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The most northeastern record of the Turkish endemic viper, *Pelias barani* (Böhme and Joger, 1984), from northeastern Anatolia: two viper species in a valley

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***Abstract.*—The Çağlayan Valley is located in Fındıklı district of Rize province, and represents a 34.7-km linear stretch that starts in Fındıklı district and ends in the Yusufeli district borderland of Artvin province in Turkey. Moreover, the valley is the home of two endemic viper species, *Pelias barani* (a Turkish endemic) and *Pelias kaznakovi* (a Caucasus endemic), that are classified by the IUCN as Near Threatened and Endangered, respectively. Here, *Pelias barani* is documented in the Çağlayan Valley for the first time. Due to several threats, most notably a proposed hydroelectric power plant (HPP), these viper species will face increasing challenges such as habitat loss and fragmentation in the near future. Therefore, this study emphasizes that the Çağlayan Valley should be a protected area in terms of these two viper species, and it also shows this area to be the nearest contact zone between *P. barani* and *P. kaznakovi* found thus far.**

Keywords. Biodiversity, Çağlayan Valley, contact zone, Reptilia, Rize, Viperidae

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Introduction

Pelias barani, also known as Baran's Viper or Baran's Adder, is a member of family Viperidae and one of several Anatolian vipers. It was first described by Böhme and Joger (1983) based on a female specimen from northwestern Anatolia, with a type locality of 60 km N of Adapazarı, Turkey, at 400 m asl. Many subsequent studies have shown new locality records for *P. barani* from the northwestern and northeastern parts of Anatolia (Baran et al. 1997, 2001, 2005; Franzen and Heckes 2000; Kutrup 2003; Avcı et al. 2004; Kumlutaş et al. 2013; Göçmen et al. 2015; Gül 2015; Mebert et al. 2014, 2015; Gül et al. 2016a,b). In addition, the taxonomic status of *P. barani* has been evaluated in several studies. Joger et al. (1997, 2003) indicated that *P. barani* is a species distinct from *P. berus* in terms of morphological, molecular, and hemipenial data; and this status was also supported by several later studies (Kalyabina-Hauf et al. 2004; Garrigues et al. 2005). As a result, *P. barani* is an endemic species which is only distributed in northwestern and northeastern Anatolia (Göçmen et al. 2015).

Anatolia, which is also known as Asia Minor or the Anatolian peninsula, is home to three of the world's 36 biodiversity hotspots: the Mediterranean basin, Caucasus, and Irano-Anatolian (CEPF 2019; Ergüner et al. 2018), and is the biological crossroads of Asia, Europe, and northern Africa (Ergüner et al. 2018). Northeastern Anatolia in particular is considered as a diversity "hotspot within a hotspot" for the vipers because it includes at least 10 species within a radius of 200 km from Erzurum province (Mebert et al. 2015). Another Caucasus hotspot endemic viper found in the Çağlayan Valley, *Pelias kaznakovi* (Nikolsky, 1909), is classified as Endangered according to the IUCN Red List category and criteria (Gül et al. 2016b). This study reports the most northeastern record of the Turkish endemic *P. barani* (Böhme and Joger 1983), demonstrating that it is another viper species which occupies the Çağlayan Valley.

Materials and Methods

Study area. Fındıklı is a district of Rize Province, Turkey, on the Black Sea coast of northeastern Anatolia, and is also home of two large valleys: the Çağlayan and the Arılı (Selim 2009, 2011). These valleys have particular national and international importance in terms of their unique ecological features (Selim 2011). The

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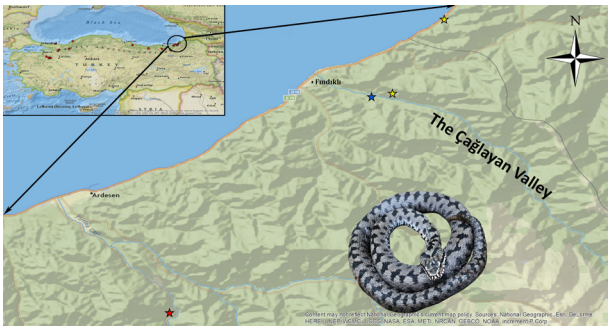

Fig. 1. Distribution map of *Pelias barani* and *Pelias kaznakovi* (created using ArcGIS 10.4). Red stars: *Pelias barani* from Mebert et al. (2015), blue star: new locality record for *Pelias barani*, yellow stars: known localities of *Pelias kaznakovi*. Inset map indicates previously known localities. *Photo by Serkan Gül.*

Çağlayan Valley includes areas covering Yusufeli and Arhavi districts of Artvin Province in the southeastern part of the valley, and is 34.7 km in length (Selim 2009). A stream in the valley, known as "Çağlayan Stream," reaches to the Black Sea and has important influences on various agricultural, settlement, forest, and aquatic ecosystems (Selim 2009). The broader area has a humid subtropical climate with an annual average precipitation of 2,296 mm recorded over the 90-year period of 1928–2018 (TSMS 2019). The study area is largely under the influence of very moist conditions, and summers are usually wetter than winters; annual rainfall is highly variable (TSMS 2019).

Specimen information. One wounded female specimen of *Pelias barani* was found by Tarık Ziya Cengiz in the Çağlayan Valley in Fındıklı, Rize, at 87 m asl on 26 June 2019 (Fig. 1). The specimen was preserved in 96% ethanol and taken to the Zoology Research Laboratory, Recep Tayyip Erdoğan University (Rize, Turkey). Photos of the specimen and its habitat (Fig. 2) were taken by the author, Serkan Gül. The snout-vent length and tail length of the specimen were taken (to the nearest mm) using a ruler and the ventral plates were counted according to Dowling (1951). The terminology used in describing the specimen is in accordance with previous studies (Franzen and Heckes 2000; Avcı et al. 2004; Baran et al. 2005; Kumlutaş et al. 2013; Gül 2015; Gül et al. 2016a,b). All external morphological characters are given in Table 1 along with the data for this species from the relevant literature. Geographic coordinates were collected using the Commander Compass Go 3.9.9 app.

Results and Discussion

Morphological features. The new specimen from a lowland population of the Çağlayan Valley shows little difference in terms of scalation and color pattern from the literature data for this species. The specimen had a total length of 525 mm (head and body length 450 mm; tail length 75 mm), 144 ventral scales, 32/30 subcaudal scales, and 23 scales on longitudinal rows of the dorsal surface at mid-body. The specimen had two apicals in contact with rostral and two canthals on each side of the head. Loreal scales between the preocular and the post-nasal were 4/4, and there were five scales between the supraoculars. Scale rows between the eyes and upper labials were 1/1 (Table 1).

Color pattern. As described previously by Gül et al. (2016a), the dorsal color pattern of the specimen is almost gray in hue, with a blackish zigzag structure across the dorsal surface (Fig. 2). The head of female specimen is relatively large (Fig. 2A). The ventral color includes many different shades of black, sometimes dark or whitish black, and the ground color of the ventral side is whitish in the anterior part, i.e., the ventral part of the head and neck (Fig. 2B). This whitish color variation continues across both upper labials and lower labials on each side of the head, and to the posterior the ventrals are black with white spots (Fig. 2C–D).

Habitat. *Pelias barani* is usually known to prefer habitats with bush, scrubland, rocky areas, hills, and oak forest (IUCN 2019). The new locality in which the specimen was found has highly transformed anthropogenic post-forest biotopes (Fig. 3A). In fact, *P. barani* actually occupies semi-open landscapes, which fits into the descriptions of the biotopes in other parts of the range, that is, with respect to the openness of the landscape and the combination of light and shade. Additionally, the species richness of trees and shrubs probably play a secondary role. The predominant species at this site include Chestnut (*Castanea sativa*), Oriental Alder (*Alnus orientalis*), European Hornbeam (*Carpinus betulus*), Common Hazel (*Corylus avellana*), various ferns such as *Pteridium tauricum,* and Blackberry (*Rubus fruticosus*) [Fig. 3B]. Other reptile and amphibian species, such as *Bufo bufo* (Pallas, 1814), *Hyla orientalis* (Bedriaga, 1890), *Anguis fragilis* (Linneaus, 1758), and *Darevskia rudis* (Bedriaga, 1886), probably occupy the same geographic area with *P. barani* (Fig. 3C).

Distribution. *Pelias barani* has a geographic range within the northwestern and northeastern coastal areas of Turkey (Fig. 1). Recently, many new geographic records have appeared in the literature, but a gap remains in terms of its geographic range in the north of Turkey. Gül et al. (2015) showed a geographic record taken from Baran et al. (2001) as the most northeastern point (see Fig. 2 in Gül et al. 2015); however, some authors have highlighted that this geographic record likely represented the "*V. pontica*" (a hybrid of *P. kaznakovi* x *Vipera ammodytes*) collected by Max. Pissié near Chorokhi, Artvin (Zinenko et al. 2013; Göçmen et al. 2015). Therefore, the geographic record presented in this study is very important with respect to establishing a contact

Table 1. Morphometric measurements and scale counts of known specimens based on data from the literature and the new locality. SVL: Snout-vent length, SSO: Scales between supraoculars, EUL: Scale rows between eyes and upper labials, DS: longitudinal rows of dorsal scales. References: 1: Böhme and Joger (1983); 2: Baran et al. (1997); 3: Franzen and Heckes (2000); 4: Baran et al. (2001); 5: Kutrup (2003); 6: Avcı et al. (2004); 7: Baran et al. (2005); 8: Kumlutaş et al. (2012); 9: Gül (2015); 10: Gül et al. (2016a); 11: Göçmen et al. (2015); 12: Current study.

Locality	**60 km N of Adapazarı**	**Camlıhemşin Ardeşen**	**Dereli Giresun**	**Dereli Giresun**	**Fırtına Valley, Ardeşen**	**Arpagözü Çaykara Trabzon**	**Arpagözü Çaykara Trabzon**	**Ballıca, Of, Trabzon**	**Sugeldi, Of, Trabzon**	**Çamlık, Vakfıkebir, Trabzon**	**Çamlık, Vakfıkebir, Trabzon**	**Çınarlı, Yomra, Trabzon**
Reference	1	2	3	3	3	4	4	5	5	5	5	5
Sex	Female	Female	Female	Male	Female	Female	Female	Male	Male	Female	Male	Female
SVL	472 mm	426 mm	605 mm	545 mm	595 mm	514 mm	395 mm	518 mm	543 mm	186–627 mm	172–197 mm	634 mm
Tail length	68 mm	50 mm	68 mm	73 mm	65 mm	69 mm	51 mm	82 mm	83 mm	32–69 mm	38–46 mm	78 mm
Ventrals	145	145	146	142	145	142	142	140	141	149	140–145	146
Subcaudals	37/37	31/31	31/30	36/36	31/30	28/29	25/28	37	33	30/31	37/38	29
Loreal scales	5/5	5/5	4/4	5/4	11/9	5/5	4/5	5/5	5/no data	4/5	4/5	4/5
Circumoculars	11/12	12/12	9/9	11/10	11/10	9/8	9/9	13/12	10/10	9/10	8/11	11
Apicals	2	no data	no data	no data	no data	1 (2)	2	2	2	2	2	2
Upper labials	10/10	9/9	9/10	9/8	9/9	9/7	9/8	9/9	9/no data	8/9	9/9	9/8
Lower labials	12/12	11/11	11/11	12/12	12/13	9/9	10/11	11/11	11/11	10/11	10/11	10/11
Gulars	no data	4/4	4/4	4/4	4/4	5/4	5/6	no data	no data	no data	no data	no data
Canthals	3/3	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2	2/2
SSO	5	no data	no data	no data	no data	4	5	no data	no data	no data	no data	no data
EUL	1/1	no data	no data	no data	no data	1/1	1/1	no data	no data	no data	no data	no data
DS	21	21	21	21	23	21	21	21	21	21	21	21

Table 1. continued. Morphometric measurements and scale counts of known specimens based on data from the literature and the new locality. SVL: Snout-vent length, SSO: Scales between supraoculars, EUL: Scale rows between eyes and upper labials, DS: longitudinal rows of dorsal scales. References: 1: Böhme and Joger (1983); 2: Baran et al. (1997); 3: Franzen and Heckes (2000); 4: Baran et al. (2001); 5: Kutrup (2003); 6: Avcı et al. (2004); 7: Baran et al. (2005); 8: Kumlutaş et al. (2012); 9: Gül (2015); 10: Gül et al. (2016a); 11: Göçmen et al. (2015); 12: Current study.

Locality	İkizce Ordu	Geyve Adapazarı	Kozlu Zonguldak	Büyükdere Çayeli Rize	Tektaş village/ Pazar	Tektaş village/ Pazar	Ömerler, Merkez, Bolu	Ömerler, Merkez, Bolu	Çamlıyayla, Bozüyük, Bilecik	Çayyaka, İnegöl, Bursa	Safa, Domaniç, Kütahya	Çağlayan valley/ Fındıklı
Reference	6	7	8	9	10	10	11	11	11	11	11	12
Sex	Male	Female	Male	Female	Female	Female	Male	Male	Female	Male	Female	Female
SVL	415 mm	503 mm	460 mm	600 mm	500 mm	508 mm	434 mm	556 mm	269 mm	455 mm	450 mm	450 mm
Tail length	57 mm	62 mm	60 mm	70 mm	65 mm	62 mm	81 mm	99 mm	42 mm	84 mm	75 mm	75 mm
Ventrals	147	145	145	142	142	143	144	145	147	144	145	144
Subcaudals	34/35	33/33	33/34	29/30	30/28	30/30	43/43+1	43/43+1	33/33+1	42/42+1	30/31	32/30
Loreal scales	4/5	5/5	4/4	5/5	4/4	4/4	4/4	5/5	4/4	4/5	4/5	4/4
Circumoculars	12/13	11/13	11/13	11/12	broken row	broken row /12	11/11	12/13	10/10	9/10	11/12	10/11
Apicals	2	2	2	2	2	2	2	2	2	2	2	2
Upper labials	9/9	9/9	9/9	9/9	broken row	9/11	9/10	9/9	9/9	9/10	9/8	9/8
Lower labials	12/12	11/11	12/12	11/12	broken row	broken row	10/11	11/11	10/10	10/10	12/11	10/11
Gulars	4/4	no data	4/4	4/4	broken row	4/4	no data	no data	no data	no data	4/4	4/4
Canthals	no	2/2	2/2	2/2	2/2	2/2	no data	no data	no data	no data	2/2	2/2
SSO	4	no data	5	5	5	5	no data	no data	no data	no data	5	5
EUL	1/1	no data	1/1	1/1	broken row	2/2	1/1	1/1	1/1	1/1	1/1	1/1
DS	22	no data	23	21	23	22	21	22	21	21	22	23

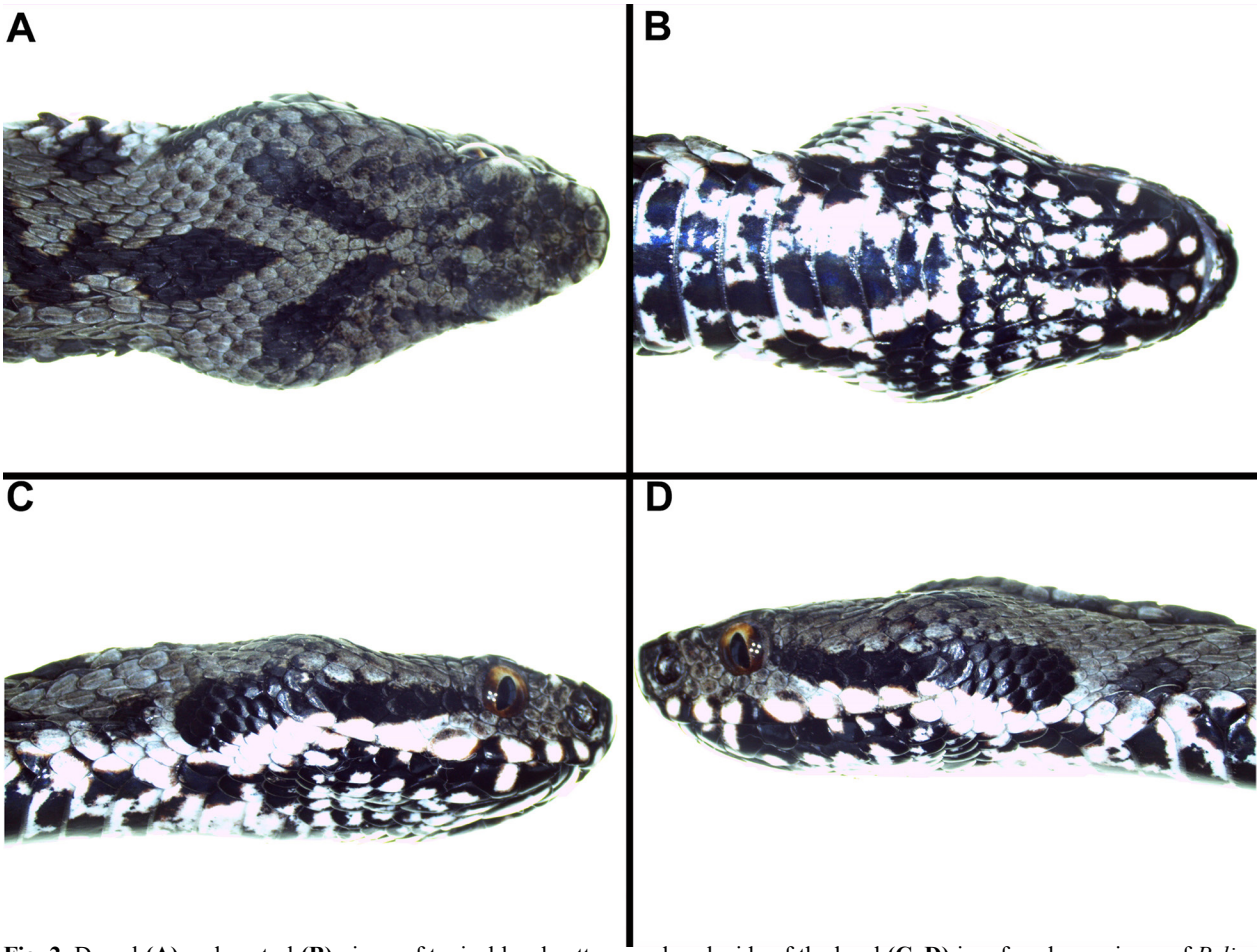

Fig. 2. Dorsal **(A)** and ventral **(B)** views of typical head pattern, and each side of the head **(C–D)** in a female specimen of *Pelias barani* from the Çağlayan Valley, Fındıklı, Turkey. *Photos by Serkan Gül.*

zone between *P. barani* and *P. kaznakovi.* While Mebert et al. (2015) reported that Işıklı Valley would be the most likely area for a contact zone between them, this study indicates that the Çağlayan Valley is the most likely contact zone between *P. kaznakovi* and *P. barani* (Fig. 4). In addition, based on the finding reported in this study, it appears that the eastern part of the Çağlayan Valley is occupied by *P. kaznakovi* whereas the western part of the Çağlayan Valley is also the habitat of *P. barani* (Fig. 4). Furthermore, with this new finding, the known distance between the *P. barani* and *P. kaznakovi* vipers is reduced from 20.3 km down to only 1.3 km. At the same time, the known distribution of *P. barani* is hereby extended by a distance of up to 19 km northeast from the nearest previously reported site (Mebert et al. 2015; Fig. 4).

An additional reason for these distribution patterns may be related to the Colchic regional characteristics. The Colchis is an ancient region south of the Caucasus Mountains at the eastern end of the Black Sea that is known for many relicts in terms of faunal and floral speciation (Tuniyev 1997). Moreover, the Colchis is a refugial area that explains the presence of relict species in post-glacial dispersal (Tarkhnishvili 2014). It seems that the Çağlayan Valley is likely to be the westernmost border of the Colchic refugium in the eastern Black Sea.

Threats and conservation status. In the IUCN Red List, *P. barani* is assigned to the Near Threatened category and criteria. General threats in this area, such as habitat loss due to tourism and recreation areas, hunting and trapping of terrestrial animals for biological resource use, deaths caused by the local people, and road deaths, are potentially threatening for the *P. barani* population (Gül 2015; IUCN 2019). In addition, the increasing human population, and consequent increases of agricultural use, building houses in hitherto unused natural areas, etc., have become additional major threats in the region over the last decade.

However, it seems that the most important threat for both *P. barani* and the overall ecosystem of the valley is hydroelectric power plants (HPP). Although the Çağlayan Valley was declared as a 1st degree priority natural protected area in 2008 by the Trabzon Regional Board for the Protection of Cultural and Natural Heritage, there are still active efforts to build HPP in the valley (Sarıhan 2019). In addition, the Arılı Valley (which is other major valley of Fındıklı) is facing the same problem (DHA 2019). This study indicates that the Çağlayan Valley hosts two endemic viper species, one of which (*P. kaznakovi*) is endemic to the Caucasus hotspot, while the other viper (*P. barani*) is endemic to Turkey. Therefore, the

Fig. 3. Several views of the habitat of *Pelias barani* from the Çağlayan Valley, Fındıklı, Turkey. *Photos by Serkan Gül.*

construction and operation of the HPP would negatively affect the natural habitats of both species, as well as the other fauna of the river systems and wildlife populations in the valley (Gül et al. 2016a,b). This pursuit of HPP may be a serious problem that leads to decreasing trends of the species populations.

Pelias barani is currently in the IUCN Red List category of Near Threatened (NT), but as stated by Mebert et al. (2015), it will probably qualify for the Vulnerable (VU) category in the near future. In this same valley, *P. kaznakovi* is currently in the Endangered (EN) category, and populations of both species have decreasing trends. Considering all of these factors, clearly the Çağlayan Valley serves as an important habitat for these two viper species of conservation concern. In addition, *Mertensiella caucasica* is an endemic salamander species of the Caucasus hotspot which is also found in this valley and it is listed as Vulnerable by IUCN (Gül et al. 2018). Therefore, the Çağlayan Valley needs to be studied more thoroughly with regard to the diverse herpetofauna and the potential impacts of continuing HPP development.

In conclusion, this study suggests that the Çağlayan Valley should be a protected area, and provides basic information for a conservation action plan for *P. barani* in light of a recent recommendation for the development of a comprehensive, global "Action Plan" for the conservation of vipers (Maritz et al. 2016).

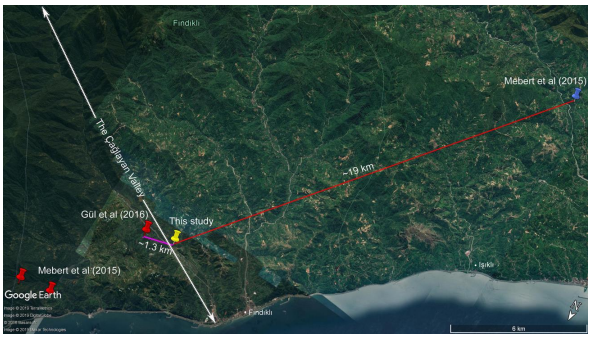

Fig. 4. Proximity of nearest known *Pelias barani* and *Pelias kaznakovi* localities (map generated using Google Earth 7.3.2). Blue pin marker: *Pelias barani* from Mebert et al. (2015), red pin markers: *Pelias kaznakovi* from Mebert et al. (2015) and Gül et al. (2016b), yellow pin marker: new locality record of *Pelias barani* in this study. Distance between blue and yellow pin markers is ~19 km. Note that the short distance between *Pelias barani* and *Pelias kaznakovi* localities in the Çağlayan Valley indicates a potential contact zone.

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