

# First confirmed records of *Iberolacerta horvathi* (Méhely, 1904) in Bosnia and Herzegovina and an updated species distribution

Maarten J. Gilbert<sup>1,\*</sup> and Wouter Beukema<sup>1</sup>

Horvath's Rock Lizard, *Iberolacerta horvathi* (Méhely, 1904), has a disjunctive distribution compared to other *Iberolacerta* species, which all occur on the Iberian Peninsula and adjoining France. This species is currently known from Austria, Croatia, Italy, and Slovenia (Cocca et al., 2021). It occurs occasionally in lowlands, but more frequently at mid to high altitudinal ranges, with a habitat often consisting of karstic rocky surfaces in open beech forests, conifer forests or low alpine scrub, depending on the elevation (Bischoff, 1984; Arnold and Ovenden, 2004). These places are usually thermophilic and dry. However, especially at lower elevations, the species may occur in deep, forest clad canyons which are relatively shady and humid. The specific habitat preferences and frequently very localised occurrence of the species have likely contributed to an underestimation of its distribution range. Also, the similar appearance of *I. horvathi* compared to the often syntopic and widespread species *Podarcis muralis* may contribute to the underreporting of this species (Vogrin et al., 2009). The species distribution is still poorly known, especially in the southern parts of its range (Cocca et al., 2021). Nevertheless, targeted surveys have led to the discovery of several new populations in the recent past (Žagar et al., 2014; De Marchi et al., 2020). Along the south-eastern distribution range limits on the Balkan Peninsula, distribution records of the species are known from Croatia, but not from adjoining Bosnia and Herzegovina, although the species has been predicted to occur in this country as well (Žagar et al., 2014; Cocca et al., 2021). Here, we present the first confirmed distribution records of *I. horvathi* from Bosnia and Herzegovina, and an updated distribution of

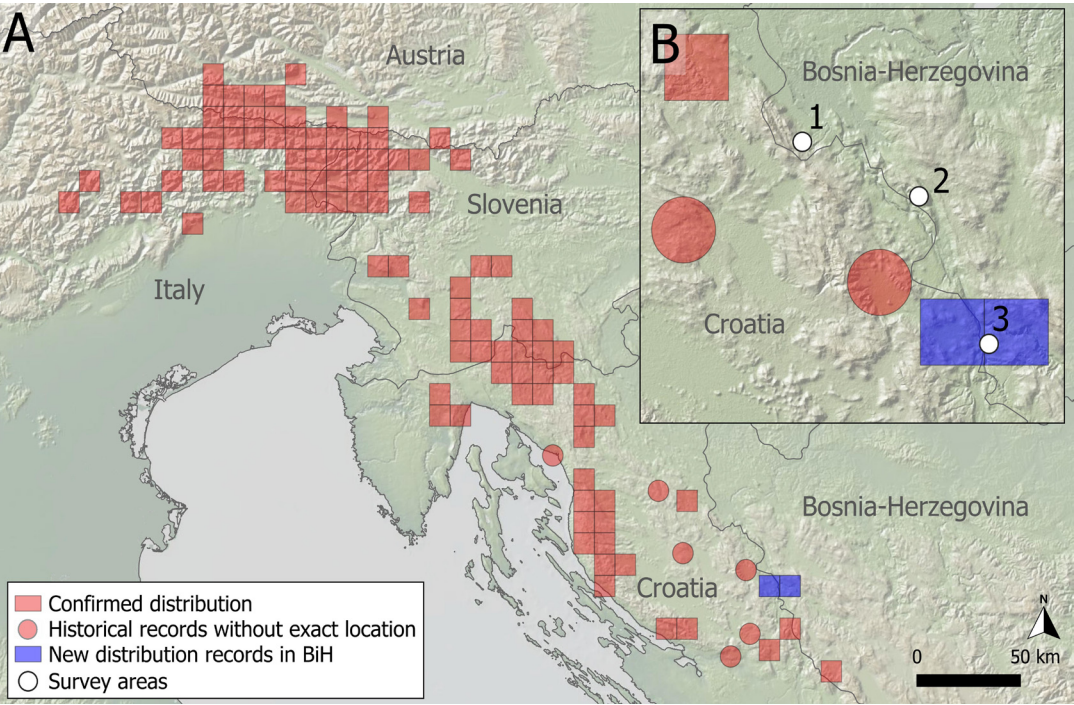
*I. horvathi*.

Surveys were conducted at three locations in the north-western part of Bosnia and Herzegovina (Fig. 1), with coordinates referring to the midpoints of the survey areas: the mountainous area south-west of Bihać (site 1: 44.7611°N, 15.8160°E); the northern bank of the Una River near Štrbački buk (site 2: 44.6597°N, 16.0029°E); and the area south of Martin Brod along the eastern bank of the Una River (site 3: 44.4709°N, 16.1413°E). The latter two areas are part of Una National Park. Suitable search areas were partially hinted by the habitat suitability map for *I. horvathi* provided by Cocca et al. (2021). The locations were visited between 7–9 August 2024. Weather conditions during the surveys were generally sunny, with maximum temperatures up to 32 °C, although local conditions varied due to factors such as shading and elevation. During the survey in the mountainous area south-west of Bihać (site 1, Fig. 1), weather conditions were initially cloudy with occasional light rain, followed by sunny weather conditions. Apparently suitable habitats were visually scanned for lizards, with a specific aim to find *I. horvathi*.

Three *I. horvathi* individuals were observed on 7 August during the afternoon (15:00–16:00 h) in the area south of Martin Brod at two locations separated 600 m from each other, which are located in two separate 10 x 10 km grid cells (site 3, Fig. 1). An adult (Fig. 2A) and a juvenile individual (Fig. 2B) were observed at the northern location (450 m elevation), and an adult male (Fig. 2C) was observed at the southern location (390 m elevation). The individuals were found at the base of largely west-facing vertical rocky cliffs along the eastern bank of the Una River (Fig. 2D). The local habitat consisted of shaded rock surfaces with sunlit patches, bordered by riparian forest (Fig. 2E). Here, the adult individuals were found on the vertical rock surfaces, roughly one meter above the ground, while the juvenile individual was found on the forest floor in the open undergrowth near the base of the cliff. The individuals were syntopic with *Algyroides nigropunctatus* and *P. muralis*. In contrast to the *I. horvathi* adults, which were

<sup>1</sup> Reptile, Amphibian and Fish Conservation Netherlands (RAVON), Toernooiveld 1, Nijmegen 6525 ED, the Netherlands.

\* Corresponding author. E-mail: maartengilbert@gmail.com



**Figure 1.** Updated distribution map for *I. horvathi*, based on 10 x 10 km grid cell level (EEA reference grid). (A) Complete distribution range of *I. horvathi*, including the new records in Bosnia and Herzegovina (BiH). (B) Detailed overview of the survey areas, the new records of *I. horvathi* in Bosnia and Herzegovina, and records from adjacent Croatia. Historical records without exact locations are visualised as circles, using the same grid cell locations as Cocca et al. (2021).

found on the vertical rock surfaces, *A. nigropunctatus* was mostly found on and near isolated rocks, while *P. muralis* was mostly found on the ground in the warmer, dryer, and more sun-exposed areas. *Lacerta viridis* was observed in the wider surroundings in more sun-exposed and well-vegetated areas. In both northern survey areas *I. horvathi* was not found. Other observed lizard species were *Anguis fragilis*, *L. viridis*, and *P. muralis* in the mountainous area south-west of Bihać (site 1, Fig. 1), and *A. nigropunctatus*, *L. viridis*, and *P. muralis* in the area near Štrbački buk (site 2, Fig. 1).

An updated distribution map for *I. horvathi*, including the new distribution records, was constructed based on distribution data from De Marchi et al. (2020) and Cocca et al. (2021), supplemented with data from GBIF (GBIF.org, 2025). Confirmed distribution data based on point locations was visualised on 10 x 10 km grid cell level (EEA reference grid). Historical records without exact locations were visualised as circles, using the same grid cell locations as Cocca et al. (2021), which are slightly deviant compared to the EEA reference grid due to the different coordinate systems used. GBIF data

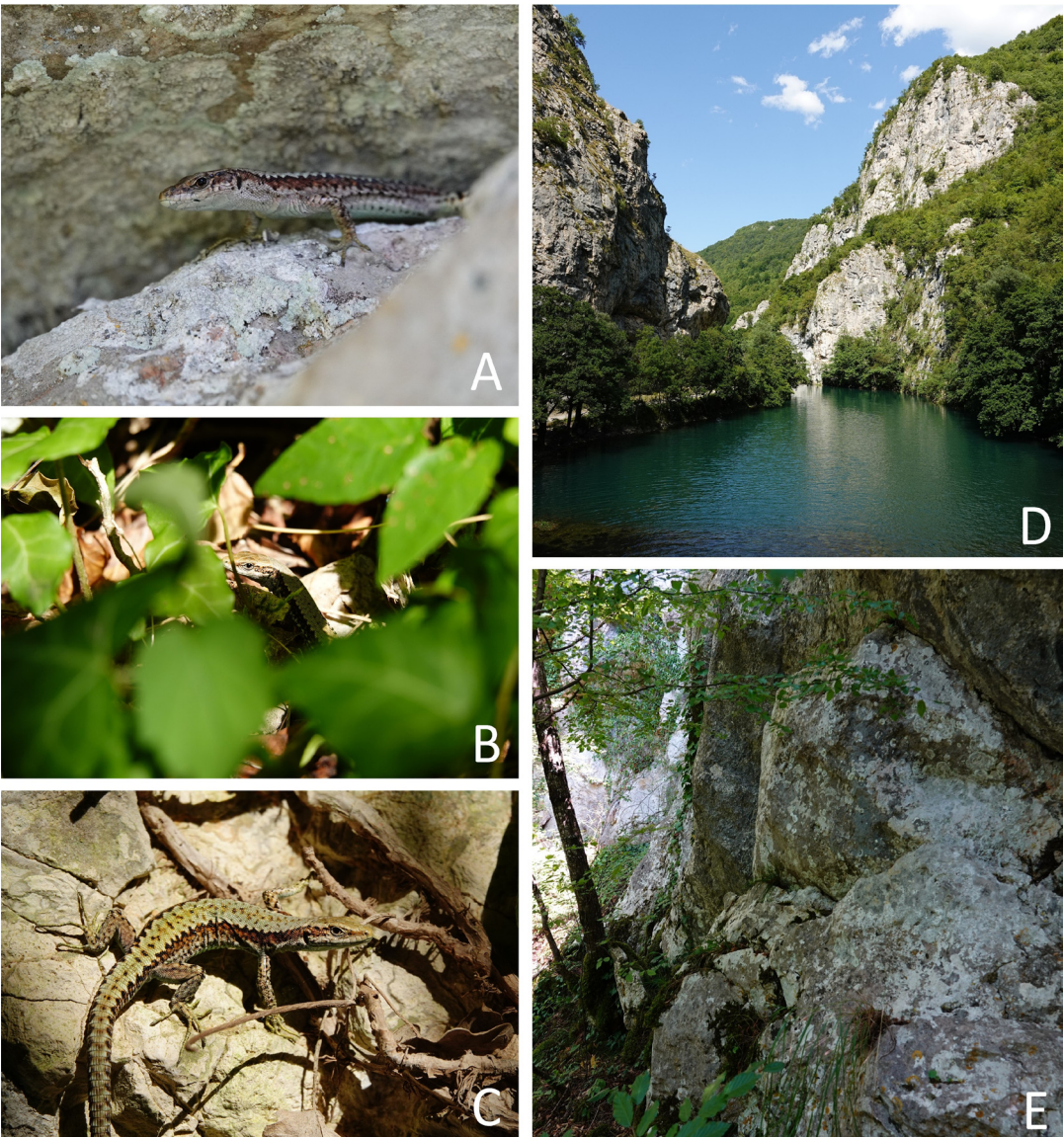
was validated manually and erroneous or inconclusive distribution records were discarded (i.e. incorrect or questionable species identification or location). Two distribution records based on the collection of Franz Werner in the Museum of Comparative Zoology, Harvard University (catalogue numbers R-25918, collected in 1867–1928, and R-15833, collected in 1914) have been georeferenced recently in 2019 and 2022, but were either placed outside the originally mentioned location (“Velebit range”) or placed within a very large range based on the original description (“Croatia”), respectively. In addition, these locations are outside the currently known species range, and were therefore omitted from the data set. Two other southern distribution records in Croatia, “Šibenik” and “Kozjak”, mentioned by Bischoff (1984) were considered highly questionable or incorrectly georeferenced, respectively, and were therefore excluded (Cocca et al., 2021). The Kozjak location is described as “Kozjak (Velebit)” in the original description by Méhely (1909), which most likely refers to Veliki Kozjak in the Velebit range near Stinica, a location which is also near to other collection



sites in the Velebit range. However, this location appears to be incorrectly placed at the similarly named Veliki Kozjak near Kijevo by Bischoff (1984). Therefore, this record was placed at Veliki Kozjak in the Velebit range, instead of Veliki Kozjak near Kijevo.

While the presence of *I. horvathi* in Bosnia and Herzegovina was expected, confirmation was thus far lacking (Žagar et al., 2014; Cocca et al., 2021).

The observations presented here provide the first documented distribution records of *I. horvathi* in Bosnia and Herzegovina. Although only three individuals were observed, the presence of a juvenile animal suggests that a reproductive population occurs at this location. It remains to be shown whether this population is isolated or in contact with other populations. A historical record on 10 x 10 km grid cell level is known from bordering



**Figure 2.** The observed *I. horvathi* individuals and habitat along the Una River. Adult (A) and juvenile (B) from the northern location and an adult male (C) from the southern location. Overview (D) and detail (E) of the occupied habitat. Photos by Maarten Gilbert.

Croatia, west of the Una River (Fig. 1), although it needs to be confirmed. However, currently the Una and Unac rivers probably form a barrier to the west and north, and separate populations on both sides, if present. Towards the south, contact with populations in the Dinara range is also unlikely, given the large distance and areas of low habitat suitability in between, but not excluded. Based on habitat suitability modelling in Cocca et al. (2021), the area of occurrence in Bosnia and Herzegovina is isolated from other areas with high habitat suitability. However, it should be noted that the predicted habitat suitability at the exact location of occurrence in Bosnia and Herzegovina was low according to this model, showing that the real distribution pattern may differ based on microclimate and other local conditions. At least locally, the species may also be present at other locations along the Una and Unac rivers, as apparently suitable conditions are present.

In the two northern survey areas, *I. horvathi* was not found despite the presence of apparently suitable habitat. This was potentially hampered by suboptimal weather conditions (either overcast or sunny and warm weather conditions). Furthermore, only a small area could be searched within a short timeframe (between two and four hours of search time at apparently suitable habitat for each location). Therefore, the presence of *I. horvathi* in the northern areas cannot be excluded, especially in the mountainous area south-west of Bihać (site 1, Fig. 1) where *I. horvathi* occurs in bordering Croatia and where the habitat is suitable (Cocca et al., 2021). Also further south, in the Dinara range in Croatia, *I. horvathi* has been recorded at two separate locations less than two kilometres from adjoining Bosnia and Herzegovina. A wider, although probably fragmented, distribution of this species in Bosnia and Herzegovina is likely.

The distribution of *I. horvathi* as currently known runs from the Southern Limestone Alps in eastern Italy, southern Austria, and north-western Slovenia, to the northern Dinaric Alps in western Slovenia, north-western Croatia, and north-western Bosnia and Herzegovina (Fig. 1). Towards the south of its distribution range, *I. horvathi* occurs locally in the Velebit and Mala Kapela ranges up to the Dinara range, which holds the currently southernmost confirmed population of this species (Žagar et al., 2014). The new distribution records from Bosnia and Herzegovina partly fill the gap between the areas of occurrence in the Mala Kapela and Dinara ranges along the south-eastern edge of the distribution range, where distribution records are particularly scarce and multiple historical records

are in need of confirmation (depicted as circles in Fig. 1). Compared to the northern parts of its distribution, populations in the south appear to be more fragmented and isolated. In part, this may be due to underreporting caused by difficult terrain, a lack of roads and paths, and remnant mine fields from past armed conflicts (Cocca et al., 2021). Nevertheless, a truly fragmented distribution along the southern edge of its range is plausible due to the specific habitat requirements of *I. horvathi*. This is also supported by habitat modelling, which shows that areas of high habitat suitability are relatively small and scattered in the south (Cocca et al., 2021).

The *I. horvathi* individuals were found at a relatively low elevation of 390 m and 450 m, especially considering that this location is situated along the southern edge of the currently known distribution range. The altitudinal distribution of *I. horvathi* ranges from 200 m to 2000 m elevation, although it is most common at elevations between 800–1200 m (Bischoff, 1984; Lapini, Richard, and Dall'Asta, 1993; Žagar, 2016). Locally, the Una River has formed a narrow canyon (Fig. 2D). Canyons can provide a suitable habitat and microclimate for *I. horvathi* at lower elevations (Lapini, Richard, and Dall'Asta, 1993). The same has been observed for other Lacertidae species, such as *Dinarolacerta mosorensis*, a predominantly mountainous and rupicolous species, which also occurs on the Balkan Peninsula and has similar habitat preferences as *I. horvathi* (Ljubisavljević et al., 2016).

While the observation of *I. horvathi* in Bosnia and Herzegovina represents an extension of its distribution range, and the species is likely more widespread than currently known, its range is highly fragmented and many populations are isolated (Vogrin et al., 2009). This may particularly be the case in the south of its distribution range, where the species also shows the largest genetic diversity (Cocca et al., 2021), and conservation measures to preserve its intraspecific diversity may be most urgent. As is the case for other *Iberolacerta* species (Pleguezuelos, 2015), its specific habitat requirements and adaptation to relatively cool, humid, and mostly mountainous areas, make the species vulnerable in a changing climate, and *I. horvathi* is currently listed as Near Threatened by the IUCN (Vogrin et al., 2009). Especially at risk are isolated populations living at low elevations at the southern edge of the distribution range and which have limited opportunities to disperse to higher elevations or other areas with suitable habitat, such as the population described here. Although this *I. horvathi* population occurs within the boundaries of

Una National Park and is therefore protected relatively well, safeguarding this newly discovered species for Bosnia and Herzegovina should be high priority.

**Acknowledgments.** We are grateful to Anamarija Žagar for providing distribution records of *Iberolacerta horvathi* and for the pre-peer review of the manuscript.

## References

- Arnold, E.N., Ovenden, D. (2004): Field guide to the reptiles and amphibians of Britain and Europe. London, HarperCollins.
- Bischoff, W. (1984): *Lacerta horvathi* Méhely 1904 - Kroatische Gebirgseidechse. In Handbuch der Reptilien und Amphibien Europas - Band 2/I - Echsen (Sauria) II, p. 265–289. Böhme, W., Ed., Wiesbaden, AULA-Verlag.
- Cocca, W., Žagar, A., Sillero, N., Jowers, M.J., Krofel, M., Lužnik, M., Podnar, M., Tvrtković, N., Carretero, M.A., Crottini, A. (2021): Genetic diversity of Horvath's Rock Lizard meets current environmental restrictions. *Conservation Genetics* **22**: 483–498.
- De Marchi, G., Bombieri, G., Boz, B., Leandri, F., Richard, J. (2020): Has the West been won? A field survey and a species distribution model of *Iberolacerta horvathi* in the Alps. *Acta Herpetologica* **15**: 3–14.
- GBIF.org (2025): GBIF Occurrence Download. Available at: <https://doi.org/10.15468/dl.cnvzje>. Accessed on 18 March 2025.
- Lapini, L., Richard, J., Dall'Asta, A. (1993): Distribution and ecology of *Lacerta horvathi* Méhely, 1904 (Reptilia, Lacertidae) in north-eastern Italy. *Gortania - Atti del Museo Friulano di Storia Naturale Udine* **14**(1992): 213–230.
- Ljubisavljević, K., Polović, L., Iković, V., Vuksanović, S., Zagora, V., Urošević, A., Tomovic, L. (2016): New records and updated distribution of the endemic Balkan rock lizards *Dinarolacerta* spp. in Montenegro. *Ecologica Montenegrina* **9**: 46–50.
- Méhely, L. (1909): Materialien zu einer Systematik und Phylogenie der *muralis*-ähnlichen Lacerten. *Annales Musei Nationalis Hungarici* **7**: 409–621.
- Pleguezuelos, J.M. (2015): Vulnerabilidad de los reptiles ibéricos al cambio climático. In: Los Bosques y la Biodiversidad Frente al Cambio Climático: Impactos, Vulnerabilidad y Adaptación en España, p. 143–151. Herrero, A., Zavala, M.A., Ed., Ministerio de Agricultura, Alimentación y Medio Ambiente, Madrid.
- Vogrin, M., Böhme, W., Crochet, P.A., Nettmann, H.K., Sindaco, R., Romano, A. (2009): *Iberolacerta horvathi*. The IUCN Red List of Threatened Species **2009**. e.T61515A87533181.
- Žagar, A., Carretero, M. A., Krofel, M., Lužnik, M., Podnar, M., Tvrtković, N. (2014): Reptile survey in Dinara Mountain (Croatia) revealed the southernmost known population of Horvath's rock lizard (*Iberolacerta horvathi*). *Natura Croatica* **23**: 235–240.
- Žagar, A. (2016): Altitudinal distribution and habitat use of the common wall lizard *Podarcis muralis* (Linnaeus, 1768) and the Horvath's rock lizard *Iberolacerta horvathi* (Méhely, 1904) in the Kočevsko region (S Slovenia). *Natura Sloveniae* **18**: 47–62.