

NEW DISTRIBUTION DATA OF THE VULNERABLE *MERTENSIELLA CAUCASICA* FROM GÜMÜŞHANE, TURKEY

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The Caucasian salamander, *Mertensiella caucasica*, is a vulnerable species, distributed in a restricted area from the southwest of Georgia to the northeast of Turkey. This study presents five new localities from the Gümüşhane province in Turkey. The new localities extent the known distribution by about 40 km southwards. We determine the species' potential distribution in this province. The habitat of *M. caucasica* has been predicted to shrink in the future and localities on the range boundary such as presented here will be important to understand the species' tolerance.

Key words: Caucasian salamander, environmental variable, habitat preference, potential distribution, range extension, southernmost locality

The Caucasian salamander *Mertensiella caucasica* (Waga, 1876) belongs to a monotypic genus (Veith et al., 1998; Üzüm, 2009). It is distributed in a small area in the Lesser Caucasus, from southwestern Georgia to northeastern Turkey (Baran & Atatür, 1998; Üzüm, 2009; Baran et al., 2012). Because the population of the species is decreasing, it is classified as Vulnerable (VU) by the IUCN Red List of the Threatened Species (Kaya et al., 2009). Not many localities are known from this species in literature. Several studies have been performed on its taxonomy, morphology, distribution and ecology (Tarkhnishvili & Serbinova, 1992; Veith et al., 1998; Tarkhnishvili et al., 2000, 2008; Veith & Steinfartz, 2004; Sayım et al., 2009; Üzüm, 2009; Baran et al., 2012; Beşer et al., 2017; Gül et al., 2017, 2018). We compiled a distribution database for the Caucasian salamander from the Province of Gümüşhane in Turkey at the most western extreme of the species' range and we determined its potential distribution with the present study.

Until now five localities were known from the Province of Gümüşhane in Turkey (Atatür & Budak, 1982; Beşer et al., 2017; Gül et al., 2017). The present study reports five new localities recorded during field studies in this province in the period 24–31 August 2012 (Table 1). The new localities represent a ca 40 km range extension. After the specimens of *M. caucasica* were photographed, and GPS data were recorded, they were released again; no specimens were collected.

To create a species distribution model for *M. caucasica* in the Province of Gümüşhane, 19 bioclimatic data layers were downloaded from Global Climate Data (available at www.worldclim.org). These data were generated from global ESRI grids at the

highest resolution (30 arc-seconds (~1 km)) for current conditions (~ 1950–2000). For the elevation, the SRTM30 dataset from CGIAR SRTM, aggregated to 30 sec., was used (available at <http://srtm.csi.cgiar.org/>). Slope data were downloaded from <http://webarchive.iiasa.ac.at/> with a 30 arc-second resolution. ArcToolbox was used to cut layers according to the country border of Turkey (extract by mask). ENMTools 1.4 (Warren et al., 2010) was used to identify a subset of data layers with a Pearson correlation coefficient of $0.75 < r < -0.75$ (Table 2).

Maxent 3.3.3k (Phillips et al., 2006) was used to perform species distribution modelling. To develop the model, five occurrence data from the literature as well as the five new locality records were used. 25% of the occurrence data were set aside as test points, and 10.000 background points were used as pseudo-absence data. Additional settings in Maxent were: regularization multiplier = 0.5, maximum iterations = 500, convergence threshold = 0.00001. To test the variable importance, a jackknife test was conducted in Maxent, and ten replicates of the were run.

Table 1. Occurrence data of *Mertensiella caucasica* in Gümüşhane

Latitude	Longitude	References	Locality
40.560937	40.058291	Atatür & Budak, 1982	Güngören
40.655866	39.400910	Atatür & Budak, 1982	Zigana
40.594266	39.152421	Gül et al., 2017	Demirkapı
40.587152	39.332630	Gül et al., 2017	Soğuksu
40.533333	38.916667	Beşer et al., 2017	Kazıkbeli Yaylası
40.470933	39.288383	This study	Altınpınar
40.385133	39.125700	This study	Gülaçar
40.391317	39.141483	This study	Gülaçar
40.349300	39.174983	This study	Kocadal
40.290583	39.250183	This study	Kocadal

Table 2. Relative contribution of climate layers to the distribution model of *Mertensiella caucasica*

Variable	Percent contribution (%)
Bio 10 (Mean Temperature of Warmest Quarter)	26.9
Bio 18 (Precipitation of Warmest Quarter)	23.5
Bio 8 (Mean Temperature of Wettest Quarter)	18.6
Bio 6 (Min Temperature of Coldest Month)	11.0
Slope	9.8
Bio 13 (Precipitation of Wettest)	5.4
Bio 5 (Max Temperature of Warmest Month)	2.5
Bio 19 (Precipitation of Coldest Quarter)	2.4

According to the species distribution model, suitable habitat for the species is present in north and central Gümüşhane, but not the south (Fig. 1). The environmental variables that contributed most to the species distribution model were Bio 10 (26.9%), Bio 18 (23.5%) and Bio 8 (18.6%) (Table 2). Bio 10 presented the most useful information when used by itself in Maxent. According to the jackknife analysis, the performance of the model was lowest without Bio 10. The final constructed species distribution models resulted in a high AUC value with a low standard deviation (0.997 ± 0.003).

According to the literature, the Caucasian salamander, *M. caucasica*, was only known from the north of the Gümüşhane province in Turkey (Atatür & Budak, 1982; Beşer et al., 2017; Gül et al., 2017). Our new localities show that the species is distributed further southwards. This is further supported by our species distribution model (Fig.). Climate conditions are one of the main factors that restrict species distributions (Cahill et al., 2013). *Mertensiella caucasica* is adapted to the Caucasus biodiversity hot spot climate (Tarhnishvili et al., 2000). In the present study, we found that at the margin of its range in Gümüşhane province the most important variables affecting the distribution of *M. caucasica* are Mean Temperature of Warmest Quarter (Bio 10), Precipitation of Warmest Quarter (Bio 18), and Mean Temperature of Wettest Quarter (Bio 8). According to Gül et al. (2018) the potential habitat of *M. caucasica* will shrink under future climate scenarios. Populations at range margins are important to assess the tolerance of the Caucasian salamander.

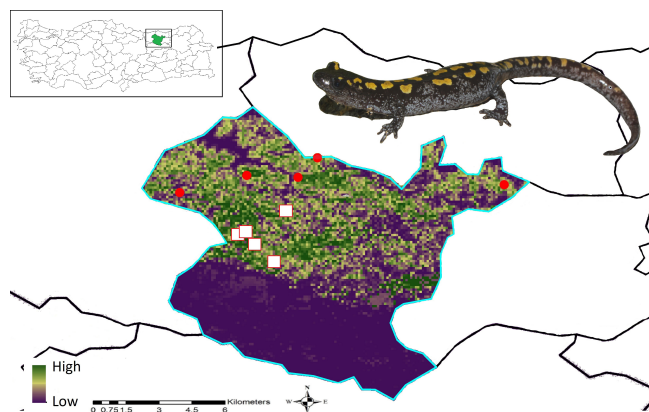


Fig. The potential distribution and habitat suitability of the Caucasian Salamander (*Mertensiella caucasica*) in Gümüşhane. Colours represent habitat suitability (see scale bar). Red circles: localities from the literature. White squares: localities newly reported in the present study.

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НОВЫЕ ДАННЫЕ О РАСПРОСТРАНЕНИИ *MERTENSIELLA CAUCASICA* ИЗ ГЮМЮШХАНЕ (ТУРЦИЯ)

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Mertensiella caucasica – уязвимый вид, распространенный на ограниченной площади от юга Грузии до северо-востока Турции. Статья содержит данные о пяти новых местонахождениях вида из провинции Гюмюшхане (Турция), расширяющих ареал вида на 40 км к югу. Мы определили потенциальное распространение вида в данном регионе Турции. Мы прогнозируем сокращение среды обитания *M. caucasica* в будущем. И местонахождения на границе ареала, подобные выявленным нами, будут важны для понимания толерантности вида.

Ключевые слова: кавказская саламандра, наиболее южное местонахождение, переменная среды, потенциальное распределение, предпочтение среды обитания, расширение ареала