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Overlooked! Formal description of a new species of Green Viper from Eastern India and Burma.

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ABSTRACT

A population of vipers in northern Myanmar and eastern India originally identified as being *Trimeresurus medoensis* Zhao, 1977, type locality Ani Bridge, Motuo, Xizang, China, at 1200 m elevation, is shown to be a morphologically divergent species.

These putative taxa were assigned to the genus *Viridovipera* Malhorta and Thorpe, 2004 by Hoser (2013), who also erected the subgenus *Simpsonvipera* Hoser, 2013 for what at the time was being treated as a single species.

The south-eastern population is herein formally named as *Viridovipera* (*Simpsonvipera*) *paracaeruleus sp. nov*.. It is physically separated from *V. medoensis* by the low elevation biogeographical barrier of the Brahmaputra drainage system.

V. paracaeruleus sp. nov. is readily separated from *V. medoensis* by the absence of a post-ocular streak.

A related species *V. mayaae* Rathee *et al*. 2022 is also placed in the subgenus *Simpsonvipera* Hoser, 2013.

A divergent subspecies of *V. paracaeruleus sp. nov*. is also formally named according to the rules of the *International Code of Zoological Nomenclature* (Ride *et al*. 1999) as amended online since, and is separated from the other two taxa by head scalation and hemipenal morphology.

Keywords: Snake; viper; Asia; Burma; Myanmar; India; China; Brahmaputra; *Trimeresurus*; *Viridovipera*; *Simpsonvipera*; *medoensis*; *mayaae*; New species; *paracaeruleus*; new subspecies; *ashokcaptaini.*

INTRODUCTION

The species *Trimeresurus medoensis* Zhao, 1977 was described from just two specimens from the south-eastern Xizang Autonomous Region in China. A morphologically similar third specimen from the vicinity of Myitkyina, northern Myanmar was formally referred to this species by Zhao *et al.* (1998). David *et al*. (2001) (cited herein as 2002a) redescribed *T. medoensis* including 26 specimens from the eastern Changlang District, State of Arunachal Pradesh, north-eastern India.

Those 26 specimens were also most similar to the Myanmar snakes referred to *Trimeresurus medoensis* Zhao, 1977 earlier, which were also inspected by David *et al*. (2001) (cited herein as 2002a).

While engaging in a genus-level review of the viper family that was published in Hoser (2013) and other papers in 2012, *Trimeresurus* Lacépède, 1804 *sensu-lato* was broken up into genera and subgenera, with *Viridovipera medoensis* (Zhao, 1977), placed in the genus *Viridovipera* Malhorta and Thorpe, 2004 and furthermore within what was then treated as a monotypic subgenus *Simpsonvipera* Hoser, 2013, based on molecular divergence from congeners.

At the time it was noted that based on the publication of David *et al*. (2001) (cited herein as 2002a), there were consistent morphological differences between the two main populations of putative *V. medoensis.*

Noting that there was a major biogeographical barrier separating the two main populations in the form of the Brahmaputra drainage system, it had been my intention to subdivide the two populations at either the species or subspecies level.

The question as to which level the taxonomic separation should be made was in fact answered by Rathee *et al*. (2022), who showed with molecular data that the two relevant populations of *V. medoensis* comprised at least two separate species, with the unnamed one being more divergent from their new species *V. mayaae* Rathee *et al*. 2022 than was *V. medoensis sensu strico*, the otherwise closest related known species.

On the basis of the preceding and noting the extreme habitat destruction ongoing in the relevant region, I have no hesitation in formally naming the Burmese and east Indian population as a new species.

MATERIALS AND METHODS

A review of the relevant literature, pertaining to *V. medoensis sensu lato* was undertaken with a view to determining differences between specimens of the putative species, including in lieu of direct inspection of specimens.

Included in this were photos of the relevant type material and similar and specimens from across the known range of the

relevant species, which were assessed at close view.

The excellent publication of David *et al.* (2001) (cited herein as 2002a) in fact answered almost all relevant questions, even though in finality, the authors made (what in hindsight was) a judgment error in concluding that populations of putative *V. medoensis sensu lato* from China, eastern India and northern Burma were all of the same species.

The molecular study of Rathee *et al.* (2022) confirmed that there were in fact two or three species currently (as of 2022) being identified as *V. medoensis.*

Literature was checked for potential synonym names of which there were none.

The taxa in question were also checked in terms of relevant placement in terms of genus or subgenus, in line with relevant published literature.

The relevant publications in terms of putative *V. medoensis sensu lato* included Das (2012), David and Tong (1997), David *et al.* (2001, 2002a, 2002b, 2011), Dawson *et al*. (2008), Griffin *et al*. (2012), Gumprecht *et al.* (2004), Guo *et al*. (1999, 2015), Harrington *et al*. (2018), Hoser (2012, 2013), Lenz (2012), Leviton *et al.* (2003), Malhotra and Thorpe (2004), McDiarmid *et al*. (1999), Purkayastha *et al*. (2020), Rathee *et al.* (2022), Ride *et al*. (1999), Wallach *et al*. (2014), Wang *et al*. (2020), Whittaker and Captain (2004), Zhao and Jiang (1977), Zhao (2006) and sources cited therein.

RESULTS

As already outlined, that the Burmese population was morphologically divergent from the Chinese population referred to *V. medoensis*, that being the type form for the species, was already known and again confirmed.

Furthermore the Indian specimens biogeographically separated from the Burmese specimens by the Hukawang Valley in north-west Burma, are morphologically divergent. See for example the strongly indented supraocular in the south Burmese specimens, versus not so in the east Indian specimens.

This in my view means a taxonomic break between these two populations as well, herein taken as being at the subspecies level.

Both populations are at this stage assigned to the same species, being described herein as new as *V. paracaeruleus sp. nov*. using a Burmese specimen as the holotype for the species. The subspecies is herein also formally named as *V. paracaeruleus ashokcaptaini subsp. nov*. based on a live specimen from north eastern India that has since been released (after being photographed).

The preceding also means that the formerly monotypic subgenus *Simpsonvipera* Hoser, 2013, now has three species, namely *V. medoensis*, *V. mayaae* (Rathee, Purkayastha, Lalremsanga, Dalal, Biakzuala, Muansanga, Mirza, 2022) and the newly named *V. paracaeruleus sp. nov*..

In terms of the formal descriptions below, the spellings of the names is intentional and should not be altered unless absolutely necessary according to the rules of the ICZN as published in the *International Code of Zoological Nomenclature* (Ride *et al.* 1999), as amended online since.

VIRIDOVIPERA* (*SIMPSONVIPERA*) *PARACAERULEUS SP. NOV.

LSIDurn:lsid:zoobank.org:act:3EEFCD17-9E8C-4F8D-B278-8639253DF93D

Holotype: A preserved young female specimen at the American Museum of Natural History, New York, USA, specimen number AMNH Herpetology R-58532, collected from near Myitkyina, Myanmar, Latitude 25.3946 N., Longitude 97.3841 E.

This facility allows access to its holdings.

Paratype: A preserved specimen at the Museum of Natural History, London, UK, specimen number 1936.7.4.43, collected at Nam Ti Valley, Kachin, Putao, Myanmar. It is incorrectly labelled "*Trimeresurus stejnegeri."* That is a taxon from mountains further east.

Detailed descriptions of both holotype and paratype of *V. paracaeruleus sp. nov*. are published in David *et al.* (2001) (cited herein as 2002a) and not repeated here.

Diagnosis: Until now *V. paracaeruleus sp. nov*. has been treated as a population of the species *V. medoensis* (Zhao, 1977), type locality Ani Bridge, Motuo, Xizang, China, at 1200 m elevation.

Type *V. medoensis* (Zhao, 1977) have a distinctive post-ocular streak, whereas *V. paracaeruleus sp. nov*. (both formally named subspecies) does not.

V. medoensis (Zhao, 1977) is herein confined to the type locality and nearby areas within China, being generally north of the main Brahmaputra River and Luhit Rivers drainage basin.

South and east of there in north-east India and far northern Myanmar is where *V. paracaeruleus sp. nov*. occurs.

The nominate form of *V. paracaeruleus sp. nov*. occurs from Myitkyina, Myanmar in the south and in the Kumon Bum mountain range extending north to the border with India.

This range is bound by low-lying drainage basins on each side to the east and west.

The nominate subspecies of *V. paracaeruleus sp. nov*. and *V. medoensis* are both readily separated from the subspecies *V. paracaeruleus ashokcaptaini subsp. nov*. by having a large supraocular on each side, long and wide, about 2.3/2.2 times as long as wide, much wider than the adjacent upper head scales and about 0.9/0.7 times as wide as internasals, strongly indented by the upper head scales; versus not so or only slightly indented in *V. paracaeruleus ashokcaptaini subsp. nov*..

V. paracaeruleus ashokcaptaini subsp. nov. is further separated from *V. medoensis* by having about 12 spines of irregular size on the proximal 2/3 of the hemipene (a trait presumably shared with *V. paracaeruleus sp. nov*.), versus about 15 spines in *V. medoensis.*

V. paracaeruleus ashokcaptaini subsp. nov. occurs west of the Hukawang Valley in north-west Burma, in the area of the Burmese and Indian Border, west to at least the Barail Range, India with the morphologically similar *V. mayaae* (Rathee *et al*., 2022) being found in the elevated areas, south and west of there.

V. mayaae is separated from other members of the genus *Viridovipera* Malhorta and Thorpe, 2004 by having a rust coloured eye in males versus bright red or amber (rarely yellow) coloured in *V. stejnegeri* (Schmidt, 1925), yellow or yellowish green in *V. vogeli* (David, Vidal and Pauwels, 2001), bright or deep red in *V. yunnanensis* (Schmidt, 1925), or green or yellowish green in *V. medoensis*, *V. paracaeruleus sp. nov*. and *V. paracaeruleus ashokcaptaini subsp. nov.*.

In all of *V. medoensis*, *V. paracaeruleus sp. nov*. and *V. paracaeruleus ashokcaptaini subsp. nov.* there is a green or yellow-green coloured eye in females versus yellow or amber in *V. stejnegeri*, yellow in *V. vogeli* and golden yellow in *V. yunnanensis*.

The three above species, within *Simpsonvipera subgen. nov*., (being *V. medoensis*, *V. paracaeruleus sp. nov*. and *V. mayaae*) are separated from the rest of the genus *Viridovipera* and other Asian pitvipers by the following suite of characters:

17 dorsal mid-body scale rows, dorsal rows 7-11 slightly keeled; 8 upper labials, first upper labials separated from nasals by a distinct suture; green or bluish green above, yellowish white below, the two separated by a bright bicolored red (below) and white (above) ventrolateral stripe (in both males and females), which occupies the whole of the outermost scale row and a portion of the second row;

ventrals less than 150; hemipenes short, thick and spinose (12-15 spines) on the proximal 2/3. Total length in adult males is about 671 mm, adult females 650 mm; tail length in males is 125 mm, females 115 mm (modified from Hoser, 2013).

Distribution: *V. paracaeruleus sp. nov*. of the nominate form occurs in Myanmar from Myitkyina, Myanmar in the south (just north-west of there) and in the Kumon Bum mountain range extending north to the border with India. The range is bound by

low lying drainages to the east and west and lower hills between the Kumon Bum mountain range and the main Himalayas to the north.

The subspecies *V. paracaeruleus ashokcaptaini subsp. nov.* occurs west of the Hukawang Valley in north-west Burma, in the area of the Burmese and Indian Border, in the Patkai Bum and Mangin Ranges, west of the Chindiwin River drainage system, and is found west to at least the Barail Range, India with the morphologically similar *V. mayaae* Rathee *et al*. 2022 being found in the elevated areas, south and west of there.

There is no evidence of sympatry between any of the preceding named forms.

Etymology: *V. paracaeruleus sp. nov*. is named in reflection of the fact that in life some dorsal scales may be etched with blue, as is some interstitial skin, that may be either turquoise blue or dark blue, the name "*caeruleus"* in Latin meaning blue and the prefix *"para"* meaning not quite.

Preserved specimens also commonly get a bluish hue.

VIRIDOVIPERA PARACAERULEUS ASHOKCAPTAINI SUBSP. NOV.

LSIDurn:lsid:zoobank.org:act:4C3D6281-1B8E-45E7-A066-B808387772C4

Holotype: An adult specimen depicted in an image in Figure 1, at top left on page 225 in David, Captain and Bhatt (2001) published in *Hamadryad* 26(2), pp. 222-238, (cited here as 2002a).

It was found within 3 km of Gandhigram village (also known as Shidi), in Changlang District, Arunachal Pradesh, elevation 1,040 m a.s.l, India, Latitude 27.2627 N., Longitude 96.5455 E.

At the present time, I am unaware of any specimens of this taxon lodged in any museums anywhere.

Diagnosis: Until now *V. paracaeruleus sp. nov*. has been treated as a population of the species *V. medoensis* (Zhao, 1977), type locality Ani Bridge, Motuo, Xizang, China, at 1200 m elevation.

Type *V. medoensis* (Zhao, 1977) have a distinctive post-ocular streak, whereas *V. paracaeruleus sp. nov*. does not.

V. medoensis (Zhao, 1977) is herein confined to the type locality and nearby areas within China, being generally north of the main Brahmaputra River and Luhit Rivers drainage basin.

South and east of there in north-east India and far northern Myanmar is where *V. paracaeruleus sp. nov*. occurs.

The nominate form of *V. paracaeruleus sp. nov*. occurs from Myitkyina, Myanmar in the south and in the Kumon Bum mountain range extending north to the border with India.

This range is bound by low-lying drainage basins on each side to the east, west and north-west.

The nominate subspecies of *V. paracaeruleus sp. nov*. and *V. medoensis* are both readily separated from the subspecies *V. paracaeruleus ashokcaptaini subsp. nov*. by having a large supraocular on each side, long and wide, about 2.3/2.2 times as long as wide, much wider than the adjacent upper head scales and about 0.9/0.7 times as wide as internasals, strongly indented by the upper head scales; versus not so or only slightly indented in *V. paracaeruleus ashokcaptaini subsp. nov*..

V. paracaeruleus ashokcaptaini subsp. nov. is further separated from *V. medoensis* by having about 12 spines of irregular size on the proximal 2/3 of the hemipene (a trait presumably shared with *V. paracaeruleus sp. nov*.), versus about 15 spines in *V. medoensis.*

V. paracaeruleus ashokcaptaini subsp. nov. occurs west of the Hukawang Valley in north-west Burma, in the area of the Burmese and Indian Border, west to at least the Barail Range, India with the morphologically similar *V. mayaae* (Rathee *et al*., 2022) being found in the elevated areas, south and west of there.

V. mayaae is separated from other members of the genus *Viridovipera* Malhorta and Thorpe, 2004 by having a rust coloured eye in males versus bright red or amber (rarely yellow) coloured in *V. stejnegeri* (Schmidt, 1925), yellow or yellowish green in *V. vogeli* (David, Vidal and Pauwels, 2001), bright or deep red in *V. yunnanensis* (Schmidt, 1925), or green or yellowish green in *V. medoensis*, *V. paracaeruleus sp. nov*. and *V. paracaeruleus ashokcaptaini subsp. nov.*.

In all of *V. medoensis*, *V. paracaeruleus sp. nov*. and *V. paracaeruleus ashokcaptaini subsp. nov.* there is a green or yellow-green coloured eye in females versus yellow or amber in *V. stejnegeri*, yellow in *V. vogeli* and golden yellow in *V. yunnanensis*.

The three above species, within *Simpsonvipera subgen. nov*., (being *V. medoensis*, *V. paracaeruleus sp. nov*. and *V. mayaae*) are separated from the rest of the genus *Viridovipera* and other Asian pitvipers by the following suite of characters:

17 dorsal mid-body scale rows, dorsal rows 7-11 slightly keeled; 8 upper labials, first upper labials separated from nasals by a distinct suture; green or bluish green above, yellowish white below, the two separated by a bright bicolored red (below) and white (above) ventrolateral stripe (in both males and females), which occupies the whole of the outermost scale row and a portion of the second row; ventrals less than 150; hemipenes short, thick and spinose (12-15 spines) on the proximal 2/3. Total length in adult males is about 671 mm, adult females 650 mm; tail length in males is 125 mm, females 115 mm (modified from Hoser, 2013).

Distribution: The subspecies *V. paracaeruleus ashokcaptaini subsp. nov.* occurs west of the Hukawang Valley in north-west Burma, in the area of the Burmese and Indian Border, in the Patkai Bum and Mangin Ranges, west of the Chindiwin River drainage system, and is found west to at least the Barail Range, India with the morphologically similar *V. mayaae* Rathee *et al*. 2022 being found in the elevated areas, south and west of there.

V. paracaeruleus paracaeruleus subsp. nov. of the nominate form (with the above description doubling up as a formal description of this new susbspecies, with the holotype listed in the formal description of *V. paracaeruleus sp. nov.*) occurs in Myanmar from Myitkyina, Myanmar in the south (just north-west of there) and in the Kumon Bum mountain range extending north to the border with India. The range is bound by low lying drainages to the east and west and lower hills between the Kumon Bum mountain range and the main Himalayas to the north.

There is no evidence of sympatry between any of the preceding named forms.

Etymology: The subspecies *V. paracaeruleus ashokcaptaini subsp. nov.* is named in honour of Ashok Captain of Maharashtra, India in recognition of his work with the herpetofauna of India, including with respect of this formally named taxon.

SUMMARY

That undescribed species of viper can still be identified and formally named in 2022, says a lot about unrecorded diversity remaining within herpetology.

It goes without saying that within smaller forms such as small lizards in remote places, there must remain an even greater currently unrecorded species-level diversity.

The urgency with which these currently unnamed taxa need to be formally identified and managed to ensure their long-term survival cannot be understated.

According to the website https://www.macrotrends.net on 22 May 2022 the population of India rose by over 13 million people in year 2021 alone, rising from a base of 1.393 billion people.

All those people need to be fed, clothed, housed and so on, meaning yet more pressure on the few relatively wild and untouched places left.

Adjoining countries like Bangladesh and China are in a similar position with massive and growing human populations and the consequent environmental devastation.

The ecosystem crisis is further exacerbated by the urgent need for most of these populations of people who remain poor by world standards to raise living standards, which will also cause further habitat destruction as resources are extracted to help raise the very low current living standards.

Unfortunately, the long-term survival of both the preceding forms of snake formally named and many other reptile species in the region will only be assured if the rampant human population growth is stopped and reversed. Neither currently seem likely and may only happen in the event of some unforseen human crisis such as war or pandemic.

However nature does abide by rules and you cannot have infinite growth within a finite system and so the long term prospects for both humanity, who's footprint on the planet is expanding and the reptile species in question, being confined to ever shrinking areas, can only be regarded as bleak as noted in Hoser (1989, 1991, 1993 and 1996).

Both the preceding formally named species are also subject to the existential threats outlined by Hoser (2019a-b).

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CONFLICTS OF INTEREST - NONE