### Introduction

In the last few years, an explosion of interest in mapping of species distributions has occurred (e.g., Sillero et al., 2014; Mediani et al., 2015; Mizsei et al., 2017). This was fuelled by an increased need for information on the geographic distribution of biodiversity and by new and improved techniques (Franklin, 2010). Exact knowledge of the spatial dispersion of a taxonomic group of any rank is crucial for the decision-making process in both biodiversity management and conservation. Furthermore, distribution data are important to studies of biogeography, evolutionary biology, and ecology (Sillero et al., 2014). Turkey has three biodiversity hotspots, namely the Caucasus, the Irano-Anatolian region, and the Mediterranean Basin (Myers et al., 2000). The Caucasus hotspot in particular is one of the richest regions on Earth in terms of global biodiversity (Olson and Dinerstein, 2002). It includes habitats in Azerbaijan, Armenia, Georgia, the northeastern part of Turkey, and the northern part of the Caucasus in Russia, as well as a small part of northwestern Iran (Zazanashvili and Mallon, 2009).

Rize is a province in northeastern Turkey located in the Transcaucasia region of the Caucasus hotspot and contains one national park, four nature parks, and one nature monument, all protected by the Ministry of Forestry and Water Affairs. It has an area of ca. 3920 km² with some unique biodiversity, including 1650 vascular plant (118 endemic) and over 300 vertebrate species (239 birds, 61 mammals, 16 fishes, nine reptiles, nine amphibians; MFWM, 2014). Here, we provide the first updated set of maps for the distribution of amphibian species in Rize Province.

### Materials and methods

Data were obtained from our own fieldwork performed in the years 2013–2014 throughout Rize Province. Surveys were carried out in twelve districts including İkizdere, Kalkandere, İyidere, Derepazarı, Center, Güneysu, Çayeli, Pazar, Hemşin, Ardeşen, Çamlıhemşin, and Fındıklı. We conducted 30 days of sampling between March and September, and all surveys were done in the form of recording calls, surveying at breeding sites, locating egg masses and visual encounter surveys. Furthermore, surveys were conducted during daytime and sometimes at night, at elevations ranging from 0–2200 m.

In order to produce maps, we downloaded an ESRI shapefile pack with suitable map contents for Turkey (http://www.turkeyshapefile.com/maps_en.html). Subsequently, a map including boundaries of Rize

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**Abstract.** The Caucasus biodiversity hotspot covering the northeastern part of Turkey is one of the richest regions in terms of global biodiversity. Rize Province is located in the Transcaucasia region portion of this hotspot. We here report on our efforts to map the amphibian fauna of the province, which includes two salamanders (*Mertensiella caucasica, Ommatotriton ophryticus*) and seven frogs (*Bufo bufo, Bufotes variabilis, Hyla orientalis, Pelodytes caucasicus, Pelophylax ridibundus, Rana dalmatina, R. macrocnemis*). Our maps of species distributions, species richness, and habitat heterogeneity are the first of their kind for amphibians in Rize Province.

**Key words.** Biodiversity, heterogeneity, *Mertensiella caucasica*, species richness
Province was extracted using a mask found within the spatial analysis in ArcGIS 10.4 software (http://www.esri.com), which allowed us to produce maps with grids for each species. These maps with the grid were generated using the grid index features in the ArcToolbox of ArcGIS 10.4. We used Universal Transverse Mercator (UTM) grids of 5 x 5 km size and projected the databases to the same coordinate system (WGS84).

We also created a species richness map using SAM v4.0 software (Rangel et al., 2010). Elevation data for topographic heterogeneity were downloaded from USGS Products, a global digital elevation model, with a horizontal grid spacing of 30 arc seconds. Climate heterogeneity data were used using nineteen bioclimatic variables that have 30 second (~1 km²) spatial resolution (WorldClim: Fick and Hijmans, 2017). Both climate and topographic heterogeneity maps were created using a python-based ArcGIS toolbox for spatial studies developed by Brown (2014).

Results

Our fieldwork revealed the presence of nine amphibians species from five families (Salamandridae, Bufonidae, Hylidae, Pelodytidae, Ranidae), including two species of salamanders and seven frogs, in Rize Province. We detail our observations in the following species accounts.

Family Salamandridae

Ommatotriton ophryticus (Berthold, 1846) (Fig. 1A), Northern Banded Newt.—This species was found in forests composed of birch, oaks, eastern hornbeams, alders, chestnuts, and rhododendrons. The distribution of this species was limited to elevations of 0–1500 m (Fig. 3A). The IUCN Red List status of *O. ophryticus* is Near Threatened (Olgun et al., 2009).

Mertensiella caucasica (Waga, 1876) (Fig. 1B), Caucasian Salamander.—This species is the most important indicator species in the Caucasus hotspot. It prefers mixed and deciduous forests. During our fieldwork, the species was found near small mountain streams, and it generally prefers to live at elevations of 300–2200 m (Fig. 3B). The IUCN Red List status of *M. caucasica* is Vulnerable (Kaya et al., 2009a), but Gül et al. (2018) stated that its status will be more endangered in the near future in terms of climate change and should be re-evaluated.

Family Bufonidae

Bufo bufo (Linnaeus, 1758) (Fig. 2B), Common Toad.—Ten records were obtained during recent surveys. The elevational range of this species is from 200–3000 m (Fig. 7), where the species prefers to live in coniferous, mixed, and deciduous forests. According to the IUCN Red List, assessment information is Least Concern (Agasyan et al., 2009).

Bufotes variabilis (Pallas, 1769) (Fig. 2F), Variable Green Toad.—This species was not commonly encountered during fieldwork. It generally prefers to live in the coastal areas of Rize (Fig. 6B), and its IUCN Red List status is Data Deficient (Avci et al., 2015).

Family Hylidae

Hyla orientalis (Bedriaga, 1890) (Fig. 2G), Oriental Treefrog.—This species is distributed exclusively at low elevations (approximately 0–750 m) (Fig. 4B), and it can be found almost anywhere, including on artificial
Figure 2. Frogs from Rize Province, Turkey. (A) An adult male *Pelodytes caucasicus* at the edge of pond. (B) Male *Bufo bufo* seen on the side of the main road in Pazar. (C) Male *Pelophylax ridibundus* in a pond at Güneysu. (D) An unsexed *Rana dalmatina* on the edge of a pond at Fındıklı. (E) A *Rana macrocnemis* male in a montane habitat near a stream. (F) An individual of *Bufo variabilis* encountered during burrowing. (G) Male and female individuals of *Hyla orientalis* in amplexus, encountered in a puddle. Photos by Serkan Gül.
surfaces, in agricultural areas, in forests, and in seminatural areas. It has not been assessed for its IUCN Red List status yet.

Family Pelodytidae

Pelodytes caucasicus (Boulenger, 1896) (Fig. 2A) Caucasian Parsley Frog.—Within its range in Rize, this species inhabits dark, closed-canopy humid forests and prefers mixed forests. It was found at elevations >1000 m during our surveys (Fig. 4A). This species is endemic to the Caucasus hotspot. It is considered Near Threatened (Kaya et al., 2009b) according to Red List criteria.

Pelophylax ridibundus (Pallas, 1771) (Fig. 2C), Eurasian Marsh Frog.—This is a water-dependent species and prefers to inhabit a wide variety of flowing and stagnant water habitats, including rivers, brooks, ponds, and lakes. During our fieldwork, P. ridibundus was seen much more frequently at lower elevations (Fig. 5A). This species is considered of Least Concern (Kuzmin et al., 2009a) in the assessment of the IUCN Red List.

Rana dalmatina (Fitzinger in Bonaparte, 1838) (Fig. 2D), Agile Frog.—During fieldwork we found R. dalmatina in the forest and in semi natural areas, but it also appeared in areas near tea plantations, usually at elevations > 300 meters (Fig. 5B). It is classed as a species of Least Concern (Kaya et al., 2009c) in the IUCN Red List.

Rana macrocnemis (Boulenger, 1885) (Fig. 2E), Caucasian Brown Frog.—This species inhabits any type of mountain forest, from hornbeam bushes to

Figure 3. Distribution of Ommatotriton ophryticus (A; pink dots) and Mertensiella caucasica (B; blue dots) in Rize Province, Turkey.

Figure 4. Distribution maps of Pelodytes caucasicus (A; red dots) and Hyla orientalis (B; green dots) in Rize Province, Turkey.
humid coniferous woods. Its dispersal is similar to that of *R. dalmatina* and these two species can occur sympatrically (Fig. 6A). The assessment of its status is Least Concern (Kuzmin et al., 2009b) in the IUCN Red List.

**Discussion**

Turkey is home to 39 amphibian species including 16 frogs and 23 salamanders (AmphibiaWeb, 2018). Rize Province is a special area in terms of biodiversity, as it has approximately 25% of these species. Kaçkar Mountains National Park, around 70 km east of Rize Province in northeastern Turkey, is the richest area with regard to amphibian species (Fig. 8A), and this national park hosts six of nine amphibian species. It appears that amphibian species richness is not high in places where climatic heterogeneity is low or high. By contrast,
species richness intensifies at intermediate levels of climate heterogeneity (Fig. 8B). Moreover, in the area survey, it was especially interesting that 70% of species occurred in the 300–1000 m elevation band. At the higher elevations, this number decreased to 30%. This situation probably arises from the geographic structure of Rize Province, which is relatively small because climate variables tend to be more homogeneous at smaller scales (Mwangi, 2010). Topographic heterogeneity likewise indicates pattern in the distribution of amphibians in Rize Province. Amphibian species richness here was greatest in areas without extreme topographic heterogeneity (Fig. 8C).

References


![Figure 8. Amphibian species richness of Rize Province, Turkey (A), climatic (B) topographic (C) heterogeneity of the region.](image-url)
Mapping the distribution of amphibian species in Rize Province, Turkey


