
MOUNTAIN VIPERS IN CENTRAL-EASTERN TURKEY: HUGE RANGE EXTENSIONS FOR FOUR TAXA RESHAPE DECADES OF MISLEADING PERSPECTIVES

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Abstract.—Turkey harbors a high diversity of viperid snakes, many with a high threat level on the International Union for Conservation of Nature (IUCN) Red List, yet perception about even basic topics, such as distributions and conservation statuses, remain poor. We initiated a multi-year project 7 y ago to compensate these shortcomings and present herein dramatically improved information on the status of mountain vipers of central-eastern Anatolia (Asian Turkey): Bolkar Viper (*Montivipera b. bulgardaghica*), Albizona Viper (*M. b. albizona*), Wagner's Viper (*M. wagneri*), and partly Ottoman Viper (*M. xanthina*). The data originate from our fieldwork and a comprehensive search of all records available, including information from literature, online resources, locals, and herpetological experts. This resulted in 51 new localities, complemented by 36 published records, which were refined with new information, including four corrected/removed records and two records that were combined with new records due to their proximity. We summarized all records with precise information in a supplemented list of 85 localities, which is compared to current literature and the range maps available on the IUCN Red List of Threatened Species, the global standard reference for consultation on range maps and conservation status of species. Consequently, we report on large range extension of > 100 km in all four mountain viper taxa, increase the extent of occurrence for each viper taxon 4–8 times, reduce the distribution gaps between all pairs of parapatric, related, and ecologically similar mountain vipers, and discuss taxa delimitation, putative contact zones and conservation aspects.

Key Words.—Albizona Viper; Anatolia; Bolkar Viper; conservation; IUCN Red List; *Montivipera b. albizona*; *Montivipera b. bulgardaghica*; *Montivipera wagneri*; *Montivipera xanthina*; Ottoman Viper; taxa delimitation; Wagner's Viper

INTRODUCTION

Turkey has a high viper diversity with at least 11 currently recognized species belonging to the genera *Macrovipera*, *Montivipera*, *Daboia*, and *Vipera* (e.g., Joger 1984; Mallow et al. 2003; Budak and Göçmen 2008; Mebert et al. 2015a; Göçmen et al. 2018; Freitas et al. 2020). This unusually high viper diversity for a Palearctic country likely is the result of its complex

biogeographic history and habitat diversity (Stümpel et al. 2016); however, taxonomy and phylogeography of Anatolian vipers is still a controversial issue (Stümpel and Joger 2009; Mebert et al. 2016). Most of these vipers received a threat status from the International Union for Conservation of Nature (IUCN) higher than Vulnerable, including three of the eight viper species listed globally as Critically Endangered (IUCN 2020). Unfortunately, references about distribution and ecology of Anatolian

vipers are very limited (e.g., Göçmen et al. 2014, 2017; Mebert et al. 2016), and often portray an unrealistic situation, as explained herein. This also applies to the genus *Montivipera* (mountain or rock vipers), which has experienced a tumultuous history and was taxonomically separated from other Palearctic vipers by Nilson et al. (1999). A few taxa have been described in the last 150 y (Ottoman Viper, *M. xanthina*, Radde's Viper, *M. raddei*, Lebanon Viper, *M. bornmuelleri*, and Latifi's Viper, *M. latifi*), whereas more recent taxonomic research resulted in the description of a number of new taxa (Wagner's Viper, *M. wagneri*, Bolkar Viper, *M. bulgardaghica*, Albizona Viper, *M. albizona*; and Kuhrang Viper, *M. kuhrangica*). Species delimitation among these taxa has remained controversial (e.g., Nilson and Andren 1986, 1992; Schätti et al. 1991; Sindaco et al. 2013), but some recent studies provided more clarity on relationships among mountain vipers (Stümpel and Joger 2009; Stümpel 2012; Stümpel et al. 2016).

Some of the mountain vipers are rather colorful (*raddei*, *wagneri*, *albizona*) or show a highly variable and contrasting color pattern (*bulgardaghica*, *xanthina*) that, combined with their putative rarity, led to a temporary illegal collection frenzy for the pet trade in the 1980s–90s. Frequent commercial trading, privately and at reptile expositions, combined with the fear that the few known populations could be irreversibly negatively affected, led to the categorization of several species with a high threat status by the IUCN in the 1990s. A new round of IUCN reassessments in 2008 mainly implemented a higher threat level of mountain viper species compared to the ones published 15 y earlier in 1996, yet without any new supporting information about population aspects and taxonomic clarifications. Unfortunately, concerns about putative illegal over-collecting of many vipers have persisted, even though there is a complete lack of corroborating data over the last decade aside from anecdotes about illegal export of a few individuals that would have only a very limited impact at the population or species threat level. On the other hand, substantial threats caused by habitat destruction, e.g., mining activities, valley flooding for electric power generation, massive livestock grazing, or plantation sprawl, was strongly underestimated (Mebert et al. 2016; Zinenko et al. 2016).

Furthermore, competitive interactions among interested people (professionals and amateurs) have continued after the last IUCN Red List assessment in 2008 and produced a generally tense climate of distrust, misinformation, defamations, false assessments and unrealistic administrative perceptions in relation to Anatolian vipers. At the same time, a lack of basic biological studies about distribution, habitat, and population aspects of Turkish mountain vipers have prevented a realistic assessment of the extent of occurrence, population size/densities, and threat levels

of most taxa to this day. To counter the widespread misunderstanding about these vipers, we initiated a project 7 y ago to better understand the phylogeny and biogeography of Anatolian vipers and have published results on a regular basis (e.g., Mebert et al. 2014, 2017a; Göçmen et al. 2015a,b; Nalbantsoy et al. 2016; Stümpel et al. 2019). This study, as well as the previous ones, represent additional information for a work in progress, which should culminate in a much more realistic assessment about the systematic allocation and true distribution of mountain vipers in Turkey than is currently presented in publications and unpublished governmental monitoring reports. Such documents are often based on the IUCN Red List files (IUCN 2020), which are regarded as the most influential source of information for species conservation in the world (AGENDA 21. 2010. Understanding NGOs' [non-government organizations] vision for the 21st Century. Available from <https://agendatwentyone.wordpress.com/2010/06/28/understanding-ngos-non-government-organizations/> [Accessed 11 July 2019]; wiseGEEK. 2014. What is IUCN? by Ellis and Brownyn. Available from <https://www.wisegeek.com/what-is-iucn> [Accessed 10 July 2019]; and Saha et al. 2018). Our collection of new and refined information on the distribution of Anatolian mountain vipers will inform and guide key national and international policy and conservation activities and/or regulations. This information will also be useful for the scientific community and serve as an important education and information resource for the public, improve species identifications, help potential funding, and will be crucial in our goal to overhaul the respective IUCN Red List files (IUCN 2020).

We restrict our work here to four mountain viper taxa from south-central to north-eastern Turkey; hence, excluding *Montivipera raddei* and most of the core and western range of *M. xanthina*. Each species has a conservation status and current population assessment according to the IUCN Red List of Threatened Species (IUCN 2020). *Montivipera b. albizona* (Albizona Viper or Central Turkish Mountain Viper) is listed as an Endangered Turkish endemic, its Extent of Occurrence is fewer than 5,000 km² it is known from fewer than five locations, and has a continuing population decline inferred in the number of mature individuals due to the likely collection for the pet trade and intentional killing. *Montivipera b. bulgardaghica* (Bolkar Viper) is listed as Least Concern because it occurs in an area of extensive and suitable habitat that appears not under threat, has a presumed large overall population, and is unlikely to be declining fast enough to qualify for listing in a more threatened category. *Montivipera wagneri* (Wagner's Viper) is listed as Critically Endangered, is endemic to Turkey, has experienced a population decline of more than 80% from exploitation and collection for the

international pet trade over the past three generations (18 y), and is predicted to have a continued population decline from over-collection and planned dam construction in the Aras River Valley, which would cause a loss of over 80% of suitable habitat for this species. *Montivipera xanthina* (Ottoman Viper) is listed as Least Concern in view of its wide distribution, large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category.

Our primary objective is to initiate a process to counter the general lack of knowledge about Turkish mountain vipers, from simple distribution to population biology and ecology, which is preventing any reliable assessment of species recognition and conservation statuses. It is therefore urgent to rapidly improve our knowledge of the true range limits, population sizes, species delineation, and relevant environmental factors that may affect population dynamics. This can be achieved quickest with a multi-faceted approach by compiling geographic data on population extent and habitat occupancy in general and molecular and morphological data from contact zones or contiguous (parapatric) populations of two or more viper species (Mebert et al. 2015b, 2017b). Finally, it is our overriding objective to provide tools for appropriate future conservation assessments (Extent of Occurrence, Population Size/Trend) and actions/management by publishing herein the massively enlarged distribution size of Turkish mountain vipers than is officially known.

MATERIAL AND METHODS

Taxonomic and morphological considerations.—Beginning in 2013, we started to compile a database on *Montivipera*, focusing on Turkey. We engaged in a holistic approach and compiled data from all available sources, including annual field excursions and sampling of representative genetic tissues for species delineation, searching all literature references, contacting authors of online photos and reports, questioning locals as well as herpetologists that have been active in Turkey. We here largely follow the taxonomic concept of Stümpel et al. (2016) but expect changes in the future (Freitas et al. 2020).

The Albizona Viper was originally described as *Vipera albizona* by Nilson et al. (1990), placed into the genus *Montivipera* by Nilson et al. (1999), and subsequently confirmed by Garrigues et al. (2005). Recently, *M. albizona* was suggested as a subspecies of the Bolkar Viper (*M. bulgardaghica*) due to molecular evidence (Stümpel and Joger 2009; Stümpel et al. 2016). Because the distinction between the two subspecies has become blurrier with new, often photographic, material,

we apply the subspecies epithet of such specimens listed herein based on its proximity to the historically known distribution, and/or topographically linked habitats. Potential contact (or transition) zones between them are purely speculative due to lack of data but are suggested and briefly discussed based on geographic proximity of new material.

The similar and somewhat overlapping color pattern between *M. wagneri* and *M. b. albizona* and the missing information of a putative contact zone (or most proximate populations) between them, may render the taxon allocation of some individual vipers solely based on photographic and geographic data difficult. Taxon allocation of such data, however, was decided based on its proximity to the nearest known mountain viper location, reflecting that no two *Montivipera* taxa are known to overlap (Mebert et al. 2016; Stümpel et al. 2016), and a combination of following features: (1) Morphology: To be viewed only tentatively because there seems to be a large overlap of external characters based on published and our own information. Furthermore, diagnosis by previous authors (see Table 1) was retrieved from very small samples, usually representing two to three populations from the northern range limit of each taxon, thus missing a more widespread geographic variation inherent in each taxon. (2) Habitat: Is the habitat linked to other conspecific populations? We visually evaluated potential connecting corridor to other known sites of *Montivipera* populations at < 5 km distance for suitable rocky habitat on plateaus or along valleys < 2,200 m elevation using satellite images from Google Earth Pro. (3) Molecular: We screened haplotype association for a few sampled specimens and compared them with published data. We investigated mitochondrial DNA following Stümpel et al. (2016) and compared the obtained sequences to the current published ones in GenBank using BLAST online. All the evaluation and

TABLE 1. Differences in morphology between Albizona Viper (*Montivipera bulgardaghica albizona*) and Wagner's Viper (*M. wagneri*) both from northern populations, based on Joger et al. (1988), Nilson et al. (1990), and Mulder (1994).

Morphological Character	<i>M. b. albizona</i>	<i>M. wagneri</i>
Lateral blotches	Blackish spots	Dark vertical stripes
Inner circumoculars	≤ 13	≥ 12
Ventral scales	≤ 155	≥ 161
Size mid-dorsal blotches incl. black borders	≥ 9 scales wide	< 9 scales wide
Contact occipital spots to first dorsal blotch	Disconnected	Connected up to 50%
Contact occipital spots to postorbital stripe or first lateral blotch	Connected up to 50%	Disconnected

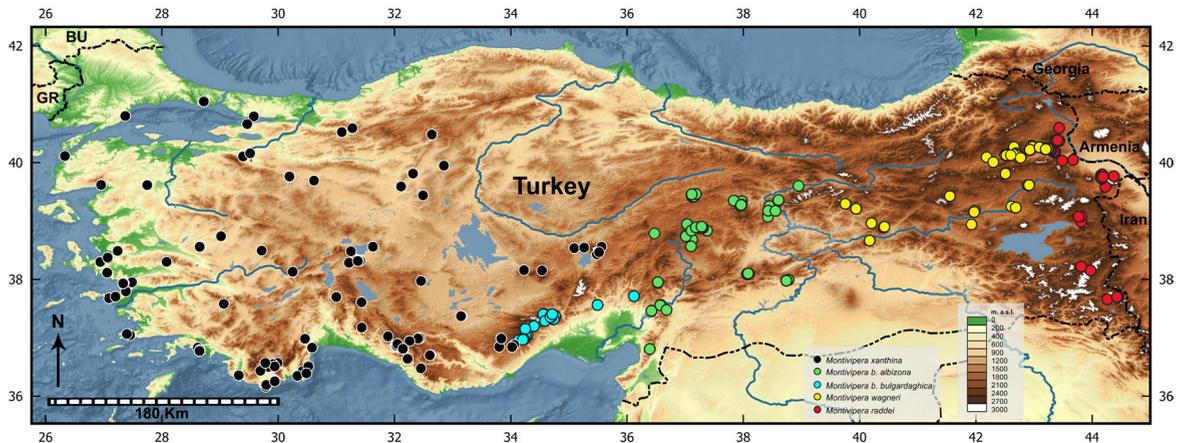


FIGURE 1. Updated distribution of mountain vipers in Turkey. Points represent locality records (see Locality List in Supplemental Information) for Ottoman Viper, *Montivipera xanthina* (black), Albizona Viper, *M. b. albizona* (green), Bolkar Viper, *M. b. bulgardaghica* (light blue), Wagner’s Viper, *M. wagneri* (yellow), and Radde’s Viper, *M. raddei* (red). Locality marks for western and inland Ottoman Viper (*M. xanthina*) are not complete, but sufficiently representative, as they are not the focus in this study. Black interrupted lines represent country borders. A larger version of this map is accessible in Supplemental Information.

taxon allocations, in particular those that originate from photos only, should be seen as provisional until finer analysis (i.e., a more complete genetic and morphological analysis) is available. We summarized and listed most relevant and available locality data of *Montivipera wagneri*, *M. b. bulgardaghica*, and *M. b. albizona*, but also the south-eastern range segment of *M. xanthina* which is most proximate to other mountain viper taxa (see Locality List in Supplemental Information).

RESULTS

The updated range of the four mountain viper taxa (Fig. 1) generally shows a rather continuous range of

Montivipera taxa from west to east, much different from the general perception of isolated populations or as presented in IUCN Red List files. Listed numbers in the distribution maps (Fig. 2 and subsequent maps presented for each taxon below) correspond to locality numbers in the specimen/habitat photographs and Locality List in the Supplemental Information.

Wagner’s Viper (*Montivipera wagneri*).—We provisionally assign all *Montivipera* specimens, including those based on photographs, that originate from south of the Munzur Mountains in the provinces Tunceli and Erzincan, and from east of the Euphrates River Valley in provinces farther south, to *M. wagneri*.

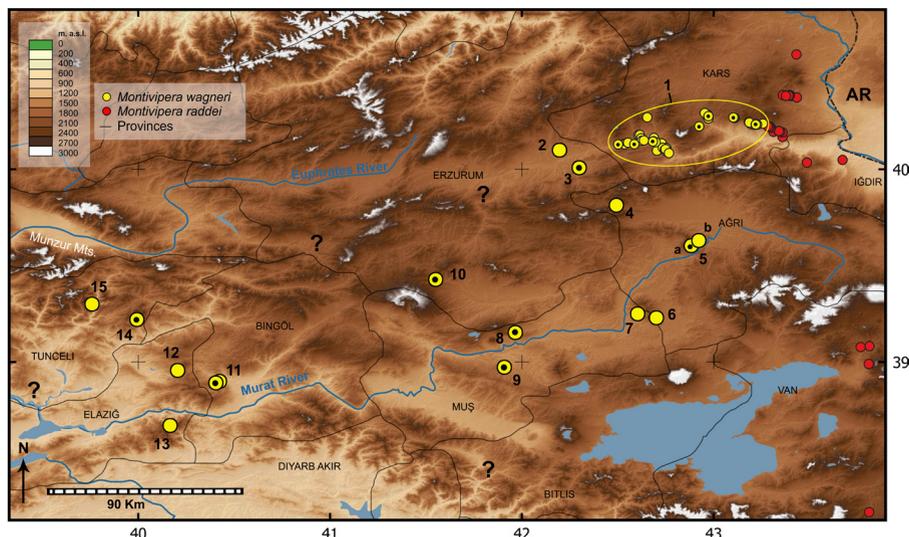


FIGURE 2. Updated distribution of Wagner’s Viper (*Montivipera wagneri*) and adjacent locations of Radde’s Viper (*M. raddei*) in Turkey. Numbers refer to the Locality List in the Supplemental Information, but only for *M. wagneri*, as *M. raddei* is not the focus of this study. Several samples used for genetic analysis originate from Aras Valley (circled locality-1) and other single locations that are indicated with a black center. Question marks indicate areas where further *Montivipera* populations are expected but require confirmation. A larger version of this map is accessible in Supplemental Information.

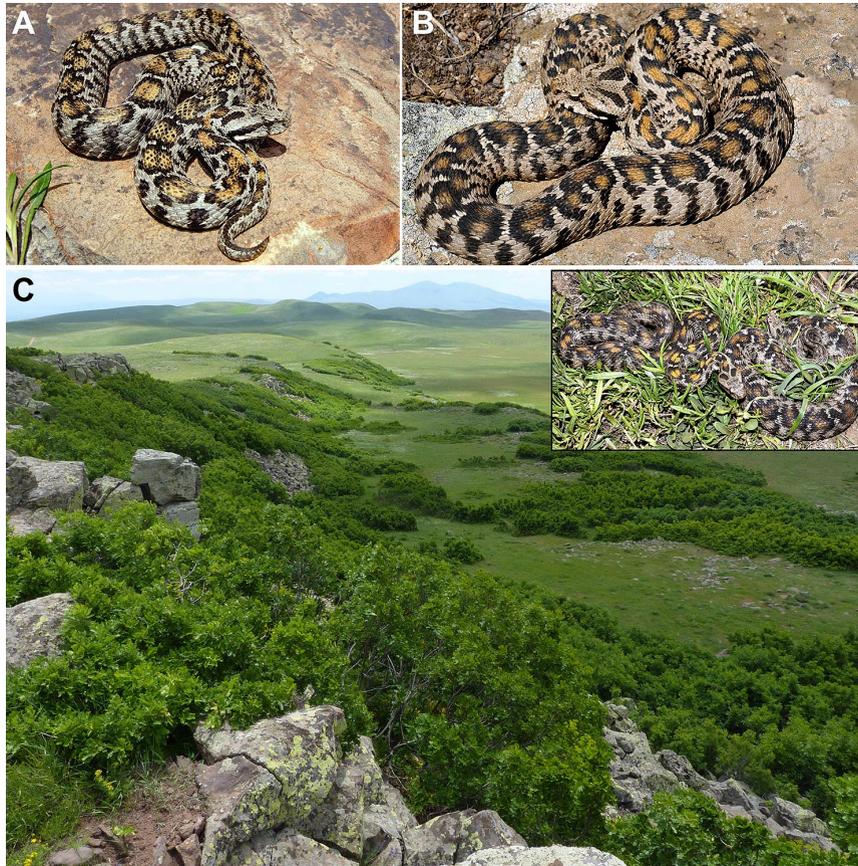


FIGURE 3. Range extensions of Wagner's Viper (*Montivipera wagneri*) in Turkey. (A) Individual from Günindi, district Kağızman/Kars, near eastern end of encircled locality-1, respectively contact zone with *M. raddei* (Mebert et al. 2016); (B) Individual from locality-4a, Dereköy, district Tutak/Agri; (C) locality-8, habitat and two Wagner's Viper from the area between Bostancılar and Akçakaynak, district Bulanik/Muş. (A, C, and insert photographed by Konrad Mebert and B by Naşit İğci).

The range extends about 250 km west of the previously known western limit near Horasan (locality-2 in Fig. 2; Kumlutas et al. 2015) and includes also recently discovered published (Göçmen et al. 2014; Yıldız et al. 2018) and unpublished sites in the provinces Kars, Ağrı, Muş, Erzurum, Bingöl, Elazığ, and Tunceli (Figs. 3 and 4, plus Supplemental Information Figs. S1–S7). Complementary to these allocations, all *Montivipera* records from northwest of the Munzur Mountains and west of Euphrates River are assigned to *M. b. albizona*.

Albizona Viper or Central Turkish Mountain Viper (*Montivipera bulgardaghica albizona*).—Correction of Terra Typica: the terra typica of *albizona* was originally given as Kulmac Dağları (Nilson et al. 1990), a mountain chain that begins in the west just north of the villages Harmandalı and Kürkçüyurt, district Altinyayla/Sivas, and ends in the east at Yılanlı Mountain, district Kangal/Sivas. The entire 70 km mountain chain appears to provide some suitable habitat for *Montivipera* vipers, but not as extensive as the Tecer Mountains parallel to the north, a well-known site for *M. b. albizona*

(localities 25–28 in Fig. 5 and Supplemental Information Figs. S7E, S9). Recent discussions with the senior author of the description and provision of coordinates, however, revealed that the terra typica lies 100 km farther east near the Karaşar Geçidi (= K. pass), district Divriği/Sivas (see locality-23 below). We also present new and refined localities in the provinces Erzincan, Malatya, Kayseri, Sivas, Kahramanmaraş, and Hatay (Supplemental Information Figs. S7–S12), as well as a large southeastern extension into province Adiyaman (locality-45 in Fig. 5, photographs in Fig. 6, and more specimens depicted in Supplemental Information Fig. S13) about 145 km south and 195 km east of previously known sites (Göçmen et al. 2014). The distribution map in Fig. 5 also replaces the one presented in Çiçek et al. (2017), which is based on previous literature and photographic records, all presented herein with more precision and corrections, where appropriate. No vouchers could be located for the presence of *M. b. albizona* in Sivas-province districts Gemerek, Yıldızeli and Zara (Çiçek et al. 2018; Kerim Cicek, pers. comm.), but see discussion appended to locality-34 in Supplemental Information.



FIGURE 4. First confirmed presence of Wagner's Viper (*Montivipera wagneri*) in Tunceli Province, Turkey. Habitat and a Wagner's Viper from locality-14, Tahkini Yaylasi-Pohoz Mevki, northeast of Turnayolu, district Nazimiye/Tunceli. (Photographed by Konrad Mebert).

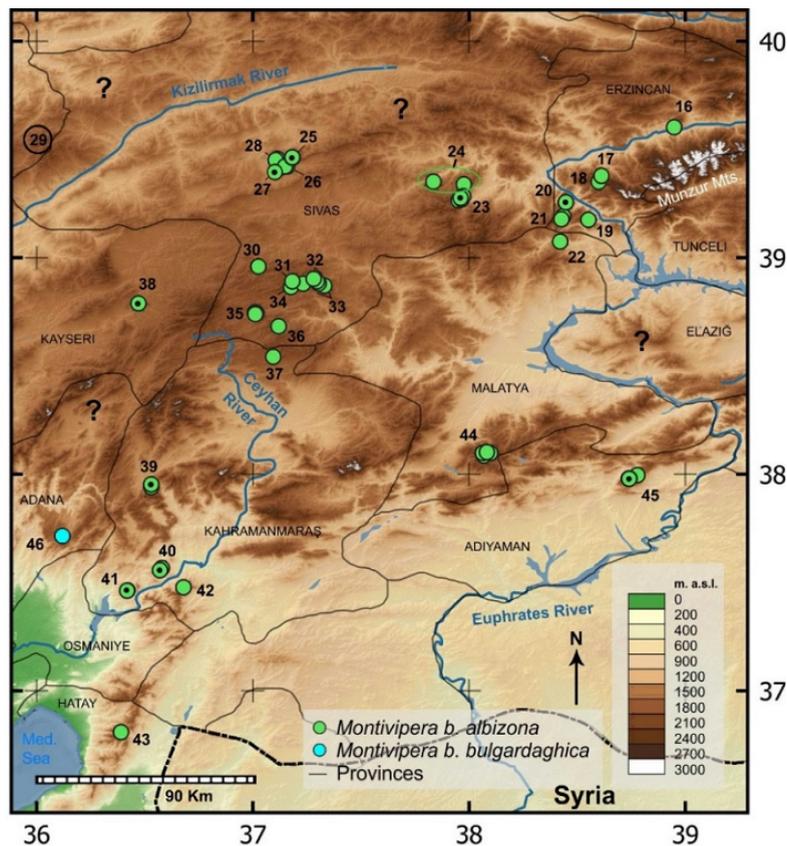


FIGURE 5. Updated distribution of Albizona Viper (*Montivipera bulgardaghica albizona*) and nearest record of the Bolkar Viper (*Montivipera b. bulgardaghica*) in Turkey. Numbers refer to the Locality List in the Supplemental Information. Samples used for genetic analysis are indicated with a black center, except for locality-40 from Başkonuş, Merkez/Kahramanmaraş, which refers to an albumin analysis by Göçmen et al. (2009). Question marks indicate regions where further *Montivipera* populations are expected but require confirmation. An enlarged version of this map is in Supplemental Information.



FIGURE 6. The new, currently most southeastern, locality of Albizona Viper (*Montivipera bulgardaghica albizona*) in Turkey at the Nemrut Archaeological site, district Kahta/Adiyaman, locality-45. Depicted is one of the treeless areas near the peak and one of the Albizona Vipers found there (see more examples in Supplemental Information Fig. S13). (Photographed by Mehmet Zülfü Yıldız).

Bolkar Viper (*Montivipera b. bulgardaghica*).—We extend the range about 13 km west within province Mersin and 130 km east in province Adana (Fig. 7). We include photographic vouchers (Fig. 8 and Supplemental Information Figs. S14–S16) of this species. Information about the records is given in the Locality List in the Supplemental Information.

Ottoman Viper (*Montivipera xanthina*).—Only south-eastern records are mapped herein (Fig. 9; but see wider view in Fig. 1). In the Locality List (see Supplemental Information), we summarize new and refined (from previously published, mainly primary sources) records of the Ottoman Viper from its southeastern-most range, adjacent and as close as 11 km from *Montivipera bulgardaghica* ssp. We include photographic vouchers (Fig. 10 and Supplemental Information Figs. S17 and S18), including the first documentation of *M. xanthina* from the province of Mersin.

DISCUSSION

Distribution and conservation aspects.—Among snakes, vipers are perceived as disproportionately threatened with extinction, and thus, acquiring information on their distribution, ecological niche, and natural history is fundamental to better understand their biology and assess their conservation status (Maritz et

al. 2016; Alencar et al. 2018; Saha et al. 2018). This has also become evident to us since the start of this project in 2013, because the biology of vipers in Turkey has remained poorly studied to this day, including studies on their distributions and population statuses with only fragmentary or misleading information. This lack of good data is reflected in the IUCN Red List files in three of four *Montivipera* taxa treated herein (*M. wagneri*, *M. b. bulgardaghica*, *M. [b.] albizona*) and in most recent scientific publications (Kumlutaş et al. 2015; Tok et al. 2015; Gül et al. 2016; Tuniyev 2016; Kurnaz et al. 2018; Ahmadi et al. 2019), Turkish provincial governmental reports (e.g., Çiçek et al. 2017; Avcı et al. 2018), and in virtually all books that include chapters on vipers from Anatolia (e.g., Phelps 2010; Sindaco et al. 2013; Geniez 2015).

By using a combination of published results, satellite images from Google Earth Pro, as well as the increasing provision of open online landscape photos, we conclude that suitable habitat for most viper species appears relatively extensive across much of Anatolia. When combining key factors, such as southern aspect, elevation, and coarse-rocky surface structure (no fine sediments) to provide shelter for night, hibernation, and prey, potential new locations can often be pinpointed on satellite images. We have also extended the habitats of *Montivipera* spp. from rocky mountain slopes with bushes (e.g., Aras Valley in Kars, locality-1, Supplemental Information Fig. S1) and light forests

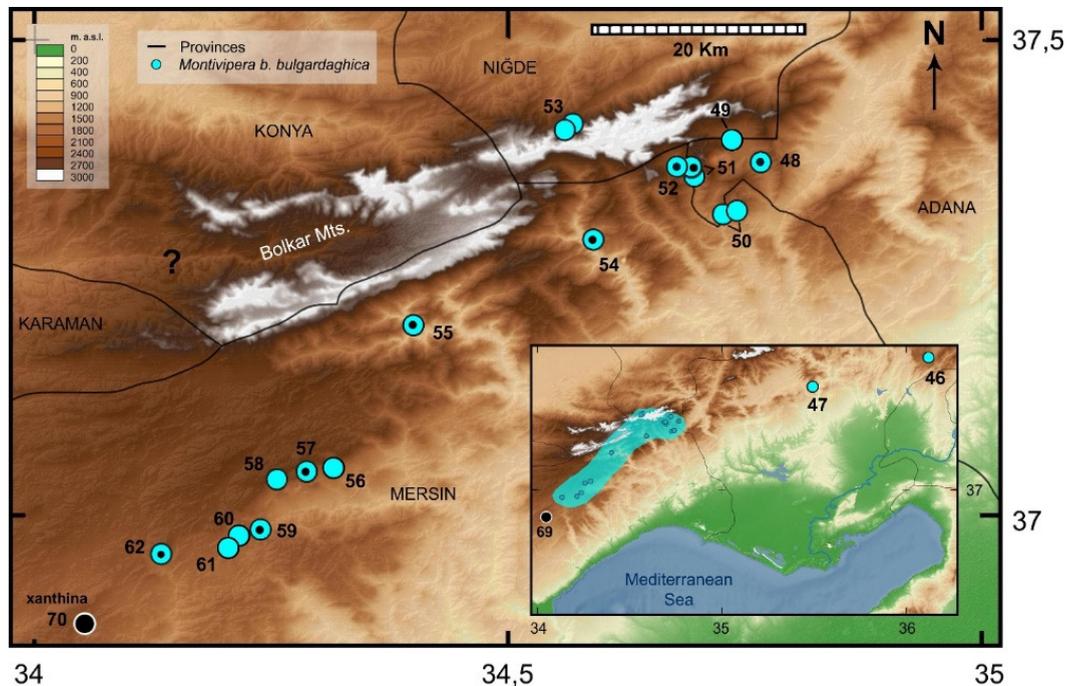


FIGURE 7. Updated distribution of Bolkar Viper (*Montivipera b. bulgardaghica*) in Turkey. Inset map repeats the same sites overlaid by a light blue shading but enlarged to show the two eastern-most sites (localities-46 and -47, see vouchers in Fig. 8). Numbers refer to the Locality List in the Supplemental Information. Samples used for genetic analysis are indicated with a black center. Question marks indicate areas where further *Montivipera* populations are expected but require confirmation. A newly discovered Ottoman Viper (*M. xanthina* (black dot-70) near *bulgardaghica*-locality-62 indicates a potential contact zone between them. An enlarged version of this map is in Supplemental Information.

(e.g., Kar Boğaz Valley in Fig. 8, from localities-50–52, and Göller in Adana, locality-46), to wet riparian habitats (e.g., Ovacık/Sivas locality-25, Supplemental Information Fig. S9), dry steppe-like stony hills (e.g., Otluca/Ağrı locality-5 and Dolabaş/Muş locality-7 and Supplemental Information Figs. S2 and S3), treeless rocky mountain summits (e.g., Bozdağ Tepesi/Hatay locality-43 and Mt. Nemrut/Adiyaman locality-45, Fig. 6), agricultural fields at about 1,000 m elevation (Bostanlı/Kahramanmaraş locality-41, Supplemental Information Fig. S11), and hilly-rocky high elevation plateaus around 1,800–2,200 m elevation (e.g., Karakuyu/Sivas locality-36, Yılanhöyük locality-31, Masman Basi/Erzincan locality-21, Hisarlık Plateau/Konya locality-78, Mağara-Kirobasi/Mersin locality-72, Supplemental Information Fig. S17). In particular, the extensive bush and grassland on flat, rocky plateaus are rarely listed as habitat for *Montivipera* spp. in surveys and the general literature (see example in Supplemental Information Fig. S4). Yet, these plateaus are common and extensive in eastern Anatolia and likely constitute a largely neglected habitat for mountain viper surveys with the potential for many overlooked populations. Hence, lack of finding vipers results from insufficient field exploration and coordination with good weather conditions for surface activities of these generally secretive snakes, particularly those living in semi-arid climates across most of inner Anatolia. In only seven

years, we tried to compensate for those insufficiencies by systematically optimizing field and desk work, including networking, with a pioneering focus on new regions and addressing all available sources of recent locality data on vipers. This resulted in a rapid accumulation of distribution knowledge for some mountain vipers (other Turkish viper taxa show a similar trend and are currently being analyzed as well). Compared to the range maps published on the IUCN Red List of Threatened Species (IUCN 2019), the Extent of Occurrence for *Montivipera b. bulgardaghica* was enlarged by more than four times (from 1,300 to 6,000 km²), with extensions of about 13 km in western (locality-62, Fig. 7) and 130 km in northeastern (locality-46, Fig. 7) directions from the corresponding IUCN range (see Fig. 11). The distribution area for *Montivipera b. albizona* was enlarged by about eight times (from < 5,000 km² to 38,500 km²; see Fig. 11), with extensions of about 145 km to the south (locality-43, Fig. 5) and 160 km to the east (locality-45, Fig. 5); similarly the extent of occurrence for *M. wagneri* was enlarged about eight times (from 2,500 to 21,000 km²; see Fig. 11), with extensions of about 226 km in southwestern (locality-15, Fig. 2), and 30 km in eastern directions to Günindi, Kars (locality-1, the eastern-most of the *wagneri*-localities shown in Fig. 2), whereas the range of *M. xanthina* was extended by 150 km east (locality-70, Fig. 9) across the vast highland plateau from its nearest previously published record in

Kumlutaş et al. (2004). We can safely assume that these large range extensions will concomitantly increase the total population size of each taxon, even though the many mountain valleys with suitable habitat between the listed localities have not been explored thus far. Yet, with the core of *Montivipera* diversity contained in Anatolia, it remains with the Turkish government to safeguard existing populations and implement any necessary conservation measures against threats from habitat destruction and climate warming (Mebert et al. 2016; Ahmadi et al. 2019).

We anticipate that many viper species of Anatolia will follow a similar path of revelations as was experienced with Orsini's Viper *Vipera ursinii* in France, which once was estimated to consist of six to nine populations with a total of 200–300 animals by the late 1980s (Corbett 1989; Stumpel et al. 1992), but surveys up to 2008 corrected those numbers to 21 populations with a potential carrying capacity of 168,000 vipers (Lyet et al. 2013). Similarly, there has been rapidly increasing distribution knowledge for Karst Viper *Vipera u. macrops* (Jelić et al. 2013) and Greek Meadow Viper, *V. graeca* (Mizsei et al. 2016, 2018). Not unexpectedly, the biogeographic situation of vipers in Anatolia is increasingly resembling other Palearctic vipers occurring in southern Europe, where every mountain/valley has (or had, if the habitat has since become too degraded or lost) its population of vipers, a situation already quite well predicted by Schätti et al. (1991).

The often-cited major threat through illegal collection by Baran and Atatür (1998) or IUCN (2020) appears outdated for Turkey, except for very small and isolated populations that could be quickly overexploited. Yet such specific cases are not known for Turkey. Indeed, neither reports by the Turkish authority, nor recent workshops with our attendance as viper experts at the Viper Specialist Group-IUCN meetings in Greece (2014) and Morocco (2017) revealed any large-scale sampling or smuggling of vipers out of Turkey. Similarly, no illegal snake smuggling aside from single specimens, which itself is biologically irrelevant for the survival of a population and much less that of a species, have been found by a governmental compilation of smuggling cases from 2007–2017 (General Directorate of Nature Conservation and National Parks, Turkey. 2018. Official statistics on the number of biosmuggling cases in Turkey from 2007–2017. Available from <http://www.milliparklar.gov.tr/resmiistatistikleryeni> [Accessed 5 March 2019]), or by a new summary study on biosmuggling in Turkey (Birben and Gençay 2019), inquiries from NGOs, commercial markets, breeders or other scientists, as well as our own experience (Mebert et al. 2016). According to the Convention on Biological Diversity (<https://www.cbd.int>), however, in which Turkey participates, countries have the right to their biological diversity and should control the access

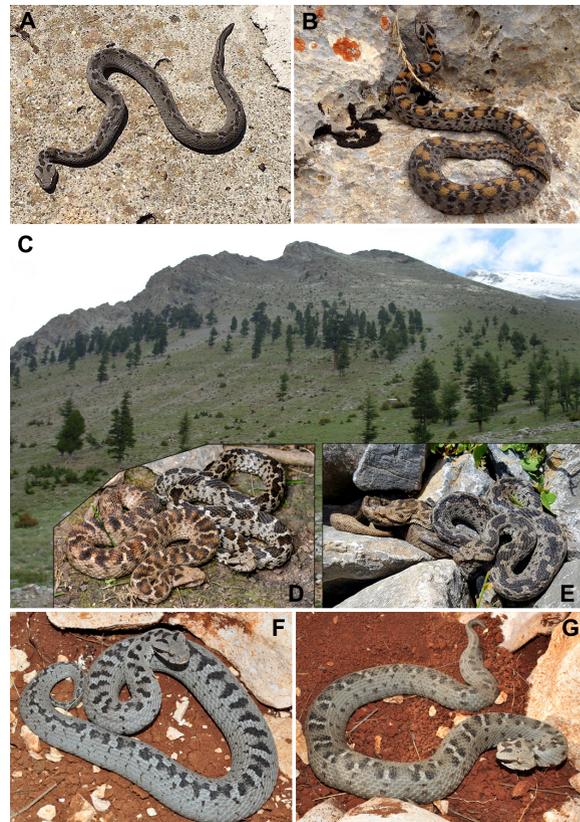


FIGURE 8. Distribution updates of the Bolkar Viper (*Montivipera b. bulgardaghica*) in Turkey. (A) locality-46, Göller Yaylasi, district Kozan/Adana (Photographed by Şensu Küçükates); (B) locality-47, Kizildam, district Aladağ/Adana, specimen with a color pattern more typical for *albizona* (Photographed by Karim Amri); (C) locality-51, Kar Boğaz Valley, district Pozanti/Adana (Photographed by Mehmet Zülfü Yıldız); (D) male and female vipers (Photographed by Bayram Göçmen); (E) male and female vipers from nearby locality-50 (Photographed by Fabien Bettex); (F) male and (G) female vipers from western-most locality-62, Ünlük Tepesi, Gavuruçtuğu, district Erdemli/Mersin (Photographed by Mert Kariş).

to their biological resources to secure sustainable use. Precautions against bio-smuggling is important in this context even for single specimens. Although a variety of viper species were exported from Turkey in the past without permission, and illegal collection has been cited as a threat issue for all four *Montivipera* taxa treated herein (see respective files in IUCN 2020), this activity has significantly reduced in the past 20 y. This has been due to regulations and governmental projects on this subject and the increasing risk of illegally exporting bio-goods out of Turkey, and also due to the saturation of the pet market with captive-bred specimens. Fortunately, today, anyone from Turkey or abroad can conduct studies after receiving appropriate and collaborative permits from the governmental bodies.

Another aspect that grew out of the non-representative fear about illegal collecting relates to non-academic herpetologists and naturalists that post their new viper

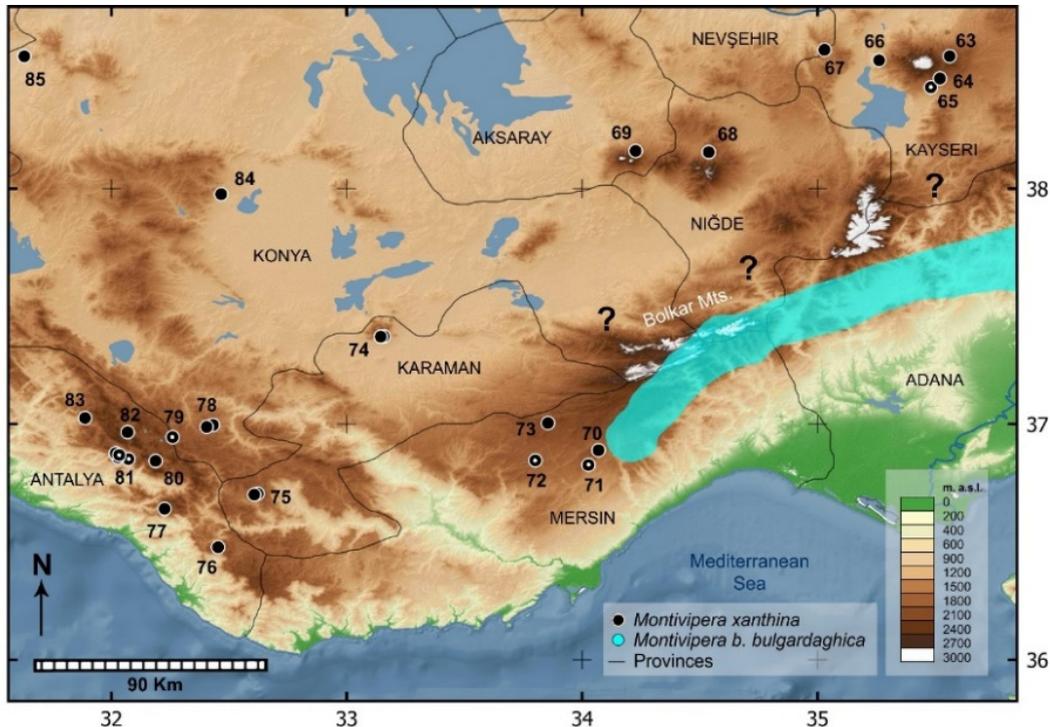


FIGURE 9. Southeastern distribution of Ottoman Vipers (*Montivipera xanthina*) in Turkey. Numbers refer to the Locality List in the Supplemental Information. The corresponding International Union for Conservation of Nature (IUCN) map also includes an area for *M. xanthina* near where Adana, Niğde and Kayseri provinces meet. Because none of the literature in the IUCN assessment (IUCN 2020) includes such a reference, we presume that area may represent district Ulukışla/Niğde and relates to the listing of *M. xanthina* for Bolkar Dağı Ulukışla in Başoğlu and Baran (1980), which later was described as *M. bulgardaghica* (Nilson and Andren 1985). Samples used for genetic analysis are indicated with a white center dot and are either listed in Table S1 (Supplemental Information), except for locality-65 from south Ercyies Mt., Develi/Konya, which refers to an albumin analysis by Göçmen et al. (2009). Question marks indicate areas where further *Montivipera* populations are expected but require confirmation of taxon allocation. An enlarged version of this map is in Supplemental Information

findings on social media. We have contacted most authors of such posts, yet a few were still unwilling to share their locality information to prevent population-damaging sampling. Such fear, however, is not realistic based on the extensive habitat and distribution that vipers occupy in Turkey today, as we demonstrate in this paper. On the contrary, locality data could be more usefully applied to conservation needs by assessing the extent of occurrence, habitat constituents, population sizes and immediate local threats to certain species that otherwise may risk extinctions of entire populations with 100s to several 1,000s of specimens. It was recently concluded that the most prevalent threats facing more than 8,000 threatened or near-threatened species on the IUCN Red List of Threatened Species (IUCN 2020) are agriculture and overexploitation (Maxwell et al. 2016; Grooten and Almond 2018). Habitat degradation through agriculture, but also through overgrazing, urban sprawl, and plantations poses massive structural landscape changes with often severe negative effects on susceptible terrestrial species such as vipers. Substantive information on the conservation status of a threatened species, such as range, population size, and

its ecological context, will depend on comprehensive local data to better promote its survival in the future.

Concerning conservation aspects, we strongly argue that there are stronger and more realistic threats to viper populations than illegal collection for the international pet trade. The principal threats for Anatolian mountain vipers are likely posed by wide-scale habitat degradation and destruction, mainly through overgrazing by domestic livestock (goats, sheep, cattle), agriculture and plantations, suburban sprawl, and valley flooding through dam construction (Ettling et al. 2015; Maxwell et al. 2016; Mizsei et al. 2016; Çiçek et al. 2018; Grooten and Almond 2018). In particular, Palearctic steppes have become one of the most endangered terrestrial biomes of the world through high rates of conversion and widespread degradation (Török et al. 2016). In Turkey alone, more than 44% of the natural steppe and steppe forest area has been lost due to conversion to cropland, afforestation, and overgrazing, putting Anatolian mountain vipers that depend on rocky montane grassland under increased conservation risk (Ambarlı et al. 2016; Wesche et al. 2016; Mebert et al. 2016). Because livestock changes

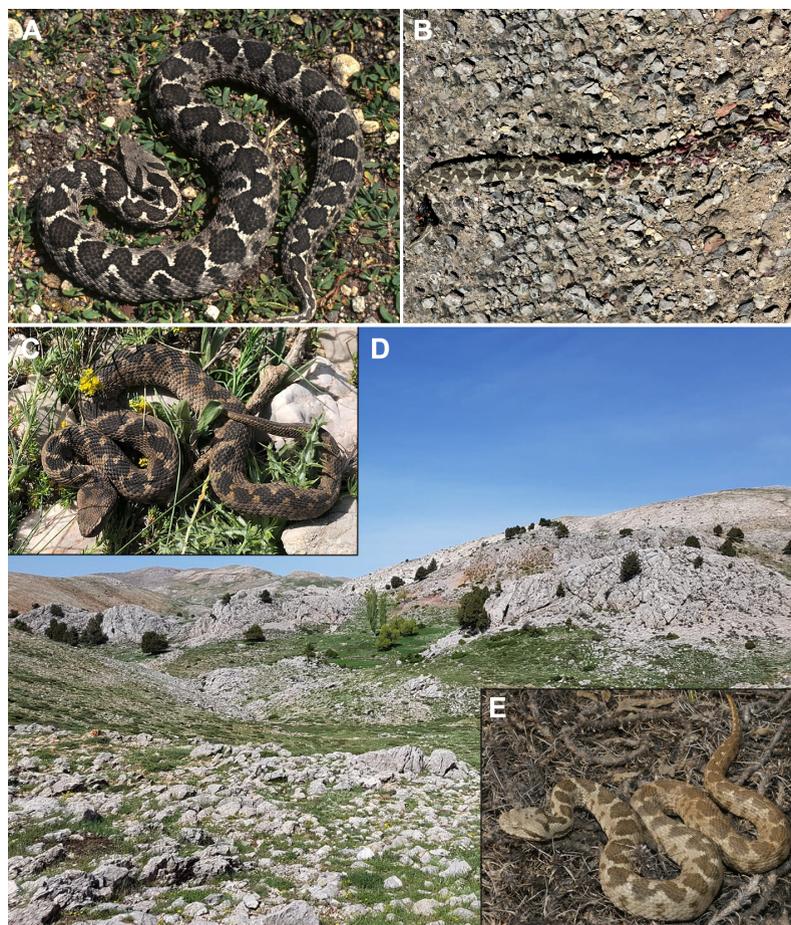


FIGURE 10. Updated distribution of Ottoman Vipers (*Montivipera xanthina*) from its southeastern range borders in Turkey. (A) Individual from locality-66, west of Erciyes Mt., Subaşı, district Incesu/Kayseri (Photographed by Johan Nylander); (B) Viper from locality-68, Azatli Dam, Çiflik/Niğde (Photographed by Mert Karış); (C) and (D) locality-70, *M. xanthina* and habitat, northwest Kuşluca (Toros), district Erdemli/Mersin (Photographed by Fabien Bettex); (E) Viper from locality-71, northwest Akpınar, district Erdemli/Mersin (Photographed by Konrad Mebert).

vegetation structure and cover in ways important to small mammals, community-level total abundance of small mammals typically declines with grazing (Schielz and Rubenstein 2016), which in turn negatively affects the food base of snakes. Similarly, Rotem et al. (2016) found that reptile diversity decreased with grazing at arid sites. To maintain viper diversity in Turkey, as well as most other fauna and flora, it is necessary to consider those threats and publicly address them in the future.

Taxa delimitation.—Because the IUCN Red List assesses threat levels primarily at the species level (IUCN 2020), delimitation of species becomes relevant; however, insufficient geographic data often hampers the biologically meaningful categorization of taxa into species, subspecies, or local populations. This partly applies also to *Montivipera* species for which traditional species classification has been the standard in the IUCN Red List. This standard is increasingly challenged by means of expanding geographic sampling and delimiting species using molecular methods. In

the most recent study, Stümpel et al. (2016) assessed roughly a low 2–3% sequence divergence of three mt-genes (CYTB, COX1, ND5) among *Montivipera wagneri*, *M. b. bulgardaghica*, and *M. b. albizona*, a situation asking for systematic re-evaluations in the future (Freitas et al. 2020). Comparatively, a new study on the Transcaucasian Ratsnake, *Zamenis hohenackeri*, largely sympatric with our *Montivipera* spp. herein, showed a broad intergradation zone (gene flow) between subspecies that diverged at around 5% *cyt b* (Hofmann et al. 2018), higher than in aforementioned *Montivipera* taxa. Bradley and Baker (2001) suggested that *cyt b* divergence by < 2% between small mammal taxa is indicative of subspecies level, whereas divergence from 2%–11% requires more methodological evaluation (morphological, genetic, ecological, etc.), and divergence of > 11% can be considered a species. Even though one may expect that snake genera delimit by different levels of *cyt b* divergence and might not be comparable to small mammals, various studies that include closely related snake species in sympatry, where species integrity is

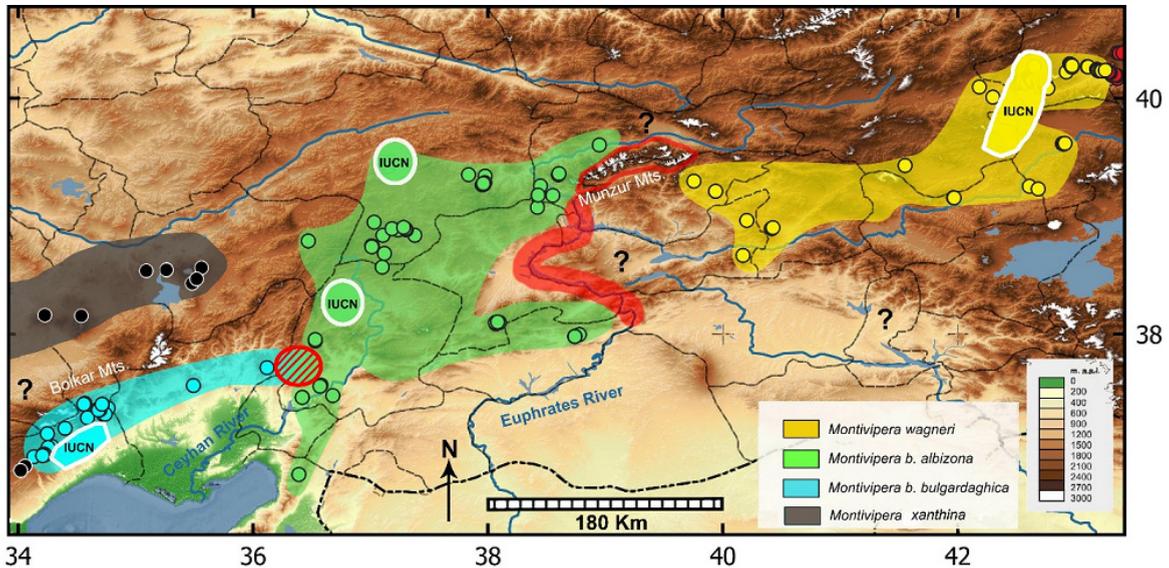


FIGURE 11. Updated distribution of mountain vipers in south-central to north-eastern Anatolia, Turkey, with known localities as colored circles on top of same color shaded areas representing their interpolated ranges: dark grey Ottoman Viper (*Montivipera xanthina*), light blue Bolkar Viper (*M. b. bulgardaghica*), green Albizona Viper (*M. b. albizona*), yellow Wagner's Viper (*M. wagneri*). For the latter three taxa, the smaller, white-bordered, and color-saturated polygons represent the approximate and much smaller distribution maps as depicted in the respective files of the International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN 2020). The red transparent band over the Euphrates River leading north to a red-bordered area encircling the Munzur-Mercan Mountains indicates the prominent landscape feature separating most proximate populations between *M. b. albizona* and *M. wagneri* or may represent their potential contact zone. Similarly, the red-hatched circle near the Ceyhan River reflects a potential contact or transition zone between the subspecies of *M. b. bulgardaghica* and *M. b. albizona*. Question marks indicate areas where additional *Montivipera* populations are expected but require confirmation. An enlarged version of the map is placed in Supplemental Information.

naturally tested (Harrison 1993), show *cyt b* divergence at an equivalent magnitude and range. For example, the Southern and Northern watersnakes (*Nerodia fasciata* and *N. sipedon*, respectively), diverge by 9% *cyt b*, but produce very wide hybrid zones (20–100 km) that align (are constrained) along environmental factors (Mebert 2008, 2010); Western and Eastern grass snakes (*Natrix helvetica* and *N. natrix*, respectively), differ by 6.9% with limited unidirectional nuclear gene flow across a narrow contact zone between taxa (Kindler et al. 2017); a divergence of 5.2% exists between partly sympatric Mexican and Checkered gartersnakes (*Thamnophis eques* and *T. marciannus*, respectively), or 5.5% between Western Aquatic and Coast gartersnakes (*T. couchii* and *T. elegans*, respectively; de Queiroz and Lawson 1994); and sympatric North American brown snakes (*Storeria* spp.) differ by 8% (Alfaro and Arnold 2001). Within the Anatolian mountain vipers, a 9% difference separates *Montivipera wagneri* and *M. raddei* with no sign of introgression along a sharp parapatry line, consisting of a 5–10 m wide shallow stream separating them north of Kağızman, Turkey (Mebert et al. 2016; Stümpel et al. 2016).

In contrast, taxa with incomplete speciation and/or hybridization tend to show levels of *cyt b* divergence < 5%, such as indicated by the complete fusion of ratsnake lineages in southern Canada, classified as species

by Burbrink et al. (2000) that differ by 3.5% and are regarded as conspecific (Gibbs et al. 2006), or the Plains and Butler's gartersnakes (*Thamnophis radix* and *T. butleri*, respectively), that differ in Wisconsin by < 1% (de Queiroz and Lawson 1994; Alfaro and Arnold 2001) or < 2% in the more variable ND4 (Placyk et al. 2012), likely as a result of ancient and long-standing mtDNA-introgression reflecting incomplete speciation (Placyk et al. 2012; McVay et al. 2015).

In Palearctic vipers, there are currently several recognized species with < 5% *cyt b* divergence, yet they all relate to allopatric populations or taxa for which no natural test (i.e., integrity in sympatry) is available, thus, they may as well represent temporarily isolated and locally variable subspecies, e.g., Armenian Steppe Viper *Vipera eriwanensis*, Iranian Steppe Viper (*V. ebneri*), Baran's Viper (*V. barani*), Dinnik's Viper (*V. dinniki*), Lotiev's Viper (*V. lotievi*), or some of the *Montivipera* indicated in the text (Freitas et al. 2020). Hence, one needs to compile more data from different lines of evidence (integrative approach) to show that there is a coherent pattern of distinct morphology, genetics, and geographic structure. Adequate sampling is the basis to compensate for the lack of required information with proximate populations or even contact zones between two taxa investigated for free gene flow today or in the past by molecular means (Mebert 2008, 2010;

Hillis 2019). We strive to improve our knowledge in locating these contact zones or proximate populations by molecular means, and if otherwise not possible, by consensus of color pattern variation.

Because some frequent color pattern variations between *Montivipera b. albizona* and *M. wagneri* are quite similar, taxon-allocation based on photographs of specimens from proximate populations between them presents some challenges. This convergence in color pattern might be the result of similar environmental pressure or gene flow in the past (Rajabizadeh et al. 2015), but with the knowledge that there is generally no large sympatry between two *Montivipera* taxa (Stümpel et al. 2016) save some narrow contact zones (Mebert et al. 2016), we can at least approach the delimitations or current separation between these *Montivipera* taxa based on consensus in color pattern. Indeed, there are two prominent topographic features producing a large (up to 100 km) longitudinal gap with vast stretches of unsuitable or qualitatively reduced habitat, potentially separating the ranges of the two mountain viper taxa: the huge Munzur-Mercan mountain ranges with a nearly 100 km stretch of > 2,700 m elevation along the border between the provinces Erzincan and Tunceli and the mighty Euphrates River with a hot-dry landscape of flat terrain or fine-sedimented hills and mountains < 1,000 m elevation reaching far inland from the river along the border of Malatya and Elazığ provinces. This unsuitable area is bordered in the south by the Malatya Mountain range west of the Euphrates and includes locality-45 (*Montivipera b. albizona*) in Adiyaman Province. From the eastern side of the Euphrates in southern Elazığ (Hazar Mountains) and Diyarbakir (Maden Mountains) provinces, we received credible, local reports of mountain vipers with yellow dorsal blotches resembling Wagner's Viper. These mountain ranges on both sides of the Euphrates likely constitute the southern border for regional mountain vipers, as a flatter and lower arid landscape continues from there southwards towards Syria.

In respect to the Munzur Mountains, our current information assigns all specimens without genetic data from the western end of these mountains, Erzincan Province, to *M. b. albizona*, and predict their presence in the northwestern corner of Tunceli Province, with only 25 km continuous habitat from nearby *albizona* populations in Kabataş/Erzincan (localities-17 and -18), but additional *albizona* vouchers have been confirmed with genetic samples from nearby Erzincan and Sivas localities (e.g., localities-20 and -23, Supplemental Information Table S1). Regarding the occurrence of *M. b. albizona* north of the Munzur Mountains, however, only one shed skin of *M. b. albizona* has been reported (locality-16; Mulder 1995). The nearest populations of *M. wagneri* are found in the eastern part of Tunceli

Province (photo voucher of Hengirvan, locality-15, and new specimen/molecular vouchers from 18 km distant Tahkini Yaylasi, locality-14, Fig. 4, Supplemental Information Table S1). These *M. wagneri* show virtually no *cyt b* genetic divergence (0–2 mutations over 700bp) to *M. wagneri* from 250 km farther east in Aras Valley, Kars Province, whereas there are 13–15 mutations to the currently nearest *M. b. albizona* 128 km farther west at Sandik, locality-20. The distance would be reduced to 78 km taking untested records between Hengirvan and Ziyaret Tepesi, respectively, localities-15–16. It becomes evident that the southern slopes and valleys of the Munzur Mountains need to be evaluated for a potential contact and/or transition zone between these two *Montivipera* taxa.

Whereas the Munzur Mountains might act as a potential topographic obstacle for exchange between northern populations of *Montivipera b. albizona* and *M. wagneri*, the Euphrates River is a potential barrier between these vipers farther south. The Euphrates River already flows through the Munzur Mountains in Erzincan Province where it is remarkably narrow and flanked by a steep valley, though only the Blunt-nosed Viper (*Macrovipera lebetina*) is known from its hot and dry riparian area < 1,500 m elevation (unpubl. data). Similarly, large portions of semi-arid southern and central Tunceli Province including mountains up to 2,000 m elevation appear void of *Montivipera* spp., but are inhabited by *Macrovipera lebetina* according to an experienced national park ranger with more than 30 y of province-wide service (Murat Özel, pers. comm.).

Farther south in Elazığ and Malatya provinces, the Euphrates River system widens substantially. Beginning at the northern end of the massive Keban Reservoir Lake (flooded Euphrates Valley and tributaries), the Euphrates River is flanked by alluvial plains with fine sediments on plateaus and gentle hills mostly < 1,100 m elevation, and leaving some rocky habitats in lower, drier, and warmer climate (Barry 2008), a semi-arid landscape that is less suitable for *M. wagneri* and *M. b. albizona*, but rather preferred by the larger *Macrovipera lebetina*, a potential competitor (Schätti et al. 1991). This remains speculative, however, without further field investigations and local data, and as the recently discovered contact zone between *M. wagneri* and *M. raddei* exemplified, such taxon divisions do not need to be accompanied by major landscape features (Mebert et al. 2015a, 2016). Nonetheless, there are two regions alongside the southern Euphrates River that potentially provide conditions suitable for *Montivipera* populations: between Keban and the Karakaya Reservoir Lake (40 km river course), and the outflow of this reservoir lake and the northern end of the huge Bayat-Atatürk Reservoir Lake, where the Euphrates River meanders through the eastern portion of the Malatya and Adiyaman Mountain

ranges flanked by steeper slopes and mountains > 1,000 m elevation, (e.g., see photographic vouchers from localities-22 and -45 in Fig. 8 and Supplemental Information Figs. S8, 13). These regions along the Euphrates River and the adjacent southern versant of the Munzur Mountains possibly constitute a non-continuous, first contact zone between *Montivipera* taxa. Indeed, preliminary *cyt b* analysis (750bp) shows that northern *M. b. albizona* from Sivas and Erzincan provinces show less genetic distance to populations 150–250 km farther south than to *M. wagneri* 130 km east across Euphrates (Supplemental Information Table S1).

A second contact may exist between *M. b. bulgardaghica* and *M. b. albizona* in Adana Province, previously thought to be separated by ca. 160 km between locality-48 at Elmali Bogazi (*bulgardaghica*) and locality-40 at Başkonuş Plateau (*albizona*). The contact zone is provisionally placed between the *bulgardaghica*-like specimen from Göller/Adana (locality-46 and Fig. 8A) and the more *albizona*-like specimens from about 38 km farther east at Başkonuş Plateau and Bostanlı, Kahramanmaraş Province (localities-40 and -41, Supplemental Information Figs. S7G, S10, S11). This contact region has a low elevation, and thus less suitable habitat leading to reduced gene flow, of mostly < 1,000 m (red-hatched circle in Fig. 11), and begins at the city of Osmaniye in the south, forming a western border along Keşiş River north to Kadırlı-Kesiksuyu Reservoir-Çağlayan Deresi-Çiçeklidere-Bağdaş Yaylasi (Y. = plateau) and Savrun Çayı (Ç. = river), and shows an eastern border with a line following Osmaniye-Aslantaş Reservoir Lake-Andirin-Köprüağzi Deresi. A high mountain, Ağaca Dağ at about 2,200 m elevation, borders this relatively lower region near the junction of the provinces Kayseri, Adana, Kahramanmaraş, and Osmaniye. The color pattern in south-eastern *Montivipera* populations from Kahramanmaraş and Adiyaman provinces show extreme variation, however, with large- to small-blotched specimens, with spotted to vertical-lined flanks, with round to rectangular blotches, often losing the light colored center posteriorly and with irregularly-formed borders reminiscent of *bulgardaghica* (Fig. 6 and Supplemental Information Figs. S10–S13). This large color pattern variation in the potential contact zone possibly reflect an intergradation between *M. b. bulgardaghica* and *M. b. albizona*, as it can be expected between these two conspecific clades (Stümpel et al. 2016); thus, the geographic transition might be much larger and gradual between these taxa. This is supported by an increasing genetic divergence by distance. For example, beginning with typical *M. b. bulgardaghica* at Kar Boğaz/Adana (locality-48), there are five mutations across 150 km east to *M. b. albizona* at Bostanlı/Kahramanmaraş (locality-41), but eight mutations across 360 km east to *M. b. albizona* at

Adiyaman (locality-45). Yet, many more samples from the entire region are required to elucidate the genetic character of any contact or transition zone.

New information points to a third contact zone that exists between *Montivipera xanthina* and *M. bulgardaghica* in Erdemli district, Mersin Province. Previously published data showed a shortest distance of 150 km between these mountain vipers species, i.e. between type locality-53 of *bulgardaghica* (Nilson and Andren 1985) at Bolkar Dağı, border Niğde-Mersin provinces, to the *xanthina*-locality-63 at Erciyes Mountain, Kayseri Province (Nilson et al. 1988). A consensus of *cyt b* data (Supplemental Information Table S1) and/or color pattern reduces the distance between the western-most *M. b. bulgardaghica* at Gavuruçtuğu (locality-62) to *M. xanthina* near Akpınar to 16 km (locality-71, Fig. 10E) and 11 km near Kuşluca (only *xanthina* color pattern, locality-70, Fig. 10C, D). The habitat between these localities consists of continuous rock formation along high-elevation plateaus and southern versants of the Bolkar Mountains with two north-south valleys passing through Toros and Sungur at primarily > 1,400 m elevation, that may represent the contact zone.

In summary, the distances between the distribution areas of the different *Montivipera* taxa discussed herein have been reduced dramatically: between *Montivipera wagneri* and *M. b. albizona* from 280 km down to 78 km; between *M. b. albizona* and *M. b. bulgardaghica* from 160 km down to 38 km and for *M. b. bulgardaghica* and *M. xanthina* from about 150 km down to 11 km. Yet, for all the suggested contact zones or region of proximate populations, vouchers are missing to pinpoint precise areas of species delimitation or contact zones between these clades. Hence, much sampling, in particular for molecular data, is still needed for a fine-scaled phylogeographic analysis of these mountain vipers.

Conclusion.—This study revealed dramatic changes in the distribution of central-eastern Anatolian mountain vipers compared to what was officially perceived for decades by published and governmental information. With many new localities, but also refined-published (improved precision) ones, and increased habitat variation shown in figures and/or described for some localities in Supplemental Information, it becomes obvious that all four *Montivipera* taxa treated herein have not only much greater ranges but also larger population sizes. This updated information will have effects on the conservation statuses and facilitate new and more realistic assessments for the IUCN Red List of Threatened Species (IUCN 2020), including the shift of perceived threats from overcollection to overgrazing.

The results from this paper will help to locate proximate or parapatric populations or even find contact

zones between two *Montivipera* taxa. Consequently, we hope to stimulate new studies to investigate gene flow across species ranges and test for species integrity and relevant environmental correlates that could be incorporated into effective conservation measurements and specific action plans. Finally, we urge the conservation and scientific community to seek collaborative work with Turkish authorities and researchers, raise public awareness and understanding, and thus improve tools for the conservation of these valuable species and their habitat as national treasures.

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SUPPLEMENTAL INFORMATION

MOUNTAIN VIPERS IN CENTRAL-EASTERN TURKEY: HUGE RANGE EXTENSIONS FOR FOUR TAXA RESHAPES DECADES OF MISLEADING PERSPECTIVES

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LOCALITY LIST

In the following, we list most relevant locality data of *Montivipera wagneri*, *M. b. bulgardaghica*, *M. b. albizona*, and *M. xanthina*, but latter only for its far south-eastern range next to other mountain viper taxa. The list includes our hitherto unpublished records, previously published records for which we obtained more precise locality information (mostly coordinates) from authors, and online sources evaluated directly by us and/or by contacting the authors. Coordinates provided to us were assessed based on accompanying information, such as landscape descriptions or suitable surface structures, altitude by placing locality points on Google Earth Pro maps, etc. Hence, such locality information was not always precise, and some may represent an error by several km. However, they yield sufficient information, i.e., constituents of typical habitat characteristics for these vipers, to serve as proxies or surrogate locality for the exact site, and thereby likely yield other members of the same species and population. Furthermore, administrative names and borders for listed localities are based primarily on Google Earth Pro, even though they sometime differ in relation to other digital maps, even Google Maps, and are not always up-to-date due to modifications of names and border positions by the Turkish government in relative recent (20–30 years) times. Slight border differences between our locality information retrieved from Google Earth Pro and locality placement in our digital maps drawn with the software QGIS can exist as well, yet the given locality coordinates remain the same and represent the relevant source.

Recorded localities are listed into one of three categories:

- **New**, if their localities have not been previously published in a journal and usually are at ≥ 1.5 km distant from an already known locality (80% of individual *Montivipera raddei* moved less than 2 km away from hibernations sites during two complete seasons, Ettling et al. 2013). A new locality might be based on a photograph with sufficient quality for a positive identification. The authenticity of such a photograph and the pertinent locality information was usually confirmed by us through contacting the photographer/associate.
- **Corrected** relates to published records that contained erroneous information.
- **Refined** refers to published data for which new information permits a more precise geographic localization and/or other unpublished information were made available, primarily by the original author.

The listings generally follow the format: category, location name, coordinates, n (number of specimens), altitude, date of the finding, source (literature, online, pers. comm., photographer, museum voucher), and remarks. Photo credits are given in the figure legends. Abbreviation for collection vouchers, if not appended in-text, are: ZDEU (Zoology Department, Ege University, Izmir, Turkey), MHNG (Natural History Museum of Geneva, Switzerland), GNM (Goteborg Natural History Museum, Goteborg, Sweden).

Locality names in the list usually refer to the nearest village name, sometimes a mountain or valley name, followed by the names for district/province, which is the Turkish standard format for locality references. Mapcarta.com and peakery.com have been the source of many mountain and hill names given in the respective accounts, whereas locality names were mostly drawn from Google Earth maps. Turkish terms used herein like Dag, Dagi, Daglari means Mountain, Mountains, Massif, and Tepesi means hill or peak. Elevations (or elev.) refer to meters above sea level. Each listing refers to one specimen if not otherwise mentioned by the number term ‘n’. For easy cross-referring with corresponding maps in the primary article, the listings follow approximately from a north-eastern to south-western direction for each taxon. Taxon maps were copied in from the primary article for rapid crossreferencing between listed accounts, depicted specimens and locations on maps, whereas Supplemental Figures (e.g., Fig. S3) are exclusively placed herein.

Wagner’s Viper (*Montivipera wagneri*)

Distribution of the Wagner’s Viper is shown in Fig. 2 (copied in from primary article). The list below begins with localities from its northeastern range limit:

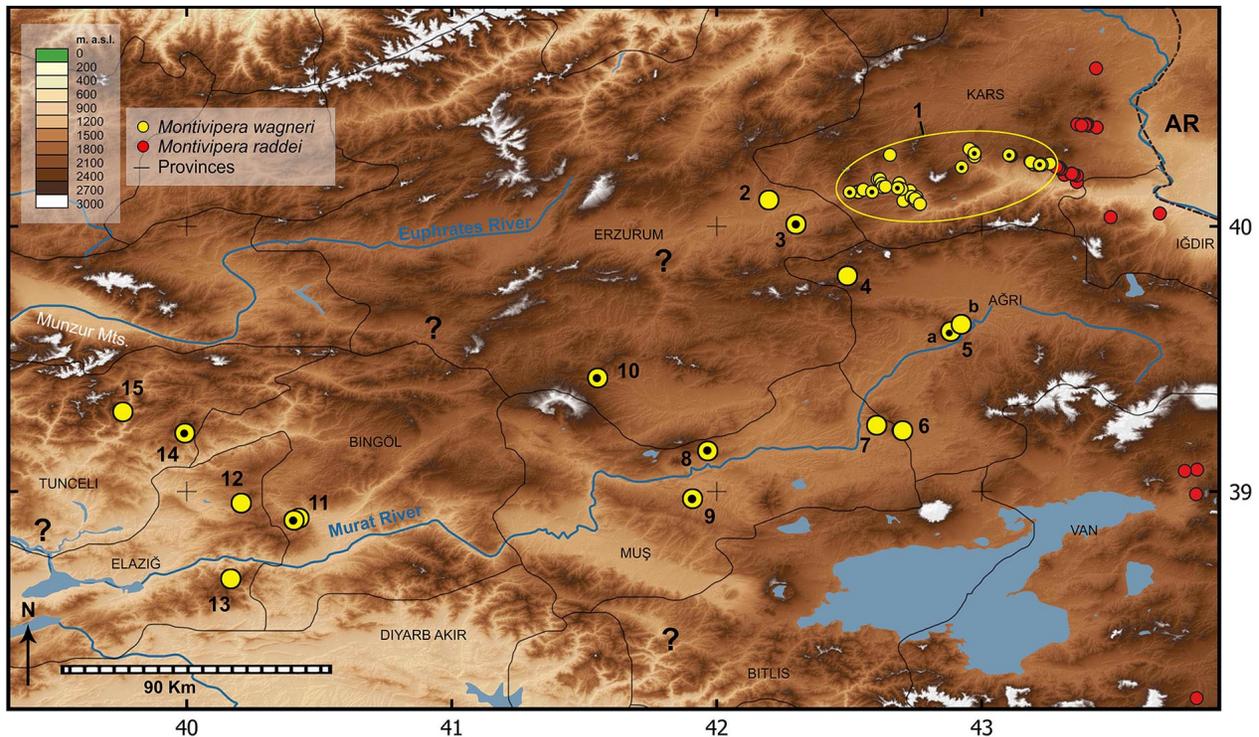
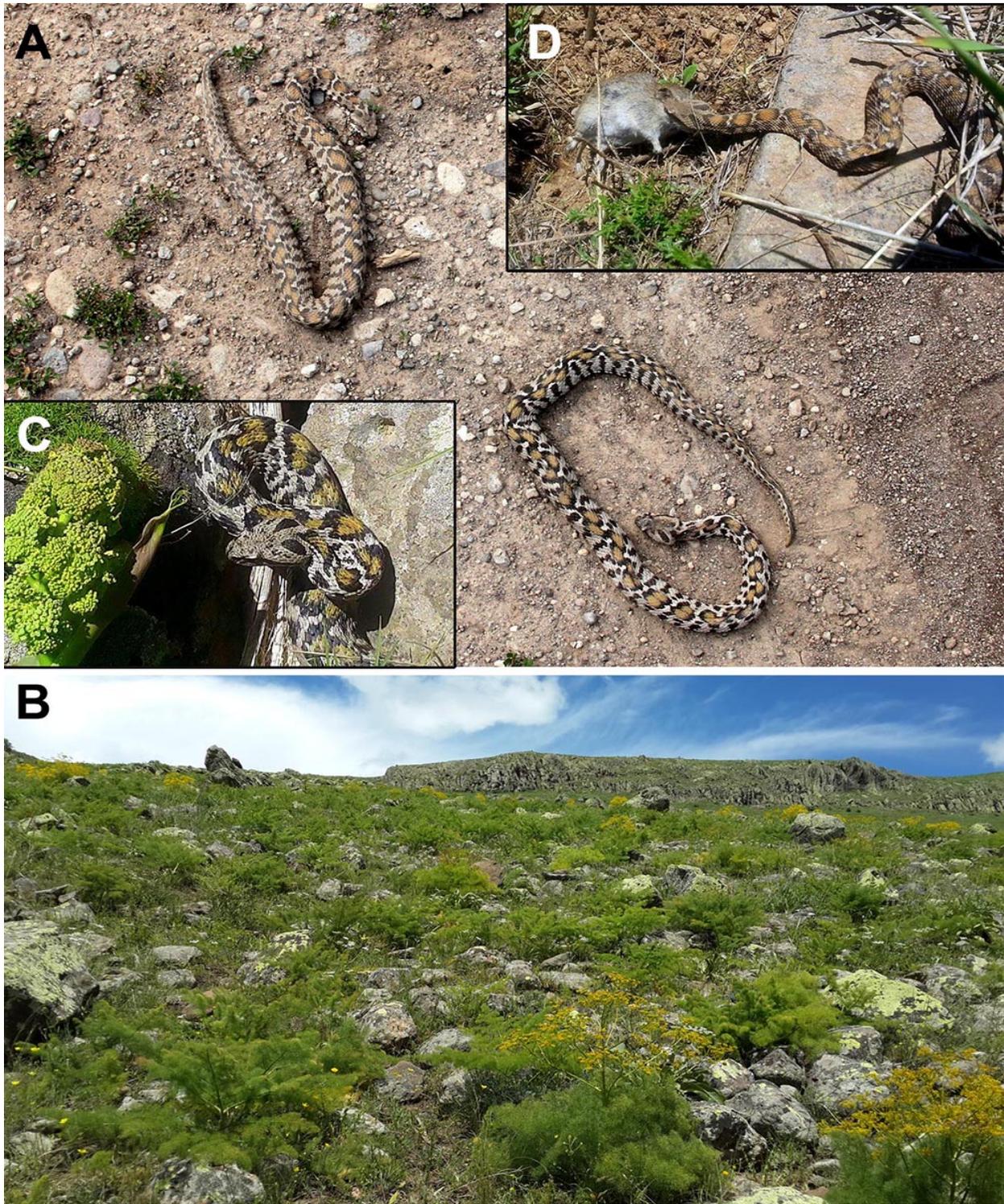


FIGURE 2-inserted from primary article. Updated distribution of Wagner’s Viper (*Montivipera wagneri*) and adjacent locations of Radde’s Viper (*M. raddei*) in Turkey. Numbers refer to the Locality List, but only for *M. wagneri*, as *M. raddei* is not the focus of this study. Several samples used for genetic analysis originate from Aras Valley (circled locality-1) and other single locations that are indicated with a black center. Question marks indicate areas where further *Montivipera* populations are expected but require confirmation.

- 1 **Refined:** The known and published range of *Montivipera wagneri*, shown as a yellow oval in Figure 2, is concentrated in the western Aras River Valley (habitats shown in Supplemental Fig. S1) of north-eastern Turkey with its eastern margin north of Kağızman, where it is replaced by *M. raddei* farther east (Mebert et al. 2015a, 2016; specimen in Fig. 3A of primary article), whereas its range extends in westerly direction outside the valley to Horasan (locality-2). Sequence data are shown in Supplemental Table S1 or labeled as specimens wg3 to wg8 and wg10 to wg16, including nr. 17462, in Stümpel (2012) and Stümpel et al. (2016). Although the range map on the IUCN Red List of Threatened Species (IUCN. 2020. op. cit.) shows a range extending 70 km south of the Aras Valley through far-eastern Erzurum province (ca. 20 km in the longitudinal direction from the eastern provincial border) and similarly into most western Ağrı province (Kaska et al. 2009), no supportive locality information was provided. Up till now, only two concrete localities have been published from outside the proximity of the Aras Valley, referring to records from the provinces Ağrı (Yildiz et al. 2018) and Muş (Göçmen et al. 2014), both relisted below.
- 2 **Refined:** hills in the agricultural landscape 4.5 km southeast of Akçataş, district Horasan/Erzurum, 40°05'43N, 42°11'04E, at 1,718 m elevation, 21 July 2013. Source: Kumlutaş et al. (2015), Yusuf Kumlutaş (pers. comm.), and also photos by Mustafa Sözen on <http://dogalhayat.org/property/cok-ozel/#prettyPhoto>.
- 3 **Refined:** Aras town, district Horasan/Erzurum, 39°59'26N, 42°17'59E, at 1,650 m elevation, 16 May 1989. Source: J. Bergman, also sequence data in Supplemental Table S1 or labeled as specimen wg9 in Stümpel (2012) and Stümpel et al. (2016).
- 4 **Refined:** branch of Güzeldere Gorge (Tahir Mts.), below Sariköy (Sarican, Sarizhan), dstr. Eleskirt/Agri, 39°47'19N, 42°29'08E, at 2,068 m elevation, year 2007. Source: Tuniyev et al. (2014, 2019) Remarks: coordinates placed by us, but reflecting all four points mentioned in respective publications: 1) branch of Güzeldere Gorge, below village Sarizhan (= Sariköy, Sarican), 3) upper Murat River Basin, 4) boundary of Caucasus Ecoregion.
- 5 **Refined+New:**
- Refined:** approximately 2.9 km northeast of Otluca, district Tutak/Ağrı, 39°36'47N, 42°53'46E, n = 4 within 400 m from coordinates, between 1,847–1,873 m elevation, 29 May 2014 (Fig. 3B of primary article, habitat in Supplemental Fig. S2B). Source: Naşit İğci, Mehmet Zülfü Yıldız, and Yıldız et al. (2018). Remarks: two of these specimens were killed by locals (Supplemental Fig. S2A).
 - New:** 3.3 km southwest of Ceylanlı, district Hamur/Ağrı, 39°37'01N, 42°54'58E, n = 6, around 1,989 m elevation, 12 May 2017 and 04 June 2017 (Supplemental Fig. S2C, D). Source: photos taken and provided by Garip Çağirci.
- 6 **Refined:** Koçaklar, district Patnos/Ağrı, 39°13'50N, 42°41'07E, at 1,895 m elevation, 28 May 2014. Source: Naşit İğci, Mehmet Zülfü Yıldız, and Yıldız et al. (2018). Remarks: based on credible local reports and photo-ID questionnaire, ca. 7 km east from nearby locality-7 in Muş province with continuous habitat between localities-6 and -7 (Göçmen et al. 2014).
- 7 **Refined:** Dolabaş, district Malazgirt/Muş, 39°15'11N, 42°36'37E, at 2,146 m elevation, 18 May 2013 (Supplemental Fig. S3). Source: Bayram Göçmen, Bahadır Akman, Naşit İğci, Mehmet Anil Oğuz, voucher ZMADYU 2013/81 (Zoology Museum of Adıyaman University Turkey) and Göçmen et al. (2014).
- 8 **New:** ca. 2 km southwest of Akçakaynak, district Bulanık/Muş, 39°09'17N, 41°58'01E, n = 5, between 1,972–2,043 m elevation, 15 June 2017 (Fig. 3C of primary article). Source: Konrad



SUPPLEMENTAL FIGURE S1. Typical habitats of Wagner’s Viper (*Montivipera wagneri*) in the Aras Valley, locality-1. A) small to large rock slides below cliffs, near Karabağ, district Kağızman/Kars; B) alpine meadows strewn with rocks near Karakurt, district Sarikamiş/Kars. These habitats occur extensively with little interruptions over > 100 km along slopes of the Aras-Kötek Valley from Günindi/Kars in the east to the province border with Erzurum, providing a massive biotope, even when not counting the many side valleys of Aras Valley with more suitable habitats. (Photographs by Konrad Mebert).



SUPPLEMENTAL FIGURE S2. Wagner's Viper (*Montivipera wagneri*) in the Kiliç Dağları (= Mountains), central Ağrı province. A) locality-5a, two Wagner's Viper killed by locals northeast of Otluca, district Tutak/Ağrı; B) habitat of locality-5a, ca. 1 km west of the killed vipers depicted in A); patches of such viper habitat, including rock fields, plateaus and cliffs, occur regularly across the entire mountainous landscape as far as ca. 70 km south into district Patnos/Ağrı, and into adjacent provinces Van and Muş; C) and D) two specimens from locality-5b, south of Ceylanlı, district Hamur/Ağrı, ca. 2 km east of killed specimens in A). (Photographed by photo by Naşit İğci [A and B,], by Garip Çağirci [C and D]).



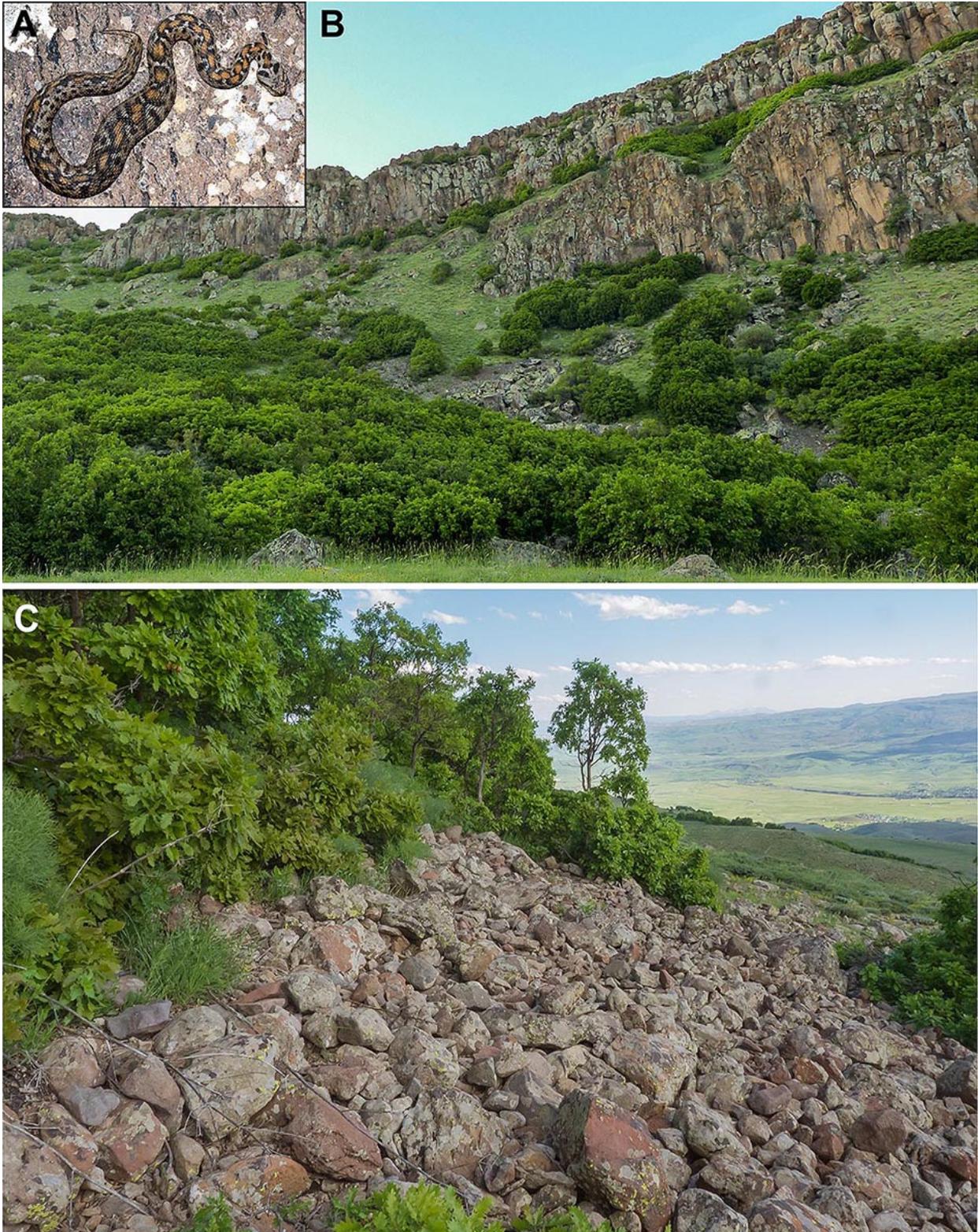
SUPPLEMENTAL FIGURE S3. Wagner's Viper (*Montivipera wagneri*) Dolabaş, district Malazgirt/Muş. A) locality-7, female; B) locality-7, montane steppe above 2,100 m elevation. (Photographed by Bayram Göçmen [A], by Naşit İğci [B]).

Mebert, Mert Kariş, Naşit İğci, Mehmet Anil Oğuz. Remarks: According Mehmet Akif Bozkurt (pers. comm.), locals from Akçakaynak confirmed this viper to be common in the small canyons near the village (39°10'10N, 41°58'08E, at 1,950 m elevation) which are adjoined by rock slides/piles and oak trees across the meadow south of the village up to locality-8.

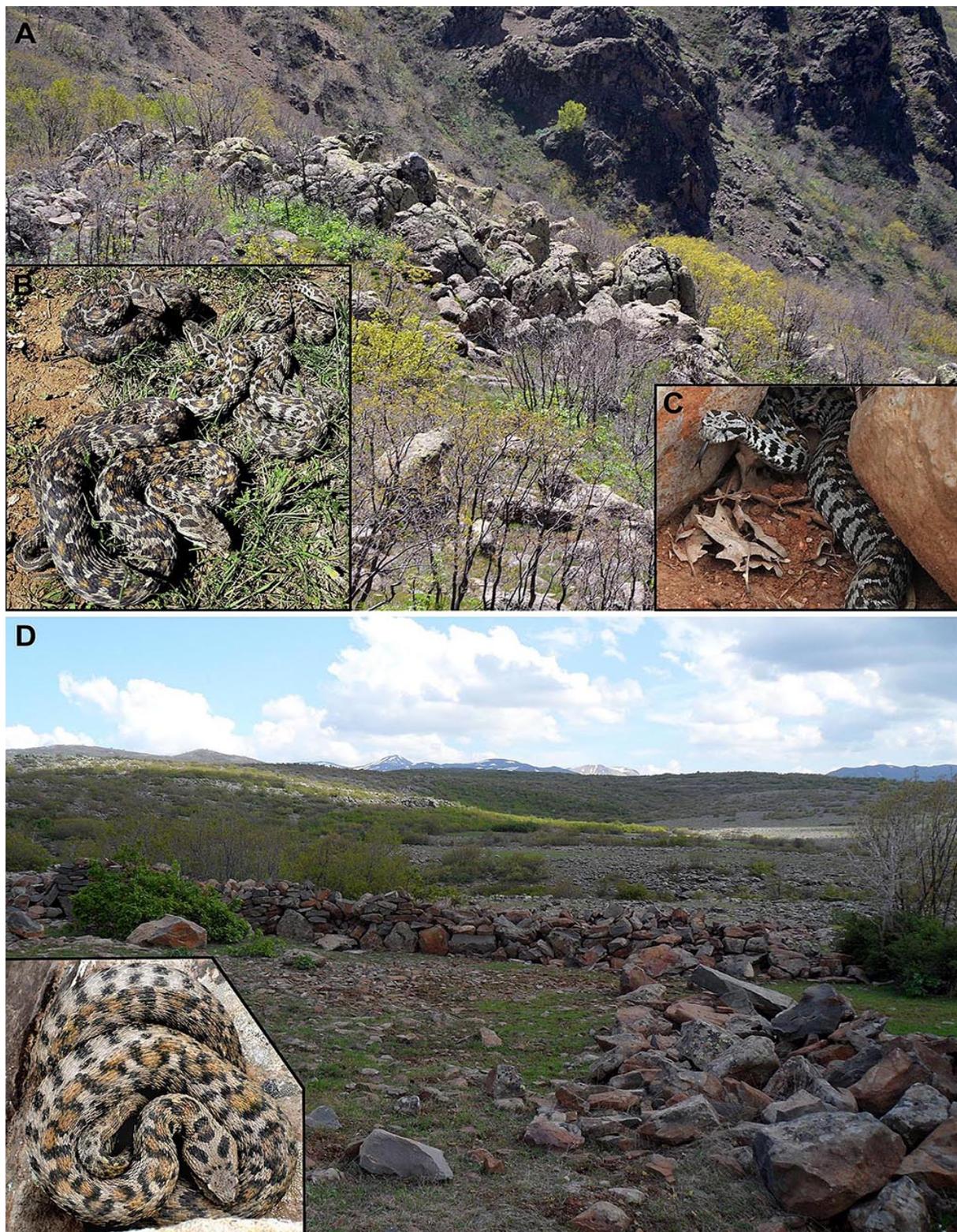
- 9 **New:** Çatakli, district Bulanik/Muş, 38°58'13N, 41°55'13E, at 1,628 m elev., 28 September 2019. Source: Konrad Mebert, Mert Elverici, Burak Akdağ. Remarks: this site together with locality-8 represents the second region for *M. wagneri* in the province Muş. It begins at a distance of max. 56 km (or 35 km acc. to multiple anecdotal information around Bilincan Mountain, south of Bulanik) west of the Dolabaş record (locality-7). Large stretches with patches of the same habitat and potentially dense populations of mountain vipers extend from locality-8 at least 40 km (or 65 km from Bilincan Mountain) westward on both sides along the Murat River, inc. riparian rock ledges, large grassy plains with stone piles, on rocky montane plateaus and slopes up to 10 km inland from the river (Supplemental Fig. S4).
- 10 **New:** Ilica, district Hınıs/Erzurum, 39°25'46N, 41°33'07E, n = 2, at 1,960 m elevation, 13 June 2017 (Supplemental Fig. S5A, B, and related habitat in C). Source: Konrad Mebert, Mert Kariş, Naşit İğci, Mehmet Anil Oğuz. Remarks: the site is 87 km southwest of Horasan (locality-2, the previously most-western published record by Kumlutaş et al. 2015), and > 60 km west of range limit by the IUCN Red List of Threatened Species (IUCN. 2020. *op. cit.*).
- 11 **New:** below the edge of the southern slope, ca. 1.9 km southwest of Topalan Köyü, district Merkez/Bingöl, 38°53'39N, 40°24'49E, at 1,715 m elevation. Molecular analysis confirmed its allocation to *M. wagneri* (cytochrome-*b* sequence Supplemental Table S1) which is similar to haplotypes wg3 to wg13 and wg16 in Stümpel et al (2016). Remarks: first records for province Bingöl.
- multiple specimens being collected and/or killed at the putative hibernation site, a rocky escarpment, on 05 May 2015. Source: video clip posted on <http://www.sabah.com.tr/webtv/yasam/bu-koyu-yilanlar-basti> and downloaded by us.
 - same general escarpment as site a., 38°53'41N, 40°24'49E, n = 8, around 1,724 m elevation, 08 April 2018 (Supplemental Fig. S6A, B). Source: Mehmet Zülfü Yıldız and Mehmet Akif Bozkurt.
 - a single specimen 0.8 km southwest of Topalan (and northeast of subsites a. and b.), 38°52'41N, 40°22'46E, at 1,681 m elevation, 06 June 2017 (Supplemental Fig. S6C). Source: photo taken and provided by Mehmet Fidan.
- 12 **New:** northeast from Bulguncuk, district Karakoçan/Elazığ, 38°57'47N, 40°12'14E, 1,708 m elev., 16 May 2012 (Supplemental Fig. S6D). Source: photos taken and provided by Anton Kozlov. Remarks: first record for province Elazığ. Currently allocated to the *wagneri*-clade based on geographic proximity of 20 km to the genetically confirmed *wagneri*-locality-10.
- 13 **New:** west of Sirmaliöya, district Genç/Bingöl (acc. to Google Earth Pro), near the border to district Palu/Elazığ, 38°40'00N, 40°19'17E, at 2,148 m elevation, 16 June 2018 (Supplemental Fig. S7A). Distribution map generated by QGIS shows locality-13 within Elazığ province (Fig. 2). Source: photo and video clip taken and provided by Murat Bahçeci. Remarks: currently allocated to the *wagneri*-clade based on geographic proximity of 31 km to confirmed *wagneri*-locality-10, representing the currently most southern record for *M. wagneri*.



SUPPLEMENTAL FIGURE S4. Habitat of Wagner’s Viper (*Montivipera wagneri*) with rocky shores (upper image) and plateau with rock piles (lower image) along the Murat River west of locality-8 in Muş province, indicating extensive suitable habitat for this species between Oğlakkaya, district Bulanik, west to Mescitli, district Merkez, and Kuşluk, district Varto. (Photographed by Konrad Mebert).



SUPPLEMENTAL FIGURE S5. A) and B) locality-10, Wagner's Viper (*Montivipera wagneri*) and habitat from Ilica, district Hınıs/Erzurum, ca. 1,950 m elevation; B) Potential habitat of Wagner's Viper (*Montivipera wagneri*) at Çobandağı, district Varto/Muş, ca. 2,200 m elevation, 20 km southwest of locality-10. (Photographed by Konrad Mebert).



SUPPLEMENTAL FIGURE S6. Distribution updates of western Wagner's Viper (*Montivipera wagneri*). A) locality-11b, habitat; B) specimens below the edge of the southern slope south of Topalan, district Merkez/Bingöl; C) specimen from locality-11c, Wagner's Viper from northern slope near Topalan, district Merkez/Bingöl; D) locality-12, habitat and Wagner's Viper near Bulgurcuk, district Karakoçan/Elazığ. (Photographed by Mehmet Zülfü Yıldız [A and B], by Mehmet Fidan [C], by Anton Kozlov [D plus inset]).

- 14 **New:** Tahkini Yaylasi (Plateau)-Pohoz Mevki, ca. 5.2 km northeast of Turnayolu, district Nazimiye/Tunceli, 39°12'38N, 39°56'17E, n = 3 within 200 m, between 1,831–1,860 m elevation, 14 June 2019 (Fig. 4 of primary article). Source: Mert Elverici, Konrad Mebert, Naşit İğci, Mahmut Aydoğdu. Remarks: first official and first genetically confirmed records for *M. wagneri* from Tunceli province (Supplemental Table S1).
- 15 **Refined+Corrected:** Hengirvan Plateau, 7.8 km northeast of Alacik, district Merkez/Tunceli, 39°17'48N, 39°45'13E, at 1,884 m elevation, 18 May 2014 (Supplemental Fig. S7B). Source: Göçmen et al. (2014) with photos by Celal Çiçek posted on Turkherptil (www.turkherptil.org), erroneously under *M. albizona* and repeated as such in Çiçek et al. (2017) and pictured also by TUDAK ([/www.facebook.com/TunceliDagcilikVeKampSporlariKulubu](http://www.facebook.com/TunceliDagcilikVeKampSporlariKulubu)). Remarks: we currently associate this specimen to the *wagneri*-clade due to its location east of Euphrates River Valley and simultaneously south of the Munzur Mountains; the regular vertical lateral blotches tend more to *M. wagneri* than *M. b. albizona* (see Table 1 and Supplemental Fig. S7B, C, D), and in particular its close proximity to the newly confirmed *wagneri*-site 18 km farther southeast (locality-14). It represents the currently most western populations for *M. wagneri*. On the other side, the nearest *albizona*-clade record (locality-16 in Fig. 5) is ca. 78 km north across these mountains, whose high elevations of mostly > 2,500 m elevation may have acted as an eco-topographic barrier due to harsh climate. Hence, molecular analysis is required for a definitive allocation of populations in between these taxa, in particular from the southern slopes of the Munzur Mountains, which are not available at this time.

Albizona Viper or Central Turkish Mountain (*Montivipera bulgardaghica albizona*)

Distribution of the Albizona Viper is shown in Fig. 5 (copied in from primary article). The locality list below is sorted approximately from north-east to north-west, followed by more southern localities:

- 16 **Refined:** between Gökaynak and Taşbulak (Ziyaret Tepesi), district Kemah/Erzincan, 39°38'00N, 38°56'59E, at 1,500 m elevation, 11 September 1994. Source: John Mulder (pers. comm. 2015), Mulder (1995) and mentioned in Göçmen et al. (2014). Remarks: this record is based only on a shed that has been lost (John Mulder, pers. comm.). It represents the nearest record to *M. wagneri* (historically 280 km to locality-2, herein adjusted to 78 km, see locality-15 for details) and is still the most northern and eastern record of the *albizona*-clade, but it requires confirmation due to its limited information and sole indication for this taxon north of the Munzur Mountains, yet the habitat, visited by us, appears suitable.
- 17 **New:** Kabataş Plateau, district Kemaliye/Erzincan, 39°21'39N, 38°36'17E, at 2,110 m elev., 07 June 2019 (Supplemental Fig. S7C). Source: photo taken and provided by Sema Sağı.
- 18 **New:** Kabataş (Karadağ), district Kemaliye/Erzincan, 39°21'03N, 38°35'59E, n = 2, at 1,796 m elevation, year 2012. Source: photo taken and provided by Kenan Görkem Gültekin. Remarks: 1.2 km across a mountain peak southwest of locality-17.
- 19 **New:** Kaynar Yaylasi (Plateau), 2 km southwest Yeşilyurt, district Kemaliye/Erzincan, 39°10'31N, 38°33'08E, at 1,667 m elevation, years 2013–2016. Source: information provided by Şevket Gültekin (pers. comm.).
- 20 **Refined:** Sariçiçek Plateau, Sandik, district Kemaliye/Erzincan, 39°15'22N, 38°26'52E, at 1,791 m elevation, 01 June 2013, ZMHRU 2013/90 (Zoology Museum of Harran University, Şanlıurfa, Turkey). Source: Şevket Gültekin, Bayram Göçmen, Mert Kariş, Deniz

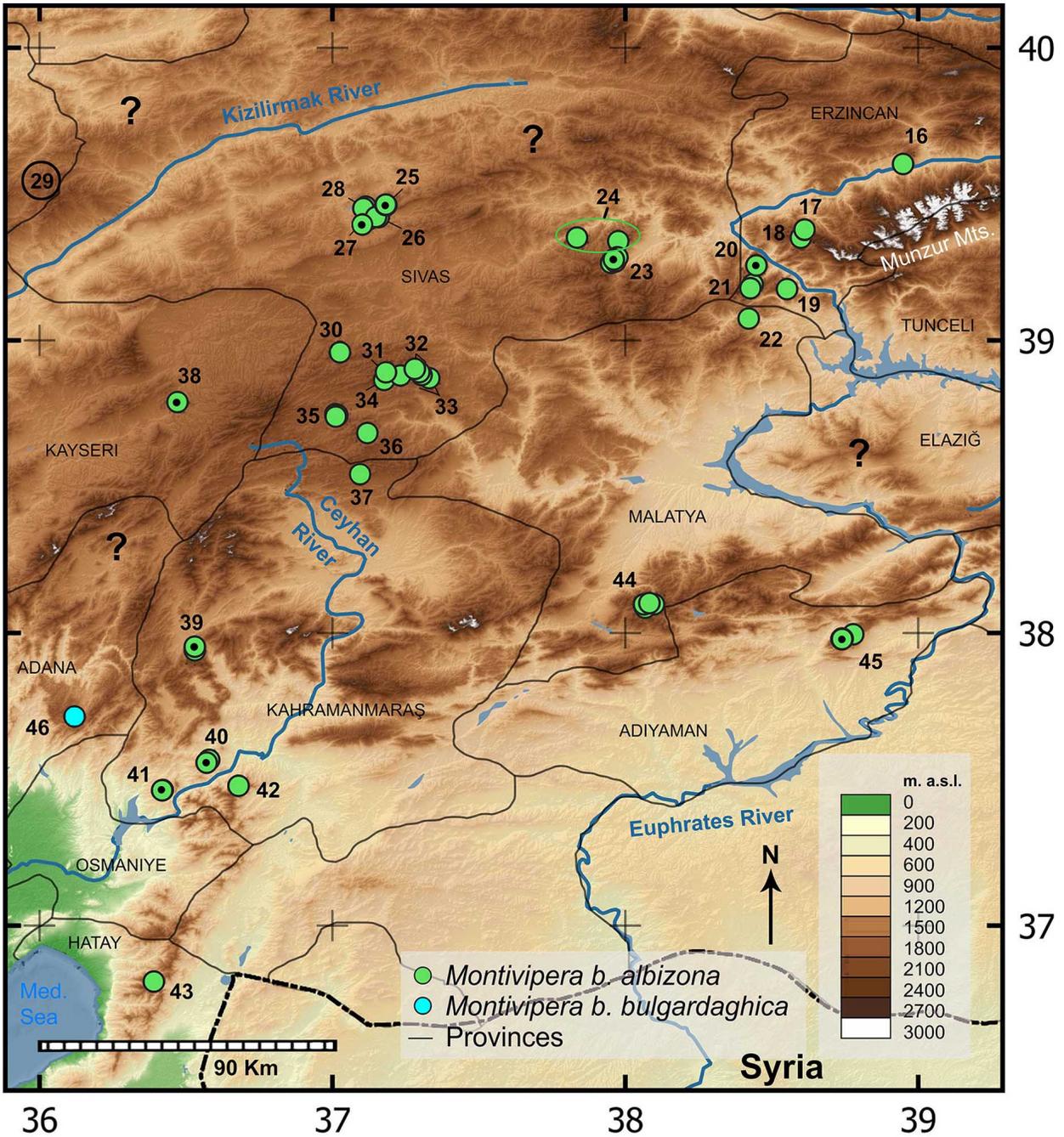
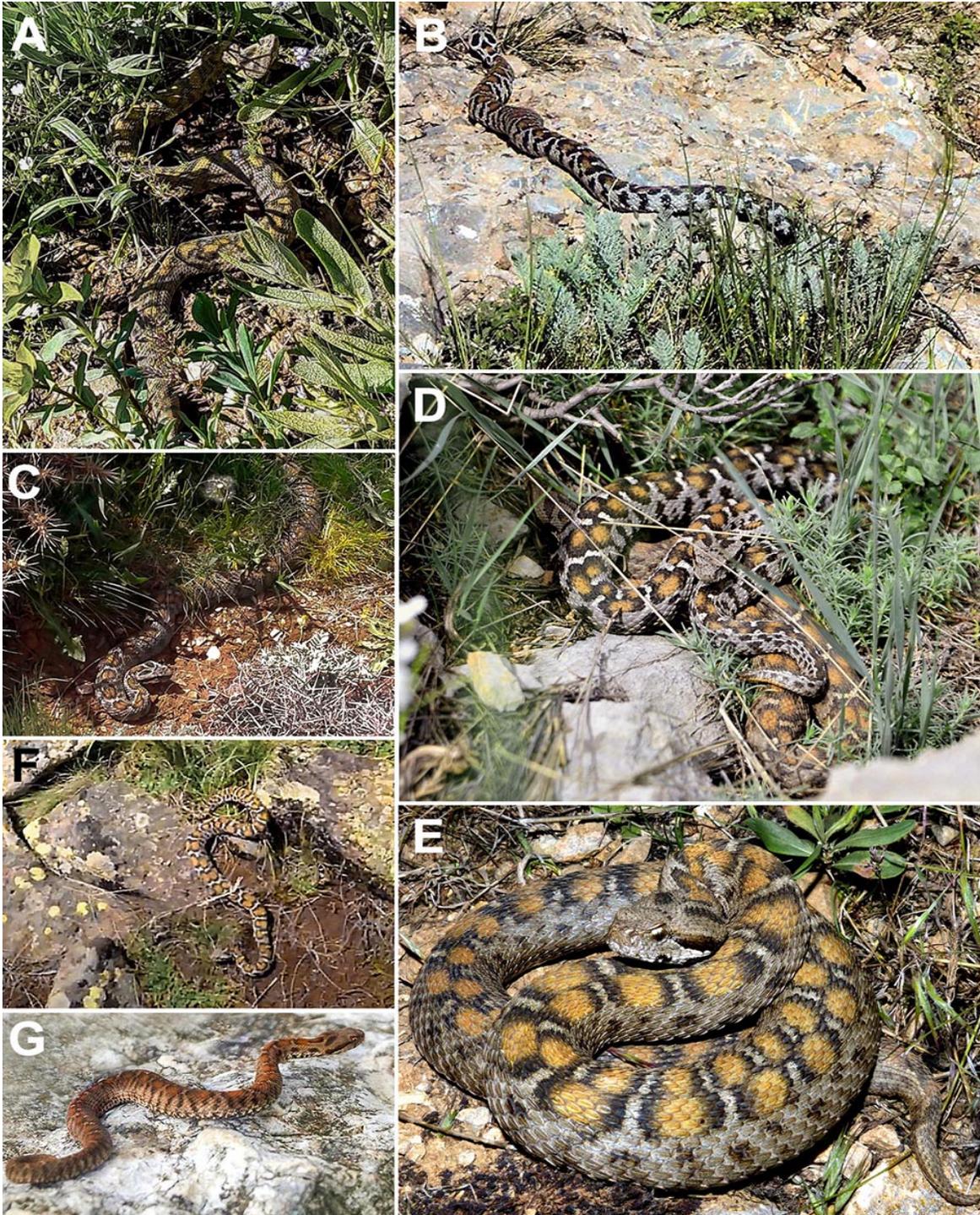


FIGURE 5-inserted from primary article. Updated distribution of Albizona Viper (*Montivipera bulgardaghica albizona*) and nearest record of the Bolkar Viper (*Montivipera b. bulgardaghica*). Numbers refer to the Locality List. Samples used for genetic analysis are indicated with a black center, except for locality-40 from Başkonuş, Merkez/Kahramanmaraş, which refers to an albumin analysis by Göçmen et al. (2009). Question marks indicate regions where further *Montivipera* populations are expected but require confirmation.

Yalçinkaya, also listed in Göçmen et al. (2014) and photos on Turkherptil (*op. cit.*), confirmed by genetic data (Supplemental Table S1).

-21 New: Kuluyar, 6.7 km southeast of Gözaydin, district Kemaliye/Erzincan, 39°10'42N, 38°25'38E, n = 2, at 1,850 m elevation, 31 May 2017 (Supplemental Fig. S7D), and another specimen from 1.5 km farther north at Mazman Başı, 6 km southwest Sirakonak Köyü,



SUPPLEMENTAL FIGURE S7. Distribution updates of western Wagner's Viper (*Montivipera wagneri*) and Albizona Viper (*Montivipera bulgardaghica albizona*). A) locality-13, *M. wagneri* west of Sirmalioya, district Genç/Bingöl, image contrast-enhanced for color pattern clarity; B) locality-15, *M. wagneri* Hengirvan, district Merkez/Tunceli, currently the western-most *M. wagneri*; C) locality-17, *M. b. albizona* from Kabataş Plateau, district Kemaliye/Erzincan, ca. 78 km from nearest *M. wagneri* site in B); D) locality-21, *M. b. albizona* Kuluyar, district Kemaliye/Erzincan; E) locality-25, *M. b. albizona* Ovacik, district Ulaş/Sivas; F) locality-36, *M. b. albizona* Karakuyu, district Gürün/Sivas; G) locality-40, *M. b. albizona* Başkonuş Sersem Plateau, district Merkez/Kahramanmaraş. (Photographed by Murat Bahçeci [A], by Celal Çiçek [B], by Sema Sağı [C], by Şevket Gültekin [D], by Konrad Mebert [E], via Ferhat Yıldız [F], by Selcen Ünüvar [G]).

district Kemaliye/Erzincan, 39°11'28N, 38°26'06E, at 1,868 m elevation, 15 May 2012.
Source: Şevket Gültekin, and photos for both sites on Turkherptil (*op. cit.*).

-22 New: Kozluk Stream, Kengerli Yazı, 4.2 km northwest of Sekizsu, district Arapgir/Malatya, 39°04'29N, 38°25'17E, at 1,603 m elevation, year 2017 (Supplemental Fig. S8A). Source: photo taken and provided by Ayfer Zincirkaya.



SUPPLEMENTAL FIGURE S8. Distribution updates of northern Albizona Viper (*Montivipera bulgardaghica albizona*). A) locality-22, Kengerli Yazı, northwest of Sekizsu, district Arapgir/Malatya; B) locality-35a, Osmandede, district Gürün/Sivas; C) locality-38, dead on road (DOR) Albizona Viper near Karaboğaz, district Pinarbaşı/Kayseri, the only record from the province Kayseri. (Photographed by Ayfer Zincirkaya [A], by Konrad Mebert [B], photo and scan by Mario Schweiger [C]).

- 23 **Corrected:** Type locality, originally given as Kulmaç Dağları, a mountain range south of Altinyayla/Sivas, Nilson et al. (1990). However, adjusted coordinates were provided by Göran Nilson in 2015 (pers. comm.); hence, the terra typica lies 100 km farther east on the eastern slopes of Beşoyuk Tepesi/ Dağı (= B. Hills/Mts.) with Ulu Tepe/ Dağı (= U. Hills/Mts.) adjacent south, and the principal Yama Dağı farther south (source mapcarta.com). The locality is Karasar, district Divriği/Sivas, (Nilson et al. 1990), 39°15'55N, 37°57'06E, at 1,630 m elevation, vouchers GNM Re.ex. 5022/ZIG (Department of Zoology, University of Göteborg, Sweden) No. 0254 (= holotype/paratype), female/male, 02 June 1989 (sequence data in Supplemental Table S1), and labeled as specimens az9, and possibly az6, in Stümpel (2012) and Stümpel et al. (2016). Further records within 2 km north and east towards Uzunkaya have been confirmed with vouchers MHNG 2537.038, 2547.028 (Fabien Bettex pers. comm., and Bettex [1993]), and records provided by a Swedish team (Johan Nylander, Börje Flärdh, pers. comm.) as far as 39°16'35N, 37°57'39E. The Yama Dağı reported in Tok et al. (2009), repeated in Çiçek et al. (2017), appears to refer also to this area (type locality) according to the potential sources listed in respective references.
- 24 **New:** sites ca. 10 km north of the type locality near the villages Soğucak (39°21'05N, 37°50'07E), Dumluca (39°20'21N, 37°58'33E) and Karağaçlı (39°22'11N, 37°57'27E) in district Divriği/Sivas (encircled localities in Fig. 5). Source: approximate location evaluated by us via comparing 3D-format of satellite images (Google Earth Pro) with topography and vegetation structure of photographic documentation by Deniz Şimşek for Soğucak, and by Ümit Yalçın for Dumluca and Karağaçlı (personal facebook sites), photos stored by us.
- 25 **New:** 4 km west of Ovacık, Tecer Dağları, district Ulaş/Sivas, 39°27'49N, 37°10'56E, n = 5 within 300 m, ca. 1,755 m elevation, 17 May 2015 and 11 June 2016 (Supplemental Figs. S7E, S9). Source: Eray Şimşek, Güray Tayyar Şimşek, Mert Kariş, Naşit İğci, Mehmet Anil Oğuz, Bayram Göçmen, Konrad Mebert and photos on Turkherptil (*op. cit.*).



SUPPLEMENTAL FIGURE S9. Albizona Viper (*Montivipera bulgardaghica albizona*) in its habitat at locality-25, northern slopes of Tecer Mountains near Ovacık, district Ulaş/Sivas. (Photograph by Konrad Mebert).

- 26 **Refined:** Kayapinar, Tecer Dağları, district Ulaş/Sivas, 39°25'17N, 37°09'29E, n = 3 within 1 km, between 1,671–1,740 m elevation, 05 June 2002, 10–11 June 2004. Source: David Jandzik (pers. comm.) and photos in David and Vogel (2010).
- 27 **Refined:** Tecer, Tecer Dağları, district Ulaş/Sivas, 39°24'50N, 37°07'18E, n = 13 within 1 km, ca. 1,680 m elevation, May and June 1992–1993 (sequence data in Supplemental Table S1). Source: John Mulder (pers. comm.), Mulder (1995), and specimens az3 and az4, and possibly also az5 or nr. 18020 in Stümpel (2012) and Stümpel et al. (2016).
- 28 **New:** Demircilik, Tecer Dağları, Ulaş/Sivas, 39°27'20N, 37°06'42E, at 1,682 m elevation, 30 April June 2014 and multiple specimens pictured by a wildlife photographer (contact information and photos deposited by us) within 1 km in 2012. Source: Gerrit Jan Verspui (pers. comm.) and J.R. (stored by us).
- 29 **Corrected:** a locality point in Fig. 1 of Stümpel et al. (2016) pointing to approximately Kizilcaova, Yozgat province (see circled nr. 29 in upper left of Fig. 5), putatively represents the northwestern-most *albizona*-locality and the only record for this taxon north of the Kizilirmak River (= Red River). After consulting respective sources, it actually refers to locality-27 reported by Mulder (1995) for the Tecer Mountains. Hence, up to now, there are no published records of the *albizona*-clade from north and west of the Kizilirmak River.
- 30 **Refined:** Çipil, district Kangal/Sivas, 38°56'54N, 37°01'52E, ca. 2,000 m elevation, 16 June 2016. Source: Konrad Mebert, Mert Kariş, Naşit İğci, Mehmet Anil Oğuz via photo of local shepherd. Remarks: Çiçek et al. (2017) also mention Kangal as a locality, but without coordinates.
- 31 **Refined:** Yılanhöyük, district Gürün/Sivas, 38°52'45N, 37°13'56E, at 1,860 m elevation, year 2017. Source: coordinates placed according to Figs. 4 and 10 (= Şekil 4 and 10) in Çiçek et al. (2017).
- 32 **Refined:** Karadağ, east of Konakpınar and surrounding, district Gürün/Sivas, 38°52'58N, 37°18'17E, at 1,856 m elevation, year 2017. Source: coordinates placed according to Figs. 3 and 19 (= Şekil 3 and 19) in Çiçek et al. (2017).
- 33 **New:** Karadoruk, district Gürün/Sivas, 38°50'20N, 37°22'38E, at 1,783 m elevation, 16 June 2016. Source: Konrad Mebert, Mert Kariş, Naşit İğci, Mehmet Anil Oğuz.
- 34 **New:** Çiçekyurt, district Gürün/Sivas, 38°50'14N, 37°06'20E, n = 2, near 1,931 m elevation, 16 June 2016. Source: Konrad Mebert, Mert Kariş, Naşit İğci, Mehmet Anil Oğuz. Remarks: Çiçek et al. (2017, 2018) listed local, unvouchered (no specimens or photos) observations of *M. b. albizona* for additional districts in Sivas province, that would extend its range farther north and west. However, these reports require confirmation due to potential confusion with other species. The observations from districts Altınyayla, Gürün, Ulaş, Kangal, and Divriği are plausible in the sense, that they are within the known range or would connect via mountains to locality-38 in Kayseri province. Those from western Sivas districts Gemerek, Şarkışla, and Yıldızeli may be correct, but approach *M. xanthina* in the south, and *Vipera (ammodytes) transcaucasiana* in the north (Mulder 2017), two viper species with which these observations might have been confused. Should *M. b. albizona* indeed exist in those western Sivas districts, they likely would occur in parapatry to one of the other viper species due to potential competition for similar resources (food, rocky shelters, etc.). *Montivipera b. albizona* possibly exists in the north-eastern districts of Sivas province including Sivas Merkez, Hafik, Zara, and Imranlı, at least in their southern portions that are continuous extensions of its habitat in the Tecer Mountains (*albizona* localities-25–28). A question mark

is placed in these regions and the western districts of Sivas province that require confirmation by identifiable vouchers. The region adjacent north of the Tecer Mountains may represent a range limit, as it is composed of large flat plains, mostly agriculturally used, or hills and mountains with relatively fine sediments. Such landscapes appear less suitable for mountain vipers, as they are poor on stable and complex rock structure and subterranean holes and crevices, which are important habitat constituents for Anatolian mountain vipers (Mebert et al. 2016).

- 35 **New+Corrected:** Osmandede, slopes of the eastern extension of the Göbekören Hüyüğü (= G. Hills) and adjacent north of Uzunöz Tepesi (= U. Hills), district Gürün/Sivas. This site was originally named as Tahtali Mountains in Teynié (1991) and extrapolated to this entire mountain range in Çiçek et al. (2017), but the observed *M. b. albizona* refers to sites adjacent-east of the principal ridges of the Tahtali Mountains and may or may not be viewed as part of those mountains (see source):
- 38°44'22N, 37°00'41E, at 1,748 m elevation, 15 June 2016 (Supplemental Fig. S8B). Source: Konrad Mebert, Mert Kariş, Naşit İğci, Mehmet Anil Oğuz.
 - 38°44'42N, 37°0'58E, n = 4 within 1 km from coordinates, between 1,650–1,740 m elevation, 30 May 1991, 30 May 2000, 07 June 2001. Source: Alexandre Teynié, Philippe Geniez, Pierre-André Crochet, F. Durand and photos depicted in David and Vogel (2010).
- 36 **New:** Karakuyu, east of Osmançali Tepesi (= O. Hills), district Gürün/Sivas, 38°41'00N, 37°07'09E, at 1,800 m elevation, 18 April 2018, approximately 11 km from the nearest known population at locality-35. Source: shepherd's photo (Supplemental Fig. S7F) and locality information sent via Ferhat Yıldız and posted on Türkiye Yaban Hayati-Wild Life Turkey (facebook.com/groups/turkiyedogalhayati/), ID confirmed by Konrad Mebert.
- 37 **New:** 3.7 km north of Alkayaoğlu, district Elbistan/Kahramanmaraş, 38°34'03N, 37°06'00E, at 1,986 m elevation, 3 July 2019. Source: photo of killed specimen taken by a shepherd and provided via mammalogist Tarkan Yorulmaz (pers. comm.). Remarks: the shepherd explained to have killed ca. 20 vipers within 1 km of this locality in the first half of 2019. The habitat is an extensive ca. 20 x 30 km rocky plateau > 2,000 m elevation to which also locality-36 belongs.
- 38 **Refined:** Karaboğaz, district Pinarbaşı/Kayseri, 38°47'21N, 36°28'15E, at 1,540 m elevation, May 2000 (Supplemental Fig. S8C and sequence data in Supplemental Table S1). Source: Mario Schweiger (pers. comm.) and specimen labeled as az7 in Stümpel (2012) and Stümpel et al. (2016). Remarks: this is the only record of Albizona Viper from the province Kayseri. The nearest record of an Ottoman Viper (*M. xanthina*) is in the Erciyes Mountains 83 km southwest (locality-63), yet, shorter distances to Ottoman Vipers likely exist along the interjacent mountain ridges and valleys.
- 39 **Refined:** Kurucaova (Armutyücesi Mountains), district Göksun/Kahramanmaraş, 37°56'27N, 36°31'49E, at 1,902 m elevation, 17 May 2011 (Supplemental Fig. S10A and sequence data in Supplemental Table S1). Source: Nikolaus Stümpel, and specimen labeled as spec1 in Stümpel (2012) and Stümpel et al. (2016). This record is 1.4 km south of a specimen found dead on the road to the Püren Pass (Püren Gecidi, Armutyücesi Mountains), Değirmendere, district Göksun/Kahramanmaraş, 37°57'12N, 36°31'48E, at 1,520 m elevation, mid-1990s. Source: Joseph Schmidtler (pers. comm.) and Stümpel (2012).



SUPPLEMENTAL FIGURE S10. Distribution vouchers and pattern variations of southern Albizona Viper (*Montivipera bulgardaghica albizona*). A) locality-39, Kurucaova (Armutyücesi Mountains), district Göksun/Kahramanmaraş; B) locality-40, Başkonuş Plateau, district Merkez/Kahramanmaraş. (Photographed by Nikolaus Stümpel [A], by Bayram Göçmen [B]).

- 40 **New:** Başkonuş Sersem Plateau, south of Yaylaüstü (Balik Mountain Range), district Merkez/Kahramanmaraş, 37°33'24N, 36°34'13E, at 1,415 m elevation, 15 May 2016 (Supplemental Fig. S7G). Source: photo provided by Selcen Ünüvar. Remarks: this specimen was found ca. 1.3 km south of a specimen (see Supplemental Fig. S10B) found by Ersen Aydın Yağmur on a resort at 37°33'59N, 36°34'43E, 1,300 m elevation, 06 July 2006, voucher ZDEU 188/2006, male, also depicted in Turkherptil (*op. cit.*) and in Göçmen et al. (2009).
- 41 **New:** Bostanlı, district Andirin/Kahramanmaraş, 37°27'49N, 36°25'13E, n = 5 within 600 m from coordinates: a) one specimen basking in/near the periphery of a wheat field at 1,028 m elev. on 05 July 2015; b) one specimen on a forest path at 1,026 m elev. on 22 May 2018, and c) three killed specimens at 999 m elev. on 4 May 2019. Source: a) Deniz Yalçinkaya, Eda Sami pers. comm. (Supplemental Fig. S11A); b) Bayram Göçmen, Mert Kariş, Deniz Yalçinkaya and photos on Turkherptil (*op. cit.*) and (Supplemental Fig. S11B); c) photo by shepherd Akif Karpuz (Supplemental Fig. S11C). Remarks: Bostanlı is ca. 38 km southeast across mountainous habitat from the nearest *bulgardaghica*-like specimen in the province Adana (locality-46). The Bostanlı locality represents the lowest altitude confirmed for the *albizona*-clade. The habitat consists of a few wheat fields and meadows with partly rocky peripheries, surrounded by deciduous broadleaf forest, indicating increased and year-round precipitation associated with rather cool diurnal temperatures for such an elevation (precipitation data for Andirin and other sites in Kahramanmaraş province, see Karabulut and Cosun 2009). This could contribute to the reasons why the Albizona Viper occurs here at lower elevations in broad sympatry with the more frequent *Macrovipera lebetina*. Even lower is an anecdotal observation by a local woman, interviewed by us, who reported her first ever observation during > 40 years residence of an orange-blotched viper in her backyard at Boğazören, Andirin/Kahramanmaraş, 37°28'59N, 36°24'45E, at 765 m elev. m, year 2018. A potential source population likely exists on the slopes above up to 930 m elevation.



SUPPLEMENTAL FIGURE S11. Lowest elevation habitat of southern Albizona Viper (*Montivipera bulgardaghica albizona*) at locality-41, Bostanlı, district Andirin/Kahramanmaraş, ca. 1,000 m a.s.l: A) approximative site of observed specimen indicated by black line; B) this specimen was found ca. 200 m more to the left (= west) of A); C) three specimens killed by locals. (Photographed by Deniz Yalcinkaya and Mehmet Zülfü Yıldız [habitat, A and B], by Akif Karpuz [C]).

-42 **New:** Gürün Tepesi, Karadere, district Merkez/Kahramanmaraş, 37°30'14N, 36°39'58E, > 1,000 m elev., summer 2014 (Supplemental Fig. S12B). Source: Durdu Mehmet Okutucu (pers. comm.) and photo on durdumehmetokutucu.blogspot.com/2015/ by the same author. Localities-40 to -42 represent the northern portion of the forested, rain-rich Nur Mountains.



SUPPLEMENTAL FIGURE S12. Distribution updates and pattern variations of southern Albizona Viper (*Montivipera bulgardaghica albizona*). A) locality-43, peak of Uzunziyaret (or Bozdağ) Tepesi (Amanos or Nur Mountains), district Hassa/Hatay; B) locality-42, Gürün Tepesi, Karadere, district Merkez/Kahramanmaraş. (Photographed by Ümit Kaplan [A], by Durdu Mehmet Okutucu [B]).

- 43 **Refined:** near peak of Uzunziyaret (or Bozdağ) Tepesi (Amanos or Nur Mountains), district Hassa/Hatay, 36°48'31N, 36°23'25E, at 2,200 m elevation, 13 October 2010 (Supplemental Fig. S12A). Source: Ümit Kaplan provided photos and videos, also depicted on *Turkherptil* (*op. cit.*) and mentioned in Göçmen et al. (2014); herein we publish the first coordinates and journal-based photographs. Remarks: currently, this is the southern-most and highest altitudinal record of the *albizona*-clade. During field expeditions in 2019, we have received information by locals that mountain vipers resembling the *albizona*-clade occur farther south along the Nur Mountains and even into the Ziyaret Mountains in southern Hatay province, thus, approaching the Syrian congeners (e.g., see Stümpel et al. 2016).
- 44 **New:** Asipinar, district, Doğanşehir/Malatya, 38°05'57N, 38°04'59E, between 1,708–1,828 m elevation, year 2016 and before. Source: shepherd Ali (interviewed by us) observed several corpulent and slow vipers with yellow-orange blotches within half a km around his house (see coordinates), most frequently in May. Furthermore, a man was bitten by a viper 2 km farther west at 38°05'10N, 38°04'04E, at 2,007 m elevation, and an orange-blotched viper was observed by another local shepherd at 38°05'52N, 38°03'49E, about 1,814 m elevation and 2 km farther east. This region requires confirmation, but viper descriptions, geographic position/elevation, and habitat render these records plausible, hence credible.
- 45 **New:** Mount Nemrut National Park in Adiyaman province, 37°58'50N, 38°44'27E (coordinates represent the peak of Nemrut Dağ at 2,168 m elevation). Source: the first pictures we received related to a specimen posted on Türkiye Yaban Hayati-Wild Life Turkey ([facebook.com/groups/turkiyedogalhayati/](https://www.facebook.com/groups/turkiyedogalhayati/)) on 23 March 2017 with the locality label “Gerger, Mt. Nemrut, 2,000 m elevation”. However, peak and the archeological site of Mt. Nemrut are located in Kahta district, whereas Gerger district begins 3.6 km farther east of Mt. Nemrut at ca. 1,960 m elevation (37°59'44N, 38°46'42E), represented by a second locality marker east of locality-45, but no separate number is given herein due to uncertainty, even though suitable rocky habitat > 1,700 m elevation continues 10 km eastward. Copies of these pictures were

stored by us before they were removed from the website, but no further information could be acquired anymore. In 2018, park rangers Hakan Akel and Bilal Mente, as well as members of our team, reported/found several specimens ($n = 6$) within a 300 m radius around the peak of Mt. Nemrut at elevations between 2,100–2,156 m elevation (Fig. 6 of primary article and Supplemental Fig. S13A, B). In 2019, a few more specimens were located as low as 2,081 m elevation, including one with black to grey-filled dorsal blotches (Supplemental Fig. S13C). Remarks: one specimen analysed exhibits eight *cyt-b* mutations over 750bp to both, *M. b. albizona* from Göksun (locality-39) and to *M. b. bulgardaghica* from Kar Bogaz Valley (localities-48 to -52), indicating some gene flow between *albizona*- and *bulgardaghica*-clades.



SUPPLEMENTAL FIGURE S13. Habitat and specimens of Albizona Viper (*Montivipera bulgardaghica albizona*) from the currently southeastern-most locality around the peak of Mount Nemrut, district Kahta/Adiyaman, locality-45. A) and B) specimens from the Nemrut Archeological site; and C) a dark specimen from Mount Nemrut. (Photographed by Hakan Akel with mobile phone [A and B], by Mehmet Zülfü Yıldız [C]).

Bolkar Viper (*Montivipera b. bulgardaghica*)

A point distribution map with new localities is presented in Fig. 7, copied in from primary article. Information about the localities is given in the list below. The localities are sorted from east to west:

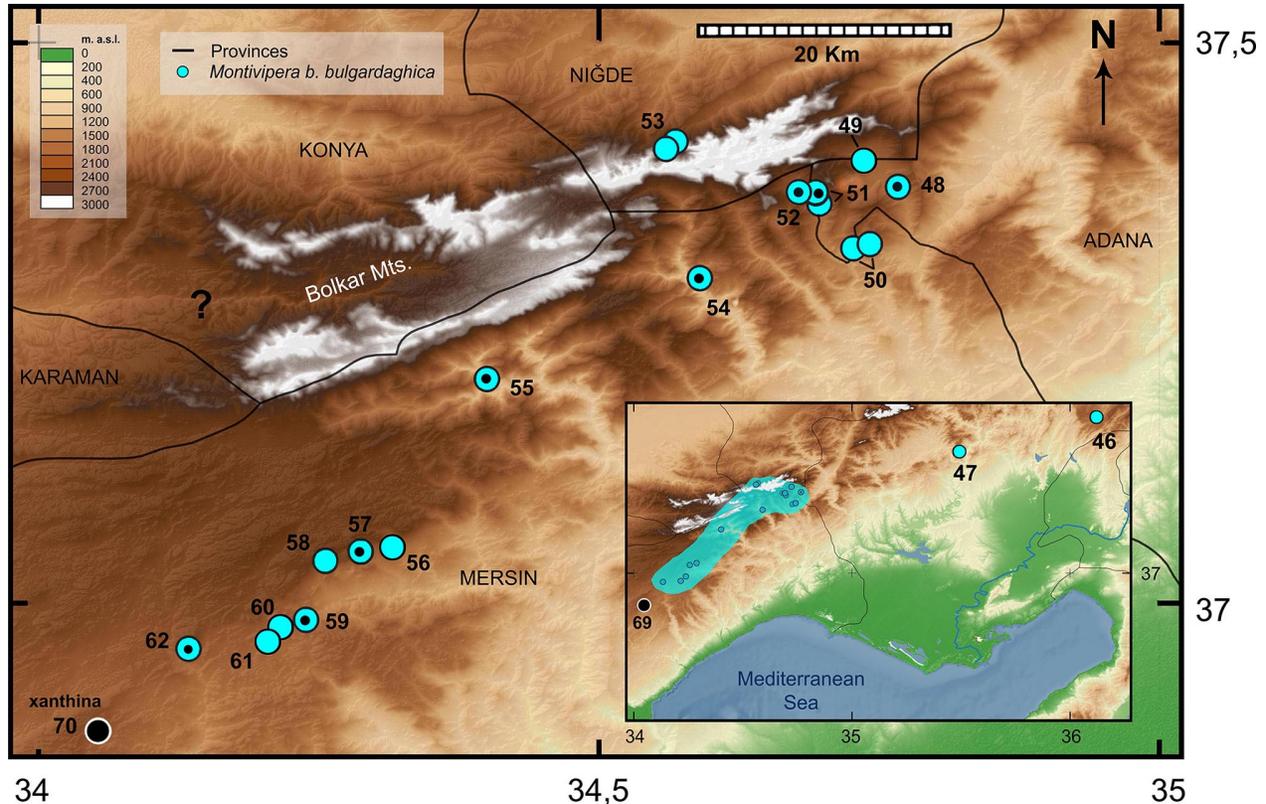
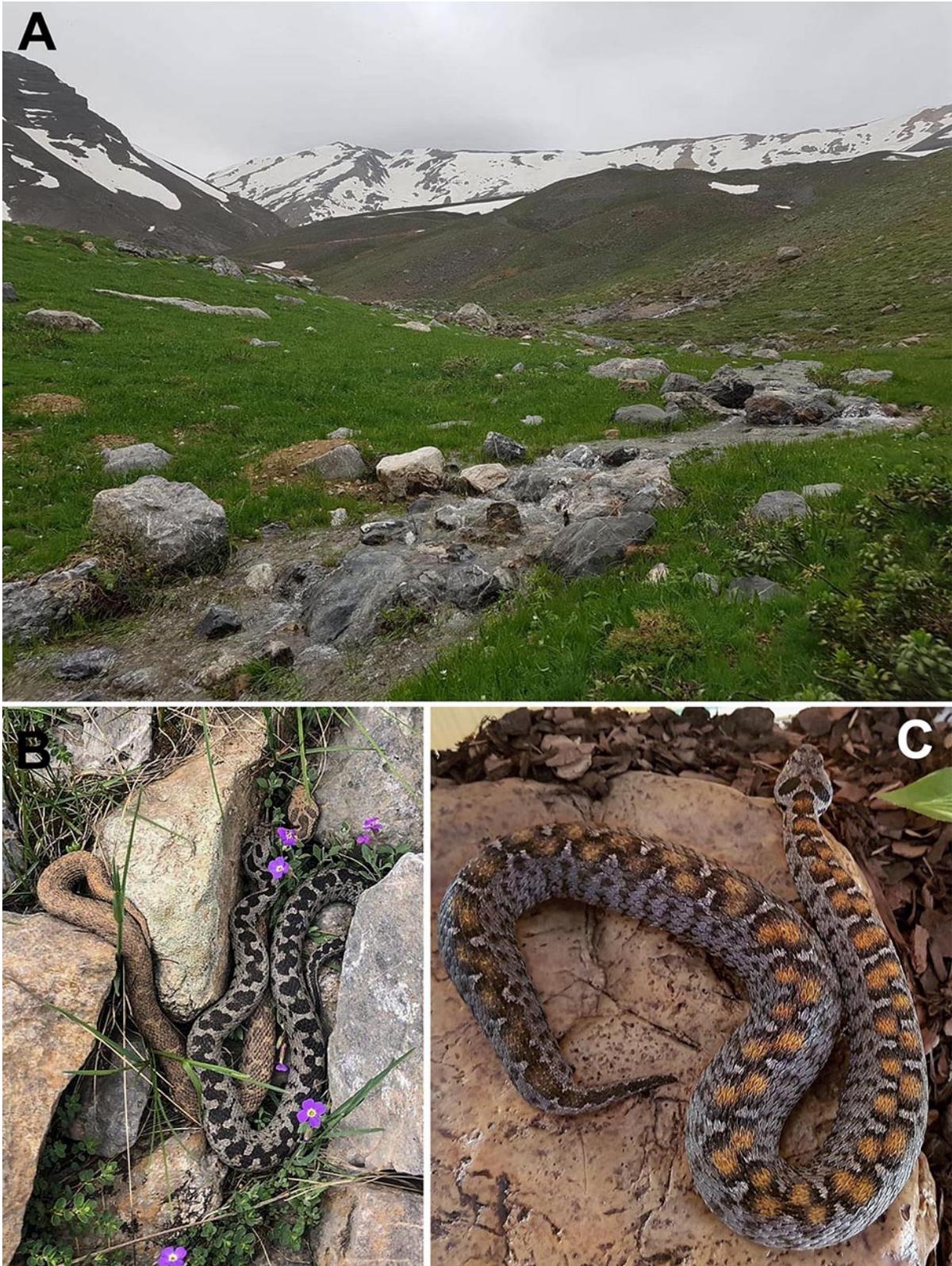


FIGURE 7-inserted from primary article. Updated distribution of Bolkar Viper (*Montivipera b. bulgardaghica*). Inset map repeats the same sites overlaid by a light blue shading but enlarged to show the two eastern-most sites (localities-46 and -47, see vouchers in Fig. 8 of primary article). Numbers refer to the Locality List. Samples used for genetic analysis are indicated with a black center. Question marks indicate areas where further *Montivipera* populations are expected but require confirmation. A newly discovered *M. xanthina* (black dot-70) near *bulgardaghica*-locality-62 indicates a potential contact zone between them.

-46 **New:** Göller Yaylasi and Çamlarca, districts Kozan-Sumbas/Adana, 37°42'53N, 36°07'09E, at 1,482 m elevation, 05 August 2017. Source: photograph by Şensu Küçükateş provided via Abdurrahman Sefali (Fig. 8A of primary article). Remarks: this specimen is provisionally set as the currently eastern-most *Montivipera* with a traditional *bulgardaghica* color pattern, consisting of longitudinally elongated ‘rectangular’ black and grey, smooth-edged dorsal blotches. Beginning at locality-42, specimens farther east show rounded ‘yellow to orange filled’ dorsal blotches that resemble typical *M. b. albizona* (see examples in Figs. S10-S12). This new record from Göller reduces the distance between the previously published distance of 160 km between *M. b. bulgardaghica* at locality-48 (see below) and *M. b. albizona* at locality-40 down to 38 km between *bulgardaghica*-locality-46 and *albizona*-locality-41.

-47 **New:** ca. 3.5 km north of Kizildam, district Aladağ/Adana, 37°33'46N, 35°29'32E, at 1,412 m elevation, 14 July 2014. Source: provided by Karim Amri (Fig. 8B of primary article). Remarks: this specimen represents a color pattern with rounded and ‘orange filled’ dorsal blotches reminiscent of northern *M. b. albizona*, indicating a transition zone between the two

- M. bulgardaghica* subspecies. However, singly occurring *albizona*-like specimens are known from within the range of typical *M. b. bulgardaghica* (Schätti et al. 1991, and specimen in Supplemental Fig. S14C from locality-51).
- 48 **Refined:** lower Elmali Boğaz Valley, district Pozanti/Adana, 37°22'16N, 34°46'00E, coordinates point to 1,625 m elevation in the valley, north Akçatekir, parallel and east to the Kar Boğaz Valley (*cyt-b* sequence data in Supplemental Table S1). Source: Nikolaus Stümpel and specimen labeled as bg10 (nr. 17465) in Stümpel (2012) and Stümpel et al. (2016).
 - 49 **New:** upper Elmali Boğaz Valley, district Pozanti/Adana, 37°24'13N, 34°42'55E, n = 3 within 130 m from coordinates, around 2,210 m elevation, 23 May 2019 (Supplemental Fig. S14). Source: Fabien Bettex (pers. comm.).
 - 50 **Refined:** Kar Boğaz (Karboğazi) Valley, district Pozanti/Adana and district Tarsus/Mersin (acc. to Google Maps), 37°18'59N, 34°43'36E, n = 12 within 1.5 km from coordinates at the center of samples found between 1,450–1,800 m elev. Source: Schätti et al. (1991, also pers. comm.) and vouchers (sampling year) MHNG 2497.046–50 (1990), 2542.066–67 (1992), 2522.008 (1990), 2547.025 (1990), 2527.085 (1992), 2541.033–34 (1993), Bettex (1993), Fabien Bettex (pers. comm.) with two specimens depicted in Fig. 8E of primary article.
 - 51 **Refined:** Kar Boğaz Valley, district Pozanti/Adana (acc. to borders on Google Earth Pro), 37°21'56N, 34°41'36E, n = 7 within 200 m, ca. 2,020 m elevation, 10 May 2014 (Fig. 8D of primary article) and late April 2015. Source: Bayram Göçmen, Mehmet Zülfü Yıldız, Bahadır Akman, Mehmet Akif Bozkurt, incl. photos on Turkherptil (*op. cit.*), and Fabien Bettex (pers. comm.), including one specimen with a color pattern reminiscent of *M. b. albizona* (Fig. S14C). Further records from within 1 km farther south on the slope at 37°21'23N, 34°41'47E, n = 2, 1,774 m elevation, 27/28 May 1993, by Johan Nylander, Börje Flärdh, J. Karlsson, Mikael Lundberg (pers. comm.) and from next to the river at 37°21'29N, 34°41'31E, n = 3, at 1,763 m elevation, 28 April 2019, by Gerrit Jan Verspui (pers. comm.).
 - 52 **Refined:** Kar Boğaz (Karboğazi) valley, north of Gülek, district Tarsus/Mersin (Google Earth Pro) or Pozanti/Adana (Google Maps), 37°21'59N, 34°40'54E, at 1,887 m elevation, 17 May 1993. It's only ca. 1 km west of locality-51, but in another province and across the valley's river. Source: Johan Nylander, Börje Flärdh, J. Karlsson, Mikael Lundberg (pers. comm.) and voucher NRM 5102 (Swedish Museum of Natural History, Stockholm), which possibly relates to specimen labeled as bg16 (*cyt-b* sequence data in Supplemental Table S1), also in Stümpel (2012) and Stümpel et al. (2016). Further records on the same slope ca. 1.1 km farther south at 37°21'18N, 34°41'12E, n = 3 within 250 m, at 1,899 m elevation, May 2016 and 2019, by Fabien Bettex (pers. comm.), and at 37°21'28N, 34°41'6E, n = 2 within 100 m, at 1,849 m elevation, May 23 August 2019, by Burak Akdağ (pers. comm.).
 - 53 **Refined:** Type locality: Kar Boghaz-Bulgar Dag (Karbogaz-Bolkar Dağı), border Niğde-Mersin, 37°24'18N, 34°33'32E, coordinates for holotype (coll. 1897) and two paratypes (coll. 1897, 1899) placed representatively at 2,500 m elevation on a southern exposed slope of Bolkar Dağı, between 2,854–2,862 m elevation (available from <https://peakery.com>, <https://mapcarta.com>), which is a peak within the similarly named Bolkar Dağları, rising up from Maden Lake, or Maidan Göl (Karagöl), and located 6 km south of the next larger village, Darboğaz. Source: Martin Holtz and Steindachner in Werner (1898), Nilson and Andren (1985), with vouchers, including the male holotype GNM 1618, and female



SUPPLEMENTAL FIGURE S14. Distribution updates of the Bolkar Viper (*Montivipera b. bulgardaghica*) from eastern Bolkar Mountains. A) habitat of locality-49, upper Elmalı Boğaz Valley, district Pozanti/Adana; B) female and male, in situ, from locality-49; C) specimen from locality-51, Kar Boğaz Valley, with orange-filled dorsal blotches resembling *M. b. albizona*. (Photographed by Fabien Bettex).

paratypes BM -1946.1.19.67 (British Museum of Natural History, London) and NHMW15136 (Natural History Museum of Vienna, Austria). Even though no further specimens have been found on that northern versant (slopes) of the Bolkar Mountains and its *terra typica* status has been doubted among experts or indicated as being confused with the similarly named localities-50 to -52 (e.g., Schmidtler et al. 1990), we visited the area and perceived it as potentially correct, or at least suitable for mountain vipers. Reasons are: 1) there is suitable habitat, 2) a specific mountain Bolgar Dağı (or Bolkar Dağı) exists, 3) the next large locality is called Darboğaz, indicating a potential name confusion, requiring the change of only the first letter from Karboğaz to Darboğaz. Data recording and language translation certainly have been more error-prone in the 19th century than today. Nonetheless, a positive or negative confirmation is still required, in particular also whether the Ottoman Viper (*M. xanthina*) may approach or occupies the northern slopes of the Bolkar Mountains, as there is currently only 80 km distance to the nearest *xanthina*-record at locality-68.

- 54 **Refined:** Kozpinari, district Çamlıyayla/Mersin, 37°17'24N, 34°35'24E, n = 2, coordinates point to an open forest on a slope at 1,410 m elevation (sequence data in Supplemental Table S1). Source: Svetlana Kalyabina-Hauf and specimens labeled as bg12 and bg13 in Stümpel (2012) and Stümpel et al. (2016).
- 55 **Refined:** Cocakdere National Park (Bolkar Dağları), north Atlılar, district Toroslar/Mersin, 37°12'00N, 34°23'59E, coordinates point to an open forest on a slope at 1,260 m elevation (sequence data in Supplemental Table S1). Source: specimen xt12 (or nr. 18017) in Stümpel (2012) and Stümpel et al. (2016).
- 56 **New:** 3 km west of Tirtar, district Toroslar/Mersin, 37°02'59N, 34°18'37E, at 1,864 m elevation Source: photo by Özkan Kurtuluş provided via Sezgin Ozlem Sahin.
- 57 **Refined:** Arslanköy, district Toroslar/Mersin 37°02'45N, 34°17'13E, n = 2, around 2,071 m elevation (sequence data in Supplemental Table S1). Source: Nikolaus Stümpel and specimens labeled as bg3 and bg4 in Stümpel (2012) and Stümpel et al. (2016).
- 58 **New:** Gazi-Arslanköy, district Toroslar/Mersin, 37°02'15N, 34°15'21E, at 2,060 m elevation, 07 June 2017. Source: Mert Kariş.
- 59 **Refined:** Çatak (Arslanköy), district Toroslar/Mersin, 36°59'06N, 34°14'18E, at 1,694 m elevation (sequence data in Supplemental Table S1). Source: Nikolaus Stümpel and specimen labeled as bg5 in Stümpel (2012) and Stümpel et al. (2016).
- 60 **Refined:** Çatak (Arslanköy), district Toroslar/Mersin, ca. 1.5 km west of locality-58 surrounding of 36°58'46N, 34°13'23E, n = 8 within 1.3 km from coordinates, between 1,733–1,895 m elevation. Source: Fabien Bettex (pers. comm.) and Bettex (1993), vouchers MHNG 2522.009-011 from 1990 and 1991, MHNG 2524.003 and MHNG 2524.005 from 4 May 1991 (Supplemental Figs. S15 and S16B).
- 61 **New:** eastern Hacialani-Gavuruçtuğu, district Erdemli/Mersin, ca. 1.6 km west of locality-60 surrounding of 36°58'11N, 34°12'37E, n = 2 within 300 m, around 1,785 m elevation, May 2015 and 2017 (Supplemental Fig. S16A). Source: Fabien Bettex (pers. comm.).
- 62 **New:** Ünlük Tepesi, Gavuruçtuğu, district Erdemli/Mersin, 36°57'33N, 34°08'01E, n = 2, around 1,985 m elevation, 07 June 2017 (Figs. 8D, E of primary article). Source: Mert Kariş. Remarks: these *Montivipera b. bulgardaghica* inhabit the currently most western site for this taxon which is only 11 and 16 km northeast from new records of *M. xanthina* at



SUPPLEMENTAL FIGURE S15. A) and B) Bolkar Viper (*Montivipera b. bulgardaghica*) from its western range, locality-60, Çatak, west of Arslanköy, district Toroslar/Mersin. (Photographed by Fabien Bettex).

localities-70 and -71 with continuous suitable habitat of south-exposed rocky slopes at > 1,700 m elevation between them (Figs. 7, 9, and 10C, D, E of primary article). It suggests that the north-south valleys with the villages Sorgun and Toros in Erdemli/Mersin may constitute a contact zone between these mountain viper species.



SUPPLEMENTAL FIGURE S16. Distribution updates of Bolkar Viper (*Montivipera b. bulgardaghica*) from its western range. A) locality-61, eastern Hacialani-Gavuruçtuğu, district Erdemli/Mersin, 1.6 km west of locality-60; B) locality-60, Çatak, west of Arslanköy, district Toroslar/Mersin. (Photographed by Fabien Bettex).

Ottoman Viper (*Montivipera xanthina*)

A point distribution map with new localities is presented in Fig. 9, copied in from primary article, followed by a list of southeastern records of the Ottoman Viper, sorted approximately from east to west. Aside from three isolated range patches in south-central Turkey (see locality list below), the distribution map in the IUCN Red List of Threatened Species (Böhme et al. 2009) shows a continuous range of *M. xanthina* extending as far southeast as the Göksu River from southern Konya province to the coastal city Silifke in Mersin province. However, neither locality information or vouchers nor listed references were provided that would indicate its southeastern-most presence in Mersin and Karaman provinces.

- 63 **Refined:** ca. 5 km west of Cebir (eastern slopes Erciyes Dağı = E. Mountain), district Melikgazi/Kayseri, 38°33'43N, 35°33'40E, at 2,334 m elevation, June 1988. Source: Göran Nilson (pers. comm.), and Nilson et al. (1988, 1990).
- 64 **New:** south of Erciyes Dağı and 9 km north of Develi, district Develi/Kayseri, 38°28'02N, 35°31'11E, at 1,840 m elevation, 07 June 2002. Source: Alexandre Teynié, Philippe Geniez, Gilles Pottier.
- 65 **Refined:** south of Erciyes Dağı, ca. 4.5 km north of Develi, district Develi/Kayseri, 38°25'48N, 35°28'52E, at 1,529 m elevation, year 2009. Source: Göçmen et al. (2009) and others by F. Bettex (pers. comm.).
- 66 **New:** west of Erciyes Dağı and 3.5 km east of Subaşı, district Incesu/Kayseri, 38°32'39N, 35°15'41E, at 1,423 m elevation, 18 May 1993 (Fig. 10A of primary article). Source: Johan Nylander, Börje Flärdh, Mikael Lundberg, J. Karlsson (pers. comm.).

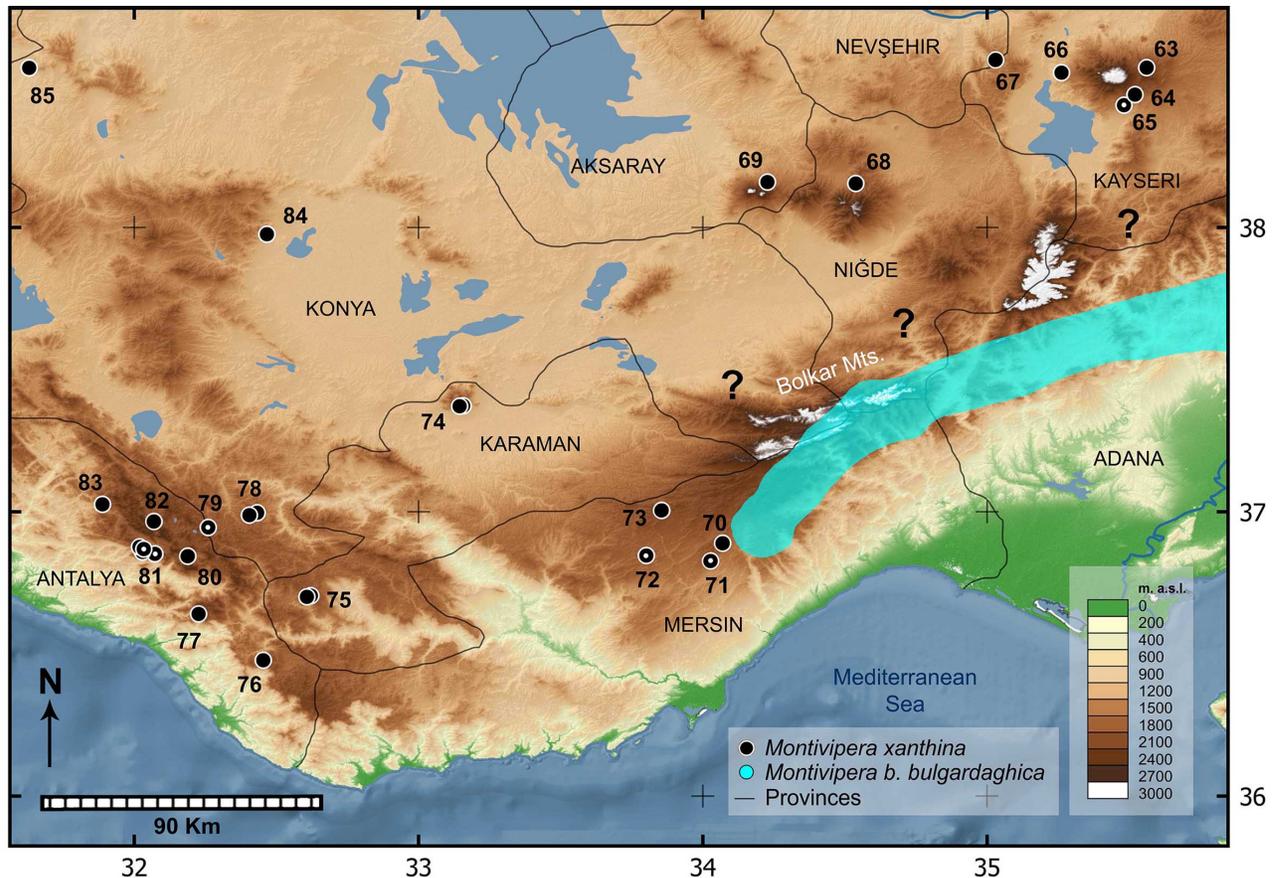


FIGURE 9-inserted from primary article. Southeastern distribution of Ottoman Vipers (*Montivipera xanthina*) in Turkey. Numbers refer to the Locality List. The corresponding IUCN map also includes an area for *M. xanthina* near where Adana, Niğde and Kayseri provinces meet. Since none of the literature in the IUCN assessment (IUCN, 2020) includes such a reference, we presume that area may represent district Ulukişla/Niğde and relates to the listing of *M. xanthina* for “Bolkar Dağı Ulukişla” in Başoğlu and Baran (1980), which later was described as *M. bulgardaghica* (Nilson and Andren 1985). Samples used for genetic analysis are indicated with a white center dot and are either listed in Supplemental Tab. S1, except for locality-65 from south Mt. Ercyies, Develi/Konya, which refers to an albumin analysis by Göçmen et al. (2009). Question marks indicate areas but require confirmation of taxon allocation.

- 67 **New**: Topuzdağı Gecidi (= T. Pass), between Dört Yol and Başdere, district Ürgüp/Nevşehir, 38°32'10N, 35°05'27E, at 1,548 m elevation, year 1992. Source: Bettex (1993), Fabien Bettex (pers. comm.), and voucher MHNG 2547.024.
- 68 **New**: Azatlı Dam, Çiftlik/Niğde, 38°09'16N, 34°32'16E, at 1,682 m elevation, 28 June 2017, DOR (Fig. 10B of primary article). Source: Mert Kariş.
- 69 **New**: ca. 2 km southwest Yenipinar, district Merkez/Aksaray, 38°09'34N, 34°13'37E, n = 2, at 1,800 m elevation, 30 May 1994. Source: V. Joubert, F. Gilles (pers. comm.).
- 70 **New**: ca. 3 km northwest Kuşluca, district Erdemli/Mersin, 36°52'50N, 34°03'37E, at 1,859 m elevation, 21 May 2019 (Fig. 10C). Source: Fabien Bettex (pers. comm.). Remarks: this specimen represents the currently shortest distance of *M. xanthina* to *M. b. bulgardaghica* (see locality-62, north Gavuruçtuğu, and also Figs. 8 and 10 of primary article) with a distance of 11 km of suitable habitat and a potential contact zone between them.

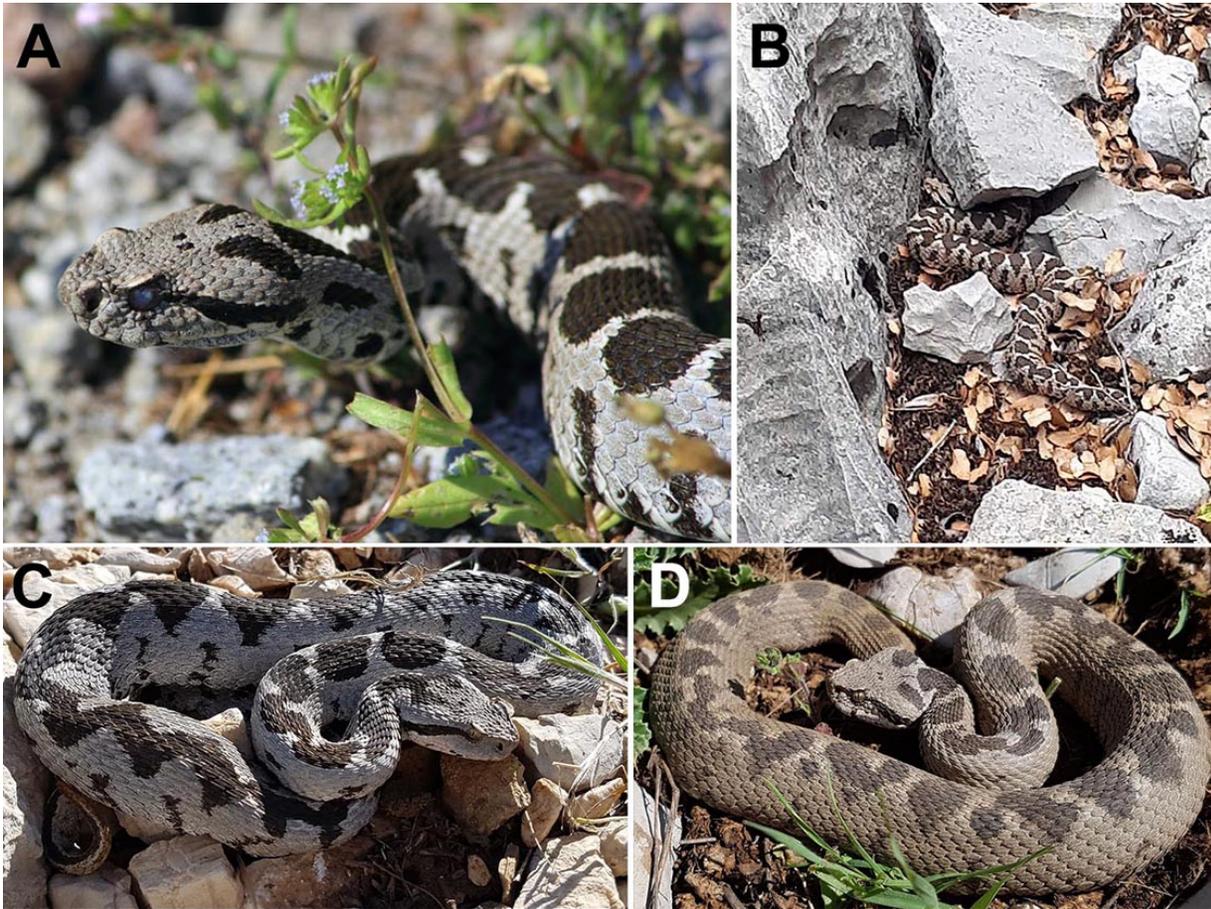
- 71 **New**: ca. 3.5 km north of Akpınar, district Erdemli/Mersin, 36°50'36N, 34°01'19E, at 1,902 m elevation, 2 May 2019 (Fig. 10E). Source: Konrad Mebert, Mehmet Z. Yildiz. Remarks: taxon allocation according to color pattern (*xanthina*-like completely filled anterior dorsal blotches). Preliminary *cyt-b* analysis (our unpubl. data) confirms this specimen indeed being closest to *M. xanthina*.
- 72 **New**: 2 km southwest of Dervişli and 14 km straight north of Magara-Kirobasi, district Silifke/Mersin, 36°50'45N, 33°48'03E, at 1,722 m elevation, 23 April 2018 (Supplemental Fig. S17A). Source: Konrad Mebert, Anil Oğuz, Mert Kariş. Remarks: this specimen represents the first dated record of *Montivipera xanthina* from the province Mersin.
- 73 **New**: 8.5 km east of Özboynuinceli, district Erdemli/Mersin, 36°59'17N, 33°50'09E, n = 5 within 400 m east and west from coordinates, around 2,091 m elevation, 2 May 2019 (Supplemental Fig. S17B). Source: Fabien Bettex (pers. comm.). This locality and localities 70 and -72 indicate that *M. xanthina* inhabits rocky-hilly plateaus > 1,700 m elevation and is replaced by *M. bulgardaghica* on the southern versant of the Bolkar Mountains beginning at locality-62.
- 74 **Refined**: Karadağ, district Merkez/Karaman, 37°22'22N, 33°09'24E, at 1,900 m elevation, 02 July 2012, and 1 km farther west at 37°22'16N, 33°08'39E, at 1,600 m, 08 June 2011 (Supplemental Fig. S18A). Source: photographs by Kürsat Akin and Özgür Kocak, respectively, both on Turkherptil (*op. cit.*).
- 75 **New**: Sariveliler, district Sariveliler/Karaman, 36°42'03N, 32°36'57E, n = 2 within 600 m east and west from coordinates, around 1,640 m elevation, June 2017 and 2018 (Supplemental Fig. S18B). Source: Bayram Göçmen and Gülay Bozkir.
- 76 **Refined**: Belbaşı, district Gazipaşa/Antalya, 36°28'39N, 32°27'13E, at 1,497 m elevation, 24 June 1997. Source: Kumlutas et al. (2004), Y. Kumlutas (pers. comm.), voucher ZDEU 250/1997.
- 77 **New**: Üçmuar Çeşmesi, Öteköy (Akdağ), district Alanya/Antalya, 36°38'25N, 32°13'34E, at 1,661 m elevation, 22 August 2018. Source: Ibrahim Zavlak (pers. comm.) and his photos on Turkherptil (*op. cit.*).
- 78 **Refined**: Ak Dağ, Hadim, district Hadim/Konya:
- north of village Hadim, 36°59'46N, 32°25'55E, n = 4, at > 2,000 m elevation, year 1983. Source: Schätti and Baran (1988), Schätti et al. (1991) with four vouchers MHNG 2403.004–05 and 2457.026–27.
 - west of Hadim at 36°59'16N, 32°24'17E, at 1,738 m elevation, 12 May 1995. Source: Mulder (1995, and pers. comm.).
- 79 **New**: Hisarlık Plateau, district Hadim/Konya, 17 km west of village Hadim, 36°56'41N, 32°15'36E, at 2,073 m elevation. Source: Mert Kariş. Remarks: our data show a divergence of one mutation over 750bp *cyt-b* to *M. xanthina* xt6, xt5, xt4 in Stümpel (2012) and Stümpel et al. (2016) from locality-81.
- 80 **New**: Mount Barçın (Geyik Mountains), district Gündoğmuş/Antalya, 36°48'42N, 32°08'57E, n = 4 within 500 m from coordinates, between 1,683–1,901 m elevation, 26 May 2019 (Supplemental Fig. S18C). Source: Fabien Bettex and Karim Amri (pers. comm.).
- 81 **New and Refined**: Geyik Mountains, Gelasandra Mahallesi, district Gündoğmuş/Antalya:
- New**: Senir Yaylasi (Plateau), 36°52'03N, 32°01'24E, n = 3 within 1.1 km from coordinates, between 1,687–1,777 m elevation, 26 May 2019. Source: Bayram Göçmen,



SUPPLEMENTAL FIGURE S17. Updates on high elevation plateau localities of Ottoman Viper (*Montivipera xanthina*). A) locality-72 at about 1,720 m elevation, extensive rocky plateau habitat and specimen north of Mağara-Kirobasi, district Silifke/Mersin; B) locality-73 at ca. 2,080 m elevation, ca. 8.5 km east of Özboynuinceli, north of Evdilek Mahallesi, district Erdemli/Mersin, and ca. 16 km north of locality-72 in A), indicating continuous plateau habitat. (Photographed by Konrad Mebert [A and inset], by Fabien Bettex [B and both insets]).

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- b. **Refined:** Geyik Mountains, Gelasandra Plateau, 3 km east of locality-81a, 36°51'29N, 32°04'07E, n = 5 within 500 m, 1,460 m elevation, 17 May 2011. Source: xt6, xt5, xt4 in Stümpel (2012) and Stümpel et al. (2016, 2018) and Afsar et al. (2019), latter describing it as a new subspecies, *M. xanthina varoli*; one specimen 700 m farther south on Aşağı Yayla, 36°51'06N, 32°04'20E, at 1,496 m elevation, 20 April 2018. Source: Konrad Mebert, Mert Kariş, Mehmet Anil Oğuz.
- 82 **New:** Kozağacı Mahallesi (Geyik Mountains), district Gündoğmuş/Antalya, 36°53'40N, 32°03'E, n = 3 within 220 m from coordinates, around 1,601 m elevation, 19 May 2019 (Supplemental Fig. S18D). Source: Fabien Bettex (pers. comm.).
- 83 **New:** 3 km east of Cimiköy, district Akseki/Antalya, 37°01'33N, 31°53'016E, n = 2, at 1,722 m elevation, 27 May 1996. Source: M. Geniez, T. Menut, F. Melki (pers. comm.).
- 84 **New:** Yazir Mahallesi, district Selçuklu (northwestern margin of greater Konya City)/Konya, 37°58'23N, 32°27'19E, 1,179 m elevation, 30 July 2018. Source: Fire Department of Konya, posted online by www.memleket.com.tr and provided by Mehmet Şekerci (pers. comm.).
- 85 **New:** Mevlütlü (30 km north-east Akşehir), district Tuzlukçu/Konya, 38°33'40N, 31°37'47E, 1,086 m elevation, year 1973. Source: Jean Garzoni via Alexandre Teynié, Philippe Geniez.



SUPPLEMENTAL FIGURE S18. Distribution updates of the Ottoman Viper (*Montivipera xanthina*) from elevations > 1,600 m elevation in its southeastern range. A) locality-74 at ca. 1,600 m elevation, Karadağ, district Merkez/Karaman; B) locality-75, Sariveliler, district Sariveliler/Karaman; C) locality-80, Barçın Mountain, district Gündoğmuş/Antalya; D) locality-82, Kozağacı Mahallesi, district Gündoğmuş/Antalya. (Photographed by Özgür Kocak [A], by Gülay Bozkir [B], by Fabien Bettex [C and D]).

SUPPLEMENTAL TABLE S1: Variation of cytochrome *b* sequence among selected specimens of *Montivipera* taxa from southern to eastern Turkey. Locality-numbers refer to the geographic origin of specimens shown in maps and locality list (above). Location district and province are given right before, resp. after the forward slash “/”. Abbreviation for initial taxon allocation: Mbu (*M. b. bulgardaghica*), Mal (*M. b. albizona*), Mwa (*M. wagneri*), Mxa (*M. xanthina*); in parenthesis the source of molecular data, e.g., our data ID-label or the cyt-*b*-label used in Stümpel (2012), Stümpel et al. (2016).

Geographic origin	6	1	1	2	3	8	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	4	4	4	4	5	5	6	6	6	6	7	7	7	7	7	7	8	8	8	8	9	
locality-48-Mbu (bg10): Elmali-Kar Boğaz, Pozanti/Adana	G	T	A	G	C	G	C	G	G	G	G	G	G	T	T	G	G	C	A	G	C	C	C	G	C	T	A	C	C	C	C	C	C	C	G	C	A	C	G	T	C	C		
locality-51-Mbu (our data Mbu13-17): Kar Boğaz Valley, district Pozanti/Adana	G	T	A	G	C	G	C	G	G	G	G	G	T	T	G	G	C	A	G	C	C	C	G	C	T	A	C	C	C															
locality-52-Mbu (bg16): Kar Boğaz, north of Gülek, Tarsus/Mersin	A	T	G	G	C	G	C	G	G	G	G	G	T	T	A	A	C	A	G	C	C	C	G	C	T	A	C	C	T	C	C	C	G	C	A	C	G	T	C	C				
locality-54-Mbu (bg12): Kozpinari, Çamliyayla/Mersin	G	T	G	G	A	G	C	G	A	G	G	A	G	T	T	G	A	C	G	G	C	C	C	G	C	T	G	T	C	C	C	C	A	T	T	C	G	T	T	C				
locality-54-Mbu (bg13): Kozpinari, Çamliyayla/Mersin	G	T	G	G	A	G	C	G	A	G	G	A	G	T	T	G	A	C	G	G	C	C	C	G	C	T	G	T	C	C	C	C	A	T	T	C	G	T	T	C				
locality-55-Mbu (xt12): Cocakdere NP, north Atlilar, Toroslar/Mersin	G	T	G	G	A	G	C	G	A	G	G	A	G	T	T	G	A	C	G	G	C	C	C	G	C	T	G	T	C	C	C	C	A	T	T	C	G	T	T	C				
locality-57-Mbu (bg3): Catak-Arslanköy, Toroslar/Mersin	G	T	G	G	A	G	C	G	A	G	G	A	G	T	T	G	A	C	G	G	C	C	C	G	C	T	G	T	C	C	C	C	A	T	T	C	G	T	T	C				
locality-57-Mbu (bg4): Catak-Arslanköy, Toroslar/Mersin	G	T	G	G	A	G	C	G	A	G	G	A	G	T	T	G	A	C	G	G	C	C	C	G	C	T	G	T	C	C	C	C	A	T	T	C	G	T	T	C				
locality-57-Mbu (bg5): Catak-Arslanköy, Toroslar/Mersin	G	T	G	G	A	G	C	G	A	G	G	A	G	T	T	G	A	C	G	G	C	C	C	G	C	T	G	T	C	C	C	C	A	T	T	C	G	T	T	C				
locality-62-Mbu (our data Mbu19-20): Gavuructugu, Erdemli/Mersin	G	T	G	G	A	G	C	G	A	G	G	A	G	T	T	G	A	C	G	G	C	C	C	G	C	T	G	T	C	C														
locality-20-Mal (our data Mal26): Sandik, Kemaliye/Erzincan	G	T	G	G	C	G	C	G	G	G	G	A	G	T	T	G	A	C	A	A	C	C	C	G	T	T	A	C	C	T														
locality-23-Mal (az9): Karasar-Uzunkaya, Divriği/Sivas	G	T	G	G	C	G	C	G	G	G	G	A	G	T	T	G	A	C	A	A	C	C	C	G	T	T	A	C	C	T	C	C	C	G	C	A	C	G	C	C	C			
locality-23-Mal (az6): Karasar-Uzunkaya, Divriği/Sivas	G	T	G	G	C	G	C	G	G	G	G	A	G	T	T	G	A	C	A	A	C	A	C	G	T	T	A	C	C	T	C	C	C	G	C	A	C	G	C	C	C			
locality-25-Mal (our data Mal54): Ovacik, Tecer Mountains, Ulaş/Sivas	G	T	G	G	C	G	C	G	G	G	G	A	G	T	T	G	A	C	A	A	C	C	C																					

locality-27-Mal (az3): Kayapinar, Tecer Mountains, Ulaş/Sivas
locality-27-Mal (az4): Kayapinar, Tecer Mountains, Ulaş/Sivas
locality-27-Mal (az5): Kayapinar, Tecer Mountains, Ulaş/Sivas
locality-38-Mal (az7): east of Karaboğaz, Pinarbaşı/Kayseri
locality-39-Mal (spec1): Kurucaova, Göksun/Kahramanmaraş
locality-41-Mal (our data Mal48): Bostanlı, Andirin/Kahramanmaraş
locality-45-Mal (our data Mal62): Nemrut Mt., Kahta/Adiyaman
locality-1-Mwa (wg15): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg:10): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg11): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg12): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg13): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg16): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg3): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg4): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg5): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg6): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg7): Aras Valley, districts Sarikamis and Kagizman/Kars
locality-1-Mwa (wg8): Aras Valley, districts Sarikamis and Kagizman/Kars

G T G G C G C G G G G A G T T G A C A A C C C G T T A C C T C C C G C A C G C C C
G T G G C G C G G G G A G T T G A C A A C C C G T T A C C T C C C G C A C G C C C
G T G G C G C G G G G A G T T G A C A A C C C G T T A C C T C C C G C A C G C C C
G T G G C G C G G G A A G T T G A C A G T C C G C T A C C T C C C G C A C G C C C
G T G G C G C T G G G A G T T G A C A G C C C G C T A C C T C C C G C A C G C C C
G T G G C G C G G G G A G T C G A C A G C C C G C T A C C T
G T G G C G C G G G G A G C T G A T A G C C C G C C G C C C
A C A C C A T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T

locality-3-Mwa (wg9): Aras town,
 Horasan/Erzurum
 locality-8-Mwa (our data Mwa77, 78):
 Bostancilar-Akcakaynak Bulanik/Muş
 locality-10-Mwa (our data Mwa74): Ilica,
 Hınıs/Erzurum
 locality-11b-Mwa (our data Mwa83):
 Topalan, Merkez/Bingöl
 locality-14-Mwa (our Mwa93): Tahkini
 Plateau-Pohoz Mevki, Nazimiye/Tunceli
 locality-14-Mwa (our Mwa95): Tahkini
 Plateau-Pohoz Mevki, Nazimiye/Tunceli

G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
 A G C G T G A A A A A T T G A T A A C C T G T C G C T C C T T A C A T A T C
 G T G A A A A A T T G A T A A C C T G T T G C T C T T T A C A T A T
 G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C C T T A C A T A T C T
 G C A G C G T G A A A A A T T G A T A A C C T G T T G C T C
 G C A G C G T G A A A A A T T A A T A A C C T A T T G C T C

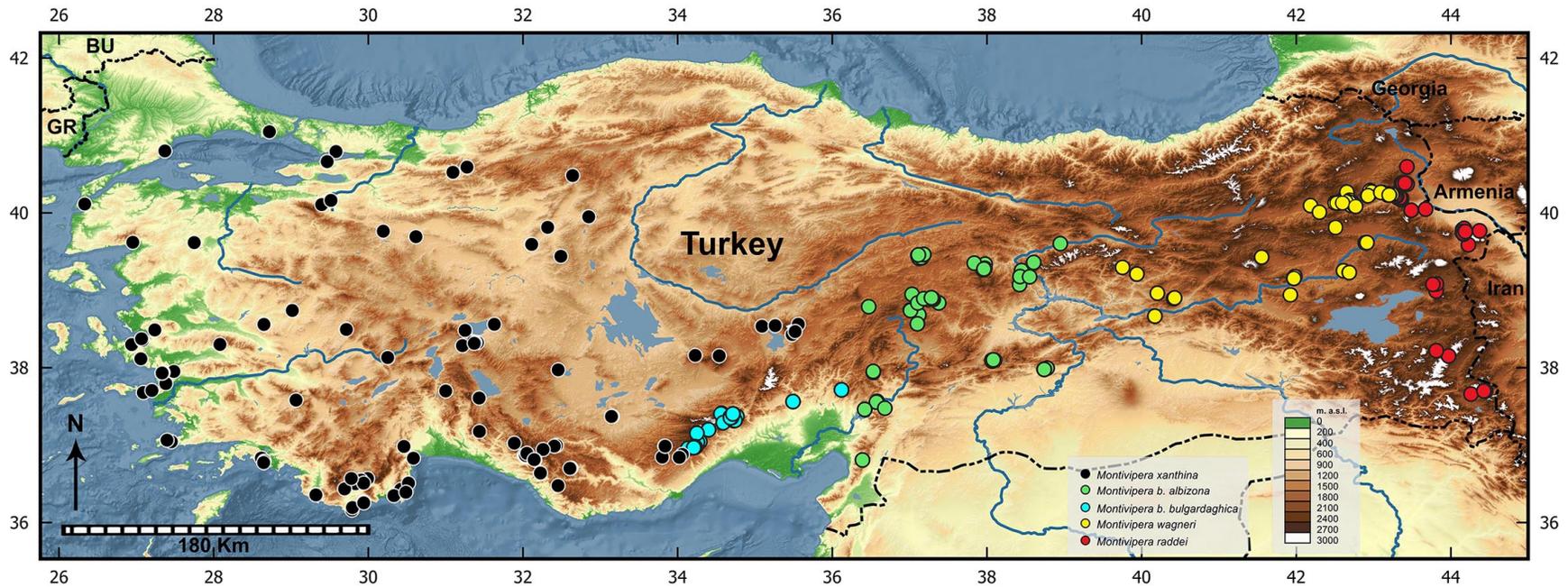


FIGURE 1-from primary article-enlarged. Distribution of mountain vipers in Turkey: *Montivipera xanthina* (black), *M. b. albizona* (green), *M. b. bulgardaghica* (light blue), *M. wagneri* (yellow), and *M. raddei* (red). Locality marks for western Ottoman Viper (*M. xanthina*) are incomplete, but sufficiently representative.

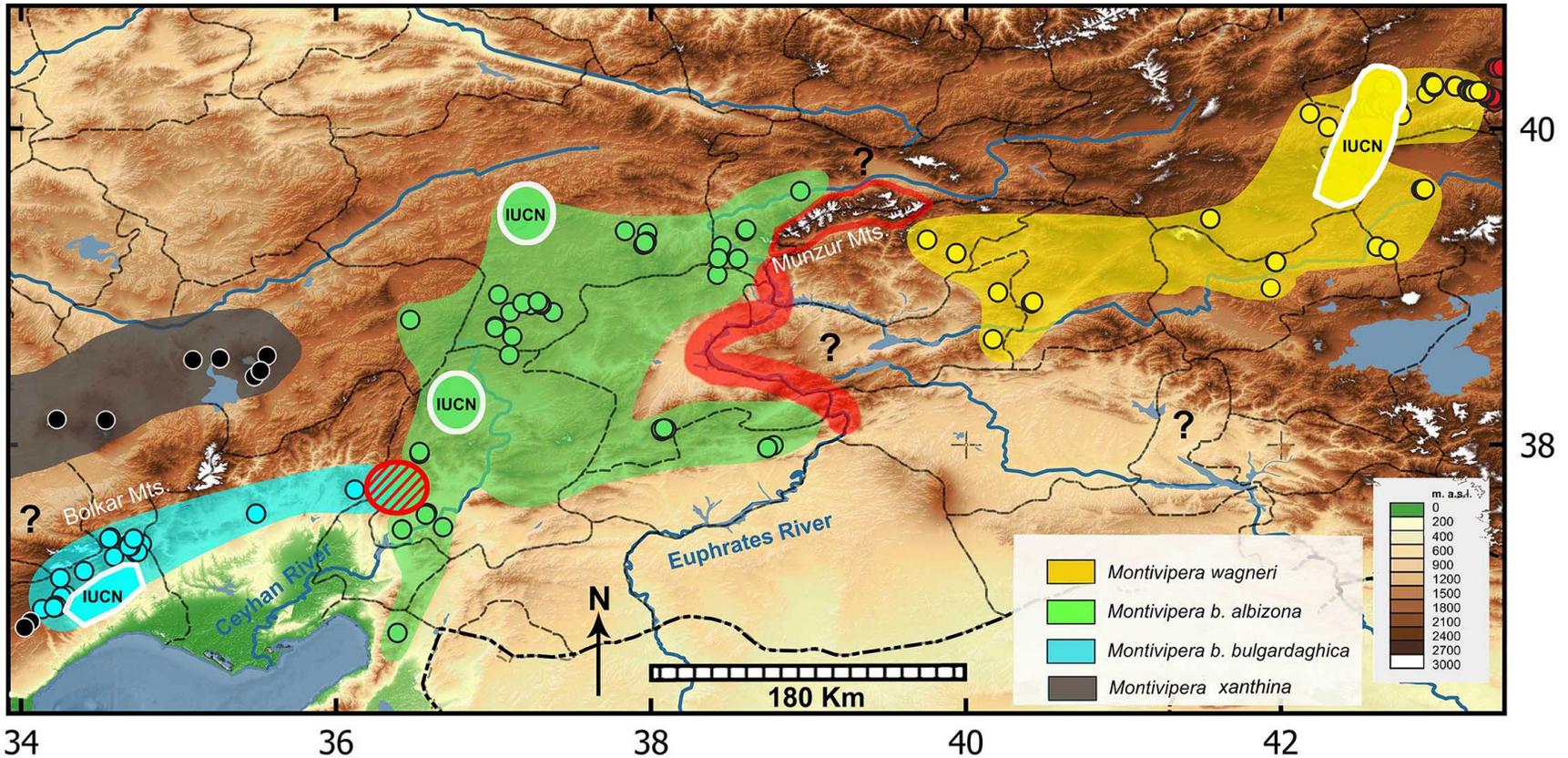


FIGURE 11—from primary article-enlarged. Updated distribution of mountain vipers in south-central to north-eastern Anatolia with known localities as colored circles on top of same color shaded areas representing their interpolated ranges: dark grey (*Montivipera xanthina*), light blue (*M. b. bulgardaghica*), green (*M. b. albizona*), yellow (*M. wagneri*). For the latter three taxa, the smaller, white-bordered, and color-saturated polygons represent the approximate and much smaller distribution maps as depicted in the respective files of the IUCN Red List of Threatened Species (IUCN. 2020. *op. cit.*). The red transparent band over the Euphrates River leads north to a red-bordered area encircling the Munzur-Mercan Mountains. They indicate the prominent landscape feature separating most proximate populations between *M. b. albizona* and *M. wagneri* or may represent even their potential contact zone. Similarly, the red-hatched circle near the Ceyhan River reflects a potential contact or transition zone between the subspecies of *M. b. bulgardaghica* and *M. b. albizona*. However, substantial further sampling is required to confirm or adjust these potential contact/transition zones. Question marks indicate areas where additional *Montivipera* populations are expected but require confirmation.

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