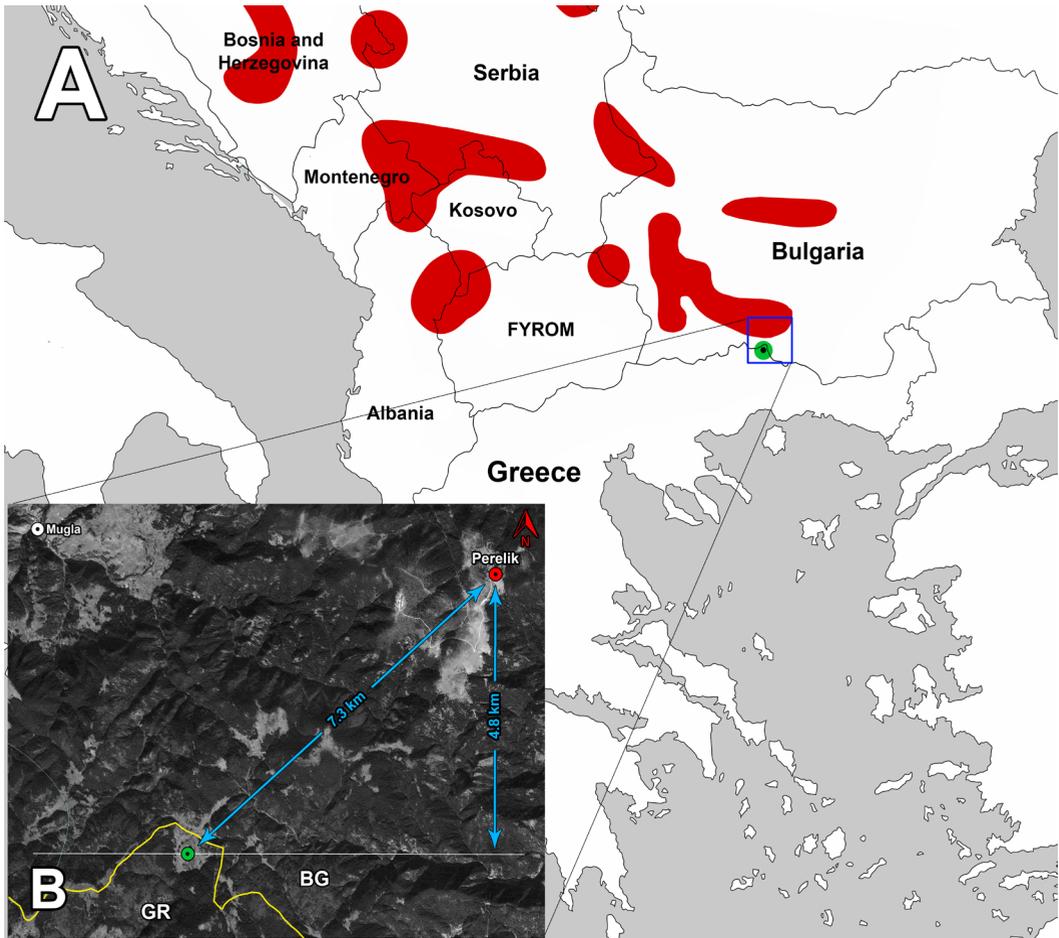
During a two-day herpetological expedition we visited the northernmost part of Fraktos Forest, in the Rodopi Mountain Range National Park (RMRNP), Greece, in order to scrutinize the possible occurrence of the Viviparous Lizard in the area. The habitat we chose to examine is a grassland plateau which consists of low herbaceous vegetation crossed by narrow brooklets and demarcated by a dense forest of Norway spruce (*Picea abies*; 41.5641° N, 24.5280° E, 1740 m a.s.l.; Fig. 1B, 2D). On 6 October 2018, during a thorough investigation, three juvenile Viviparous Lizards were observed moving and basking on the herbaceous substrate while one of them was captured and examined (Fig. 2A). On the second day, 7 October 2018, eight more juveniles and two adult individuals (one female and one male, Fig. 2B, C) were spotted

<sup>1</sup> School of Biology, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece.

<sup>2</sup> Gurguliat str.25, ap.1, 1463 Sofia, Bulgaria.

<sup>3</sup> Faculty of Biology, Sofia University “St. Kliment Ohridski”, bul. “Tsar Osvoboditel” 15, 1504 Sofia, Bulgaria.

\* Corresponding author. E-mail: info@herpetofauna.gr



**Figure 1.** A) The approximate distribution of *Zootoca vivipara* in the south Balkans depicted with red color, based on distribution maps in Biserkov (2007), Agasyan *et al.* (2010), Sillero *et al.* (2014) and Speybroeck *et al.* (2016). B) A close-up satellite image of the focal area. The location of the newly discovered population of *Z. vivipara* in Greece (green spot), the Perelik area (red spot) and the relative distance between them are shown, as well as the borders between the two countries (yellow line).

in the same meadow. In total, three specimens (two juveniles and the adult male) and two other individuals' tails were collected, deposited and accessioned in the Natural History Museum of Crete collection (voucher numbers: NHMC80.3.184.1, NHMC80.3.184.2, NHMC80.3.184.3, NHMC80.3.184.4 and NHMC80.3.184.5). Basic biometric measurements of the three collected specimens were obtained (Table 1). In both days of the survey most observations of the lizards were made in air temperatures between 13 and 15 °C.

This is the first record of the Viviparous Lizard in Greece that further enhances the number of species

of the Greek herpetofauna (Lymberakis *et al.*, 2018), whereas it is also the new southernmost location of its global distribution. Being a small and quite secretive lizard, *Zootoca vivipara* can be easily overlooked during cursory field surveys (Crnobrnja-Isailović *et al.*, 2015), which may explain the lack of observations in the focal area, in the past. Other nearby areas in the RMRNP that seem to provide suitable habitat and should be thoroughly examined for the species' potential presence are at locations: a) 41.5600° N, 24.5125° E, b) 41.5576° N, 24.5079° E, c) 41.5523° N, 24.4941° E, d) 41.5539° N, 24.5379° E, e) 41.5530° N, 24.5330° E, and f) 41.5508° N, 24.5275° E. These mountain meadows

are located even further southwards in the RMRNP and connected to the newly discovered population by narrow, untimbered, grassland corridors.

Given that peripheral populations of species can

be rare, scattered and isolated, and thus prone to implications of genetic, demographic and environmental stochasticity (Crnobrnja-Isailović et al., 2015), we deem that monitoring of the Greek population, as well as

**Table 1.** Basic biometric characters of the three collected specimens from the newly discovered population of Viviparous Lizard in Greece (in mm). (SVL) snout-vent length, (TL) tail length, (HL) head length from the tip of the snout to the posterior border of the collar, (HW) head width, (PL) pileus length, (FFL) front foot length, (HFL) hind foot length. Measurements were taken using an electronic caliper and by following the suggestions of Pérez-Mellado and Gosá (1988).

Voucher number	Stage/Sex	SVL	TL	HL	HW	PL	FFL	HFL
NHMC80.3.184.2	Juv	33.26	44.30	10.41	5.12	7.16	8.81	13.68
NHMC80.3.184.3	Juv	33.28	42.58	11.27	5.55	7.53	9.35	14.59
NHMC80.3.184.4	Adult/Male	55.3	75.33	16.95	7.18	10.29	14.41	19.98



**Figure 2.** A juvenile (A), an adult female (B), and an adult male individual (C) of *Zootoca vivipara* from the Greek population and a habitat image of the grassland plateau (D) where the population was discovered (October 2018; location: 41.5641° N, 24.5280° E). Photos by Ilias Strachinis.

genetic analysis and possible management measures, are of particular importance.

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