

**NEW RECORDS AND UPDATED DISTRIBUTION OF THE
BALKAN ENDEMIC AND THREATENED WATER FROG
PELOPHYLAX SHQIPERICUS IN MONTENEGRO**

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In this paper, we present the distribution of the Balkan endemic and vulnerable water frog *Pelophylax shqipericus* in Montenegro based on our field work and literature data. The dataset includes 129 records, 47% of which have not been published before. The new data contribute significantly to a better understanding of the distribution of *Pelophylax shqipericus* in the Skadar Lake basin and to the delimitation of the northern margin of the species' range in the Bjelopavlići Plain. The data presented provide important basic information for the study of spatial patterns and conservation measures for this range-restricted species.

Key words: Amphibians, Albanian water frog, South-eastern Montenegro, Balkan Peninsula

INTRODUCTION

The Albanian water frog (*Pelophylax shqipericus*) is the Balkan endemic species restricted to the northern and central parts of the Albanian

coast and south-eastern Montenegro (Speybroeck *et al.* 2016). It inhabits well-vegetated lakeshores, ponds, swamps, marshes, ditches, channels and banks of slow-flowing rivers (IUCN SSC Amphibian Specialist Group 2020), including several important Natura 2000 habitat types such as white willow (*Salix alba*) and white poplar (*Populus alba*) galleries, humid dune slacks and natural eutrophic lakes with *Magnopotamion* and *Hydrocharition*-type vegetation (Ljubisavljević & Iković 2020). According to IUCN criteria (IUCN SSC Amphibian Specialist Group 2020), it has been classified as a vulnerable species due to its small range and a number of threats, such as the increasing pollution, alteration and destruction of its habitats and overharvesting.

Although mapping of the distribution of this endemic species is important, a comprehensive review of records has not yet been made, at least for Montenegro. In the last decade, research into the distribution, threats, and genetic structure of *P. shqipericus* has been intensified, leading to the publication of a greater number of its finding sites (Vucić *et al.* 2018, Ljubisavljević & Iković 2020, Ljubisavljević *et al.* 2022, Papežik *et al.* 2023). Furthermore, several wetland research and conservation projects in south-eastern Montenegro (see Acknowledgements) have resulted in extensive field work and the recording of numerous new localities of this species. Therefore, it was necessary to compile up-to-date data on the distribution and range size of the Albanian water frog in Montenegro. This could be the basis for further analyses of its habitat preferences and conservation measures that should be implemented at specific sites.

In this paper we compile new records for *P. shqipericus* collected during our fieldwork as well as literature data to create a comprehensive distribution map for this water frog in Montenegro.

MATERIAL AND METHODS

The dataset of localities in Montenegro where *P. shqipericus* has been recorded consists of our unpublished data and literature sources and includes the information on locality name, coordinates and type of data source (see Supplementary information I). Literature data for localities without coordinates were listed in Supplementary information II. New records were collected during field surveys between 2019 and 2022. The species was determined by visual inspection of external morphological diagnostic characters or specific male advertisement call following Arnold & Ovenden (2002) and Speybroeck *et al.* (2016).

RESULTS AND DISCUSSION

The compiled data consist of 129 records of *P. shqipericus*, of which 47% are new data (Fig. 1). Another 2% of the new data correspond to previously published records. The gathered records allowed the creation of a more detailed distribution map and helped to identify spatial patterns in the north-western part of the species range. With the new data, the distribution of *P. shqipericus* in south-eastern Montenegro and the range limits in the northernmost part of the species' range (Bjelopavlići Plain) can be more precisely determined.

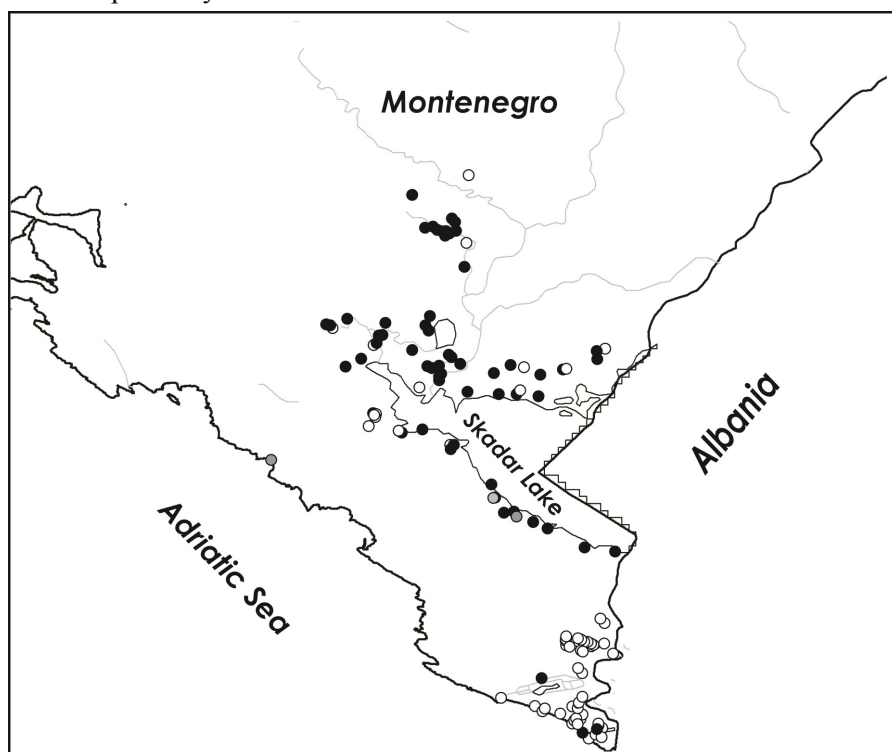


Fig. 1. Distribution of records of *Pelophylax shqipericus* in Montenegro (names and coordinates of localities are given in Supplementary Information I). Solid circles - our field data; open circles - literature data; grey circles - literature and our field data.

The data indicate that the Albanian water frog occurs in lowland areas (0 – 30 m a.s.l.) of Maritime region of Montenegro, where it inhabits wetlands - most often marshes, marshy lakeshores, vegetated banks of slow-flowing rivers, flooded meadows and ponds.

Roughly 70% of the published records are from the Bojana River Delta, which is the result of recent research on the distribution and threatening factors of the Albanian water frog in this area (Ljubisavljević & Iković 2020). The high density of records here is due to a systematic field surveys and a wide representation of suitable habitats in the form of lowland marshes.

Thorough field research from 2020 to 2022 in the Skadar Lake area yielded a large number of new detections of *P. shqipericus*, leading to a more complete representation of its distribution pattern, especially on the southern shore of the lake, in the area of Veliko Blato and in the Zetska Plain. On the southern shore of the lake, the species is most often found in bays, i.e. shallower shore sections with lush aquatic vegetation, usually in associations of white and yellow water lilies (*Nymphaea alba*-*Nuphar lutea*) and common reed (*Phragmites australis*). The species is not found along the rocky, steep parts of the lakeshore. On the less steep northern and northeastern shores, which represent a vast floodplain (Barović *et al.* 2018), *P. shqipericus* is usually found in flooded meadows.

The new record of *P. shqipericus* in the Sitnica River connects the southern and northern parts of its range in Montenegro, suggesting that the species spreads from Lake Skadar through the lower, valley section of the Morača River along the Sitnica River to the Matica River and the wetlands of the Bjelopavlići Plain.

Considering the fact that there are only two published records of the Albanian water frog in the area of the Bjelopavlići Plain (Iković *et al.* 2016, Vucić *et al.* 2018), the new findings contribute significantly to the knowledge of its distribution in this part of Montenegro and suggest that the species may have a wider distribution in the area of the middle reaches of the Zeta River following the influence of Mediterranean climate. More detailed field research would certainly be important to determine both the northern limit of the species' range and the distribution pattern along the coast, where *P. shqipericus* has so far been reported only from the marshes of Buljarica Bay (Katnić *et al.* 2017, this study) about 50 km from the Bojana River Delta. The disputable records of *P. shqipericus* on Tivat Salina (Šćepanović *et al.* 2012) were not confirmed by our fieldwork.

Although the habitats of the Albanian water frog are protected in principle in a large part of its range in Montenegro (within the Skadar Lake National Park, the Zeta River Nature Park and the Great Ulcinj Beach Natural Monument), the implementation of protection measures is slow or inadequate. Parts of the range of *P. shqipericus* outside protected areas are particularly exposed to numerous threats, although most of these places are recognized as Emerald Network sites and potential Natura 2000 sites (Ada Bojana, Knete, Šasko Lake and Buljarica Bay).

Therefore, further studies on the distribution and habitat quality of this key biodiversity species, would greatly contribute to the definition of concrete conservation measures, which would be particularly important for the remaining coastal wetlands.

CONCLUSIONS

The Albanian water frog inhabits lowland wetlands in south-eastern Montenegro, being most abundant in the Bojana River Delta and in the Lake Skadar basin. There it is usually found in marshes, vegetated banks of slow-flowing rivers, ponds, flooded meadows and lake bays with lush aquatic vegetation. Due to the influence of the Mediterranean climate and the presence of favorable habitats, it spreads further inland in the lower catchment area of the Morača River. Future surveys will show whether the species is more widespread in the Zeta River valley and in the remnants of wetlands along the Adriatic coast.

Acknowledgements

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Supplementary Information I

Information on localities, as follows: locality name, coordinates, source (field data - f.d. or literature data).

Ada Bojana: footpath to the weekend settlement, 41.8687, 19.3526, Ljubisavljević & Iković (2020); Ada Bojana: footpath to the interior of the island 41.8684, 19.3550, Ljubisavljević & Iković (2020); Bojana River Delta: ponds, 41.8669, 19.3572, Kogoj (2017); Ada Bojana: interior of the island, 41.8650, 19.3603, Ljubisavljević & Iković (2020); Ada Bojana:

nudist settlement, 41.8635, 19.3441, Ljubisavljević & Iković (2020); Gornji Štoj: surrounding ponds, 41.8758, 19.3589, Stanković (2012); Gornji Štoj: artificial pond, 41.8800, 19.3564, Stanković (2012); Gornji Štoj: footpath to the weekend settlement, 41.8720, 19.3568, Ljubisavljević & Iković (2020); Gornji Štoj: ponds on the way to the Bojana River, 41.8754, 19.3585 Ljubisavljević & Iković (2020); Gornji Štoj: ponds on the way to the Bojana River, 41.8772, 19.3572, Ljubisavljević & Iković (2020); Gornji Štoj: ponds; 41.8761, 19.3602, Ljubisavljević & Iković (2020); bank of the Bojana River: weekend settlement, 41.8711, 19.3549, f.d.; Gornji Štoj: pond on the way to the Bojana River, 41.8740, 19.3552, f.d.; hinterland of the Great Ulcinj Beach: footpath to the Tortuga beach, 41.8703, 19.3372, f.d.; hinterland of the Great Ulcinj Beach: Špatula, beginning of the footpath to Ohana Kite beach, 41.8854, 19.3328, Ljubisavljević & Iković (2020); hinterland of the Great Ulcinj Beach: footpath to Ohana Kite beach, 41.8824, 19.3305, Ljubisavljević & Iković (2020); hinterland of the Great Ulcinj Beach: Špatula, beginning of the footpath to Laguna beach, 41.8863, 19.3296, Ljubisavljević & Iković (2020); hinterland of the Great Ulcinj Beach: footpath to Laguna beach, 41.8834, 19.3273 Ljubisavljević & Iković (2020); hinterland of the Great Ulcinj Beach: near the end of the footpath to Laguna beach, 41.8810, 19.3254, Ljubisavljević & Iković (2020); hinterland of the Great Ulcinj Beach: footpath to Copacabana beach, 41.8928, 19.3108, Ljubisavljević & Iković (2020); hinterland of the Great Ulcinj Beach: footpath to Coral beach, 41.8965, 19.2899, Ljubisavljević & Iković (2020); hinterland of the Great Ulcinj Beach: beginning of the footpath to Coral beach, 41.8988, 19.2916, Ljubisavljević & Iković (2020); Donji Štoj: ponds, 41.9014, 19.2806, Kogoj (2017); Great Ulcinj Beach: pond near the abandoned bungalows, 41.9119, 19.2403, Ljubisavljević & Iković (2020); Đokaj, 41.8916, 19.3372, Ljubisavljević & Iković (2020); Bregvija: near the elementary school "Marko Nukulović", 41.8997, 19.3305, Ljubisavljević & Iković (2020); Bregvija: marsh remnants, 41.9016, 19.3251, Ljubisavljević & Iković (2020); Bregvija: roadside ditch, 41.9025, 19.3315, Ljubisavljević & Iković (2020); Bregvija: roadside ditch, 41.9057, 19.3328, Ljubisavljević & Iković (2020), 2020, Reč, 41.9127, 19.3365, Ljubisavljević & Iković (2020); Čurke, 41.9409, 19.3370, Ljubisavljević & Iković (2020); Čurke, 41.9464, 19.3311, Ljubisavljević & Iković (2020); Ulcinj Salina: widening of the outer ditch near the reservoirs, 41.9349, 19.2884, f.d.; Fraskanjel, 41.9652, 19.3735, Ljubisavljević & Iković (2020); Žaka, 41.9762, 19.3626, Kogoj (2017), Ljubisavljević & Iković (2020); Šasko Lake: boat wharf, 41.9814, 19.3306, Ljubisavljević & Iković (2020); Šasko Lake: from the Shasi restaurant to the boat wharf, 41.9804, 19.3344, Ljubisavljević & Iković (2020); Šasko Lake: from the playground near the restaurant to the raft, 41.9784, 19.3385, Ljubisavljević & Iković (2020); Šasko Lake: footpath to the raft, 41.9774,

19.3388, Ljubisavljević & Iković (2020); Šasko Lake: northwestern section of the shore in the direction of Brisko polje, 41.9838, 19.3180, Ljubisavljević & Iković (2020); Šasko Lake: western section of the shore in the direction of Brisko polje, 41.9814, 19.3176, Ljubisavljević & Iković (2020); Šasko Lake: western section of the shore in the direction of Brisko polje, 41.9799, 19.3172, Ljubisavljević & Iković (2020); Šasko Lake: southwestern section of the shore in the direction of Briska Gora, 41.9744, 19.3175, Ljubisavljević & Iković (2020); Šasko Lake: southwestern section of the shore in the direction of Briska Gora, 41.9725, 19.3216, Ljubisavljević & Iković (2020); Šasko Lake: southern section of the shore in the direction of Briska Gora, 41.9669, 19.3357, Ljubisavljević & Iković (2020); Šasko Lake: southern section of the shore in the direction of Briska Gora, 41.9660, 19.3369, Ljubisavljević & Iković (2020); Šasko Lake: northeastern section of the shore in the direction of Ambula Hill, 41.9746, 19.3491, Ljubisavljević & Iković (2020); Šasko Lake: northeastern section of the shore in the direction of Ambula Hill, 41.9756, 19.3477, Ljubisavljević & Iković (2020); Šasko Lake: northeastern section of the shore in the direction of raft, 41.9771, 19.3424, Ljubisavljević & Iković (2020); Šas, 41.9780, 19.3390, Papežik *et al.* (2023); Sukobinsko polje: Rastiška river, 42.0052, 19.3581, Ljubisavljević & Iković (2020); Lisna Bore: Rastiška river, 42.0004, 19.3629, Ljubisavljević & Iković (2020); Buljarica: marsh, 42.1931, 18.9682, f.d., Katnić *et al.* (2017); Skadar Lake, 42.3300, 19.0900, Vucić *et al.* (2018); Rijeka Crnojevića, 42.3510, 19.0400, Vucić *et al.* (2018), Papežik *et al.* (2023); Rijeka Crnojevića: across Sindon, 42.3538, 19.0344, f.d.; Skadar Lake: Mihailovići, 42.3126, 19.0746, f.d.; Skadar Lake: Poseljani, 42.3043, 19.0564, f.d.; Skadar Lake: Virpazar, near the boat-restaurant “Silištija”, 42.2455, 19.0905, Ljubisavljević *et al.* (2019); Skadar Lake: road Virpazar-Rijeka Crnojevića, roadside marsh, 42.2489, 19.0895, f.d.; Skadar Lake: Virpazar, 42.2461, 19.0910, AZŽS (2013); Skadar Lake: Virpazar, 42.2478, 19.0910, Hofman *et al.* (2015); Skadar Lake: Virpazar, 42.2470, 19.0900, Papežik *et al.* (2023); Skadar Lake: Virpazar, 42.2333, 19.0833, Hotz *et al.* (1987); Skadar Lake: Godinje, 42.2280, 19.1190, Papežik *et al.* (2023); Skadar Lake: Pješačac, 42.2263, 19.1232, f.d.; Skadar Lake: Pristan, 42.2298, 19.1472, f.d.; Skadar Lake: Krnjice, Brod, 42.2107, 19.1842, f.d.; Skadar Lake: Krnjice, Brca, 42.2070, 19.1812, f.d.; Skadar Lake: Krnjice, 42.2115, 19.1811, AZŽS (2013); Skadar Lake: Beška island, bay, 42.1644, 19.2287, f.d.; Skadar Lake: Besa, 42.1493, 19.2330, Papežik *et al.* (2023); Skadar Lake: Besa, bay, 42.1487, 19.2339, f.d.; Skadar Lake: Bljaca, 42.1260, 19.2591, Ljubisavljević *et al.* (2019); Skadar Lake: Bljaca, marshy bay, 42.1312, 19.2555, f.d.; Skadar Lake: Mrčiluka, 42.1307, 19.2435, f.d.; Skadar Lake: Bobovište, 42.1198, 19.2789, f.d.; Skadar Lake: Sjerči, bay, 42.1124, 19.2961, Stanković (2012), f.d.; Skadar Lake: Van i Šitarit, 42.0895,

19.3398, f.d.; Skadar Lake: Ckla, 42.0852, 19.3768, f.d.; Skadar Lake: Vitoja, 42.3253, 19.3632, AZŽS (2013), Ljubisavljević *et al.* (2019); Skadar Lake: Ploče, 42.3222, 19.3536, f.d.; Skadar Lake: Podhum, 42.3130, 19.3538, f.d.; Skadar Lake: Zbeljski izvori, 42.3004, 19.3143, f.d.; Skadar Lake: flooded meadow (= Kotrabudansko polje), 42.3014, 19.3175, Stanković (2012); Skadar Lake: Kujov Brijeg, 42.2753, 19.2627, AZŽS (2013); Skadar Lake: Mlinište, 42.2938, 19.2874, f.d.; Skadar Lake: Velika Mrka, 42.2687, 19.2850, f.d.; Skadar Lake: Mala Mrka, 42.2712, 19.2585, f.d.; Skadar Lake: pond (3 × 3 m) near the lake (= Mljace), 42.3033, 19.2672, Stanković (2012); Skadar Lake: Pijavnik, 42.3055, 19.2516, f.d.; Skadar Lake: Gostilj, 42.2712, 19.2386, f.d.; Skadar Lake: Gostiljska River, 42.2965, 19.2321, f.d.; Skadar Lake: Plavnica, 42.2742, 19.2005, f.d.; Skadar Lake: Vranjina, 42.2792, 19.1434, Ljubisavljević *et al.* (2019); Skadar Lake: Kurilo, Jasenice, 42.2950, 19.1694, f.d.; Skadar Lake: Kurilo, Tara stream, 42.2925, 19.1675, f.d.; Skadar Lake: Tapija Plamenačka, 42.2876, 19.1667, f.d.; Skadar Lake: Kurioci, 42.3073, 19.1923, f.d.; Skadar Lake: Kuriječki lug, channel, 42.3051, 19.1671, f.d.; Skadar Lake: Kuriječki lug, sand pits on the bank of the Morača River, 42.3040, 19.1535, f.d.; Skadar Lake: Kuriječki lug, 42.3025, 19.1582, f.d.; Skadar Lake: Ponari, near the bridge on Šegrtnica River, 42.3164, 19.1806, f.d.; Skadar Lake: Ponari, backwater of the Šegrtnica River, 42.3175, 19.1790, f.d.; Skadar Lake: Žabljak Crnojevića, 19.1349, 19.1603, f.d.; Skadar Lake: Dodoši, 42.3240, 19.1349, f.d.; Skadar Lake: Malo Blato, Bobovine, 42.3463, 19.1546, f.d.; Skadar Lake: Malo Blato, Čajin do, 42.3530, 19.1506, f.d.; Skadar Lake: Malo Blato, Sinjac, 42.3634, 19.1559, f.d.; Skadar Lake: Karuč, Kaluđerovo oko, 42.3555, 19.1038, f.d.; Skadar Lake: Prevlaka, bridge, 42.3408, 19.0978, f.d.; Skadar Lake: Prevlaka, Plijesac, 42.3414, 19.0996, f.d.; Skadar Lake: Prevlaka, 42.3322, 19.0939, f.d.; Skadar Lake: Grab, 42.3603, 19.0579, f.d.; Rijeka Crnojevića, below Lipovik, 42.3517, 19.0393, f.d.; Farmaci: Mihinja: bank of the Sitnica River, 42.4225, 19.1969, f.d.; Mareza, 42.4500, 19.2000, Vucić *et al.* (2018); Matica River: “oke”, 42.4686, 19.1504, f.d.; Matica River: Lužnica village, 42.4697, 19.1595, f.d.; Matica River: the entrance of the Lužnica village, 42.4654, 19.1657, f.d.; Lužnica marsh, 42.4644, 19.1706, f.d.; Slamni Brod: bank of the Matica River, 42.4600, 19.1744, f.d.; Lješko-poljski lug: roadside ditch, 42.4646, 19.1755, f.d.; Lješkopoljski lug: bank of the Sitnica River, 42.4613, 19.1785, f.d.; Lješkopoljski lug: Trešenica River, 42.4649, 19.1867, f.d.; water source Mareza 1, 42.4755, 19.1858, f.d.; water source Mareza 2, 42.4794, 19.1824, f.d.; Bjelopavlići: Begovina: Sušica River, 42.5072, 19.1349, f.d.; Bjelopavlići: Moromiš, 42.5308, 19.2020, Iković *et al.* (2016).

Supplementary Information II

Records of *Pelophylax shqipericus* from literature sources without exact coordinates.

Ada Bojana: along the bank of the Bojana river, Šćepanović *et al.* (2012); Skadar Lake, UTM squares CM47, CM48, CM58, CM68, Crno-brnja-Isailović & Džukić 1995, Skadar Lake: Vitoja, Bataković (2014); Skadar Lake: Kujov Brijeg, Bataković (2014); Skadar Lake: Vranjina, Bataković (2014); Skadar Lake: Crmnica, Džukić *et al.* (2003); Skadar Lake: Virpazar, Guerini *et al.* (1997), Džukić *et al.* (2003), Šćepanović *et al.* (2012), Bataković (2014), Čađenović (2014), Džukić *et al.* (2015); Skadar Lake: Orahovačko Polje, Džukić *et al.* (2015); Skadar Lake: Beška, Džukić *et al.* (2003), Bataković (2014).

Supplementary Information III

References to the localities in the Supplementary Information I and II (not previously listed in the “References” section)

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**НОВИ ПОДАЦИ И АЖУРИРАНА ДИСТРИБУЦИЈА БАЛКАНСКЕ
ЕНДЕМИЧНЕ И УГРОЖЕНЕ ЗЕЛЕНЕ ЖАБЕ *PELOPHYLAX*
SHQIPERICUS У ЦРНОЈ ГОРИ**

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РЕЗИМЕ

У раду приказујемо распрострањење балканске ендемичне и рањиве зелене жабе *Pelophylax shqipERICUS* у Црној Гори на основу нашег теренског рада и података из литературе. Скуп података обухвата 129 записа, од којих 47% није раније објављено. Нови подаци значајно доприносе бољем разумевању распрострањености *Pelophylax shqipERICUS* у сливу Скадарског језера и дефинисању северног руба ареала врсте у Бјелопавлићкој равници. Приказани подаци пружају важне основне информације за проучавање просторних образаца и мера очувања ове врсте са ограниченим ареалом.