

## New records and updated distribution of the endemic Balkan rock lizards *Dinarolacerta* spp. in Montenegro

KATARINA LJUBISAVLJEVIĆ<sup>1,\*1,3</sup>, LIDIJA POLOVIĆ<sup>2</sup>, VUK IKOVIĆ<sup>1</sup>, SNEŽANA VUKSANOVIĆ<sup>2</sup>,  
VERNES ZAGORA<sup>1</sup>, ALEKSANDAR UROŠEVIĆ<sup>3</sup> & LJILJANA TOMOVIĆ<sup>4</sup>

<sup>1</sup> Montenegrin Ecologists Society, Bulevar Sv. Petra Cetinjskog 73, 81000 Podgorica, Montenegro

<sup>2</sup> The Natural History Museum of Montenegro, Trg Vojvode Bećir-Bega Osmanagića 16,  
81000 Podgorica, Montenegro

<sup>3</sup> Department of Evolutionary Biology, Institute for Biological Research 'Siniša Stanković', University of Belgrade,  
Bulevar Despota Stefana 142, 11060, Belgrade, Serbia, E-mail address: [katarina.ljubisavljevic@ibiss.bg.ac.rs](mailto:katarina.ljubisavljevic@ibiss.bg.ac.rs)

<sup>4</sup> Institute of Zoology, Faculty of Biology, University of Belgrade, Studentski trg 16, 11000 Belgrade, Serbia

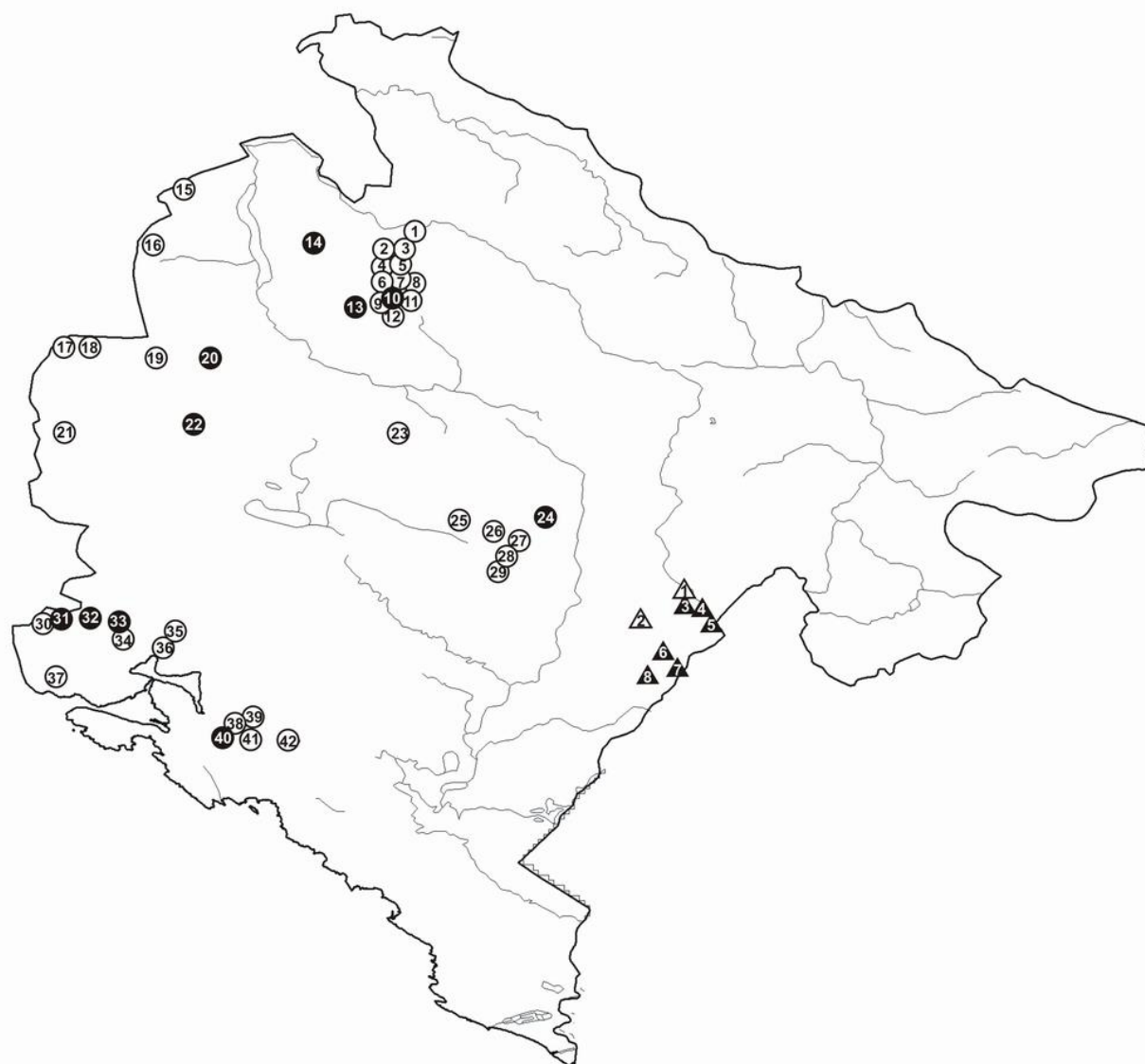
\*Corresponding author: Katarina Ljubisavljević

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The endemic Balkan genus *Dinarolacerta* (Arnold *et al.* 2007) comprises two sister species, the Mosor rock lizard *Dinarolacerta mosorensis* (Kolombatović 1886) and the Prokletije rock lizard *D. montenegrina* (Ljubisavljević, Arribas, Džukić & Carranza 2007). The Balkan rock lizards of the genus *Dinarolacerta* occur at medium to higher elevations in the mountains of the Dinaric range, and the distribution is very fragmented (Džukić 1989; Ljubisavljević *et al.* 2007a). They usually inhabit rocky outcrops near lakes and springs, around or within open forests or above the tree line (Speybroeck *et al.* 2016). The first overview of the distribution of the Mosor rock lizard in former Yugoslavia was compiled by Bischoff (1984), followed by Džukić (1989, 1991). In 2007, an isolated population of the Mosor rock lizard discovered by Džukić *et al.* (1997) was described as a separate species on the basis of molecular evidence, osteological and morphological traits, and named as *D. montenegrina* (Ljubisavljević *et al.* 2007a). Currently, *D. mosorensis* is known to be distributed in southern parts of Croatia, Bosnia & Herzegovina and generally the western part of Montenegro (Džukić 1989), while *D. montenegrina* was recorded at few localities in eastern Montenegro and north-western Albania (Petrov 2006; Ljubisavljević *et al.* 2007a, 2014; Podnar *et al.* 2014). It is assumed that the Morača River could have been a geomorphological and climatic border which separated two population groups of the ancestral *Dinarolacerta* species. Those groups eventually differentiated into *D. montenegrina* in the east, and *D. mosorensis* in the west, most likely during the late Miocene (Ljubisavljević *et al.* 2007a).

Over the past decade, populations from Montenegro have been subjected to extensive research due to their life-history peculiarities, morphological and molecular distinctiveness and conservation importance (Ljubisavljević *et al.* 2007a,b, 2008; Tomašević Kolarov *et al.* 2010). The increased interest in the study of these lizards has led to more intensive fieldwork and to the discovery of new localities of both species. Therefore, there was a need to compile updated information on the range and distribution of *Dinarolacerta* spp. within Montenegro, which could give more insights into habitat preferences and possible conservation measures.

In this paper we report 16 new records for *Dinarolacerta* spp. and compile distributional data in order to get an updated distribution map for these species in Montenegro.



**Figure 1.** Updated distribution of *D. mosorensis* (circles) and *D. montenegrina* (triangles) in Montenegro (locality numbers explained in Appendix I). Solid symbols – new records; open symbols - literature data.

The majority of new records were collected during field surveys between 2012 and 2016. The species were documented through direct visual observation and identified according to the relevant taxonomic literature (Ljubisavljević *et al.* 2007a; Speybroeck *et al.* 2016). The detailed data regarding new and published records are presented in Appendix I.

New findings of the Mosor rock lizard were reported from the north-western, central and south-western parts of Montenegro from 1132 m (Krivošije area) to 1900 m a.s.l. (Mt. Orjen) (Figure 1), with an exceptionally low altitude of 270 m in the Mrtvica River canyon. At newly recorded sites, *D. mosorensis* were most often found on limestone outcrops in the range of thermophilous (*Seslerio-Fagetum moesiacaе*) beech forests, on natural high-altitude rocks and rocky pastures (above the tree line) or those formed secondarily due to deforestation. The species was found within Oro-mediterranean forest of whitebark pine (*Pinetum heldreichii mediterraneo-montanum*) at two sites on Mt. Orjen. The distribution of the Mosor rock lizard on Mt. Orjen is more precisely defined by new findings, since only the general information of its occurrence on this mountain existed in literature (Méhely 1909; Bischoff 1984). New records in Pivska župa and especially on Golija and Njegoš Mts. make a significant contribution in filling in the gap between the findings from the Montenegrin-Herzegovinian border area and those from Mt. Durmitor. The availability of suitable habitats suggests that the Mosor rock lizard probably occurs on other mountains of the central and western part of the country. Probably the most interesting new record of *D. mosorensis* is the one from

Mrtvica River canyon. It is the lowest elevation record for this species. The lizard is found on the rocks near the water in the moist canyon bottom, bordered with sub-Mediterranean forests of oriental hornbeam (*Carpinus orientalis*) that extends well down the slopes of the canyon. This is most likely refugial site of the Mosor rock lizard, having in mind that deep canyons may contain various refugial habitats functioning as downstream and upstream corridors through higher elevation terrain between climate oscillations (Stevens 2012). The phenomenon of temperature inversion which is characteristic for mountainous areas and canyons (Thompson 1967) could create a localized pocket of suitable microclimate conditions for refugial habitat (Mackintosh 2014). Important implications of this finding are that future surveys should, together with suitable high-altitude habitats, include the possible refugial habitats of *D. mosorensis* in gorges and canyons at lower altitudes.

Only two records of *D. montenegrina* have been previously reported for Montenegro (Ljubisavljević *et al.* 2007a, 2014). Six new records expand the known distribution of the species in Montenegro to the east, and reduce the gap between Montenegrin and west Albanian localities. The Prokletije rock lizard was found between 1200 and 1700 m a.s.l. predominantly near the edge of montane beech forests on open rocky grounds or on rocks and boulders around the mountain lakes and springs. At one locality (Toke), *D. montenegrina* was recorded on scattered limestone rocks and outcrops in open wood of whitebark pine (*Pinetum heldreichii bertiscum*). It is possible that this species further occurs in favorable habitats at higher elevations between Žijovo and Komovi Mts. in eastern Montenegro. The future surveys will likely extend the known range of the Prokletije rock lizard.

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## Appendix I

Information on localities, as follows: locality number, locality name, coordinates and elevation (if available), source (new record - n.r. or literature data).

### *D. mosorensis*

1. Mt. Durmitor: Kamenjača, Veljkova ploča, 1680 m, Džukić 1989, 1991; 2. Mt. Durmitor: Zminje jezero, 43°06' N, 19°04' E, 1495-1600 m, Džukić 1989, 1991 and references therein, Ljubisavljević *et al.* 2007a,b, Polović 2011, Podnar *et al.* 2014; 3. Mt. Durmitor: Golubinje, memorial plaque of Jakov Ostojić, 1600 m, Džukić 1991; 4. Mt. Durmitor: Indini dolovi, 1700-1800 m, Džukić 1989, 1991; 5. Mt. Durmitor: above Crno jezero, Čeline, 1500 m, Džukić 1989, 1991; 6. Mt. Durmitor: slopes of Međed peak, above Mala Kalica, 1850 m, Džukić 1989, 1991; 7. Mt. Durmitor: Struga, 1894 m, Džukić 1989, 1991; 8. Mt. Durmitor: Virak, Ljubisavljević *et al.* 2007a; 9. Mt. Durmitor, Valovito lake, 43°09' N, 19°04' E, 1695 m, Džukić 1989, 1991 and references therein, Ljubisavljević *et al.* 2007a; 10. Mt. Durmitor: Stožina, 43.0979 N, 19.0690, 1768 m, n.r.; 11. Mt. Durmitor: Lomno Ždrijelo, 1900 m, Džukić 1991 and reference therein; 12. Mt. Durmitor: Srablje lake, Podnar *et al.*, 2014; 13. Mt. Durmitor: Komarnica River canyon: Klještina, 1400 m, n.r.; 14. Mt. Pivska: Trsa, 1400 m, n.r.; 15. Mt. Maglić, Podnar *et al.* 2014; 16. Mt. Lebršnik: Orlovac, Džukić 1989 and reference therein; 17. Mt. Troglav, Džukić 1989; 18. Mt. Somina, Džukić 1989 and references therein; 19. Mt. Krstac, Perović *et al.* 2010; 20. Mt. Golija: Jajac, 43.0021 N, 18.7758 E, 1550 m, n.r.; 21. Oputne Rudine Mts., Bischoff 1984 and references therein; 22. Mt. Njegoš: Oštrikovac, 42.8943 N, 18.7489 E, 1550 m, n.r.; 23. Krnovo plateau, Polović & Čadenović 2013; 24. Mrtvica River canyon: Mrtvičke grede, 42.7371 N, 19.3310 E, 270 m, n.r.; 25. Maganik: Štitovo, 1640 m, Džukić 1989; 26. Mt. Prekornica: Đevič bor, 42.7195 N, 19.2492 E, 1653 m, Iković *et al.* 2016 in press; 27. Mt. Prekornica: Crvena rupa, 42.6898 N, 19.2725 E, 1643 m, Iković *et al.* 2016 in press; 28. Mt. Prekornica: Zamršten, 42.6846 N, 19.2694 E, 1585 m, Iković *et al.* 2016 in press; 29. Prekornica Mt.: Srednja Ponikvica, 42.6739 N, 19.2671 E, 1400 m, Ljubisavljević *et al.* 2007a,b, Polović 2011; 30. Mt. Orjen, Méhely 1909, Bischoff 1984; 31. Mt. Orjen: Veliki Kabao, 42.5736N, 18.5323E, 1560 m, n.r.; 32. Mt. Orjen, 42.5749 N, 18.5847E, 1444 m, n.r.; 33. Krivošije: Tvrđava Kom, 42.5638 N, 18.6359 E, 1132 m, n.r.; 34. Krivošije: Crkvice, Méhely 1909, Bischoff 1984, Džukić 1989; 35. Krivošije: Grkavac, Bischoff 1984, Džukić 1989 and reference therein; 36. Krivošije: mountains behind Risan, Bischoff 1984, Džukić 1989 and references therein; 37. Herceg Novi: Kameno, 450 m, Džukić 1989; 38. Mt. Lovćen: Međuvršje, 42° 24' N, 18°50' E, 1360 m, Ljubisavljević *et al.* 2007a; 39. Mt. Lovćen: Jezerski vrh, Polović 2011; 40. Mt. Lovćen: Kuk, 42.3944 N, 18.8093 E, 1356 m, n.r.; 41. Mt. Lovćen: Ivanova Korita, 42.22° N, 18.50° E, 1200 m, Ljubisavljević *et al.* 2007a,b, Polović 2011; 42. above Cetinje, Bischoff 1984 and references therein.

### *D. montenegrina*

1. Mt. Đebeza, 42° 37' N, 19°33', 1600 m, Ljubisavljević *et al.*, 2007a; 2. Mt. Žijovo, 42.5736 N, 19.4840 E, 1455 m, Ljubisavljević *et al.* 2014; 3. Mt. Žijovo: Dugačko lake, 42.5990 N, 19.5559 E, 1452 m, n.r.; 4. Mt. Žijovo: Katun Lakovića, 42.5904 N, 19.5826 E, 1676 m, n.r.; 5. Mt. Žijovo: Rikavačko lake, 42.5686 N, 19.5987 E, 1335 m, n.r.; 6. Mt. Žijovo: Velika Radeća, spring, 42.5195 N, 19.5198 E, 1505 m, n.r.; 7. Kučka korita: ka Grlu Sokolovom, 42.4912 N, 19.5460 E, 1357 m, n.r.; 8. Kučka korita: Toke, 42.4795 N, 19.4960 E, 1291 m, n.r.

Literature cited for the locality data in Appendix I (not previously listed under "References" section)

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