

A new Viper species from Croatia (Reptilia: Squamata: Serpentes: Viperidae: *Pelias*).

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ABSTRACT

This paper formally names a new species of viper from Croatia, Europe as *Pelias cathrynmatteoae* sp. nov..

This range-restricted taxon has been known as distinct for some years. It is most closely related to *Pelias ursinii* Bonaparte, 1835, a species placed by most publishing authors in the genus *Vipera*

Laurenti, 1769, or alternatively the nominate taxon best known as *Vipera ursinii rakosiensis* Mehely, 1893, herein treated as a full species, that being the next most closely related species.

The putative taxa *Vipera ursinii macrops* Mehely, 1911 and *Vipera ursinii moldavica* Nilson, Andren and Joger, 1993 are treated herein as subspecies of *Vipera rakosiensis* based on their limited divergence from that taxon, but all are also included herein in the genus *Pelias* Merrem 1820.

P. cathrynmatteoae sp. nov. as formally named herein has also at times been confused with putative *P. ursinii macrops* Mehely, 1911.

P. cathrynmatteoae sp. nov. (type locality Velebit, Croatia) is split into two subspecies with *P. cathrynmatteoae kapelaensis* subsp. nov. occurring in the Kapela Range (part of the northern Dinaric Alps).

A subspecies of *P. ursinii* from far south-eastern France, east of the Durance River is also formally named for the first time as *P. ursinii alpesdehautensis* subsp. nov.. It is a distinctly different subspecies to the previously named *P. ursinii wettsteini* Knoch and Sochurek, 1955, with a type locality of den Montagne de Lure, Bases Alpes, south-east France and occurring west of the Durance River.

The southern population of *P. graeca* (Nilson and Andren, 1988) is formally named as the subspecies *P. graeca vardousiaensis* subsp. nov..

With limited distributions, combined with a strong interest in vipers among herpetologists, it would make sense for viable captive populations of the relevant taxa to be established to protect against unforeseen calamity or event that may exterminate those in the wild.

Keywords: Snake; viper, taxonomy; nomenclature; new species; vipers; Croatia; Europe; *Pelias*; *Vipera*; *Acridophaga*; *ursinii*; *wettsteini*; *rakosiensis*; *macrops*; *moldavica*; *graeca*; new species; *cathrynmatteoae*; new subspecies; *kapelaensis*; *alpesdehautensis*; *vardousiaensis*.

INTRODUCTION

In spite of centuries of scrutiny by herpetologists, there remain numerous undescribed species of vipers.

In the past 2 decades (post year 2000), dozens of species and subspecies of viper and pitviper species have been formally named from most parts of their known distribution, including Spain, Greece, Turkey, many parts of Africa, South-east Asia, the USA, Mexico and central America.

New genera have also been named in both old and new world and for both vipers and pitvipers.

Species and/or subspecies of viper formally described in the preceding 10 years (2012-2022) include the following:

Adelynhoserserpenae borealis (Tepos-Ramirez, Flores-Villela, Velasco, Lara, Garcia-Rubio and Jadin, 2021)

Adelynhoserserpenae wellsii Hoser, 2013

Atheris hetfieldi Ceraico, Marques and Bauer, 2020

Atheris mongoensis Collet and Trape, 2020

Azemiops kharini Orlov, Ryabov and Nguyen, 2013

Bitis harena Gower, Wade, Spawls, Böhme, Buechley, Sykes and Colston, 2016

Bitis (Klosevipera) kajerikbulliardii Hoser, 2013

Bitis (Klosevipera) swilae Hoser, 2013

Bitis benjaminswilei Hoser, 2022

Bitis brianwallacei Hoser, 2013

- Bitis lourenceklosei* Hoser, 2013
Bitis matteoae Hoser, 2013
Bitis oflahertyae Hoser, 2013
Bitis pintauidii Hoser, 2013
Bitis tomcottoni Hoser, 2013
Bothriechis guifarroi Townsend, Medina-Flores, Wilson, Jadin and Austin, 2013
Bothriechis nubestris Doan, Mason, Castoe, Sasa and Parkinson, 2016
Bothrops germanoi Barbo, Brooker, Duarte, Chaluppe, Portes-Junior, Franco and Grazziotin, 2022
Bothrops jabrensis Barbo, Grazziotin, Pereira-Filho, Freitas, Abrantes and Kokubum, 2022
Bothrops lenhoseri Hoser, 2013
Bothrops maccartneyi Hoser, 2013
Bothrops mexicoiensis Hoser, 2013
Bothrops monsignifer Timms, Chaparro, Venegas, Salazar-Valenzuela, Scrocchi, Cuevas, Leynaud and Carrasco, 2019
Bothrops oligobalius Dal Vechio, Prates, Grazziotin, Graboski and Rodrigues, 2021
Bothrops otavioi Barbo, Grazziotin, Sazima, Martins and Sawaya, 2012
Bothrops sazimai Barbo, Gasparini, Almedia, Zaher, Grazziotin, Gusamo, Ferrarini and Sawaya, 2016
Bothrops sonene Carrasco, Grazziotin, Cruz-Farfan, Koch, Ochoa, Scrocchi, Leynaud and Chaparro, 2019
Caudisona ehecatl (Carbajal-Marquez, Cedeno-Vazquez, Martinez-Arce, Neri-Castro and Machkour-M'Rabet, 2020)
Caudisona mictlantecuhltli (Carbajal-Marquez, Cedeno-Vazquez, Martinez-Arce, Neri-Castro and Machkour-M'Rabet, 2020)
Caudisona evatti Hoser, 2020
Causus perkinsi Hoser, 2013
Causus rasmusseni Broadley, 2014
Cerrophidion sasai Jadin, Townsend, Castoe and Campbell, 2012
Cerrophidion wilsoni Jadin, Townsend, Castoe and Campbell, 2012
Cottonus tomcottoni Hoser, 2020
Craspedocephalus peltopelor Mallik, Srikanthan, Ganesh, Vijayakumar, Campbell, Malhotra and Shanker, 2021
Craspedocephalus travancoricus Mallik, Srikanthan, Ganesh, Vijayakumar, Campbell, Malhotra and Shanker, 2021
Daboia (Oxyadaboia) oxyi Hoser, 2022
Daboia (Oxyadaboia) sloppi Hoser, 2022
Daboia crottyi Hoser, 2022
Gloydus angusticeps Shi, Yang, Huang, Orlov and Li, 2018
Gloydus huangi Wang, Ren, Dong, Jiang, Shi, Siler and Che, 2019
Gloydus lipipengi Shi, Liu, Giri, Owens, Santra, Kuttalam, Melvan, Guo and Malhotra, 2021
Gloydus rickmersi Wagner, Tuitenko, Borkin and Simonov, 2015
Gloydus rubromaculatus Shi, Li and Liu, 2017
Gloydus swild Shi, Liu, Giri, Owens, Santra, Kuttalam, Melvan, Guo and Malhotra, 2021
Macrocerastes funki Hoser, 2013
Macrocerastes hoseri Hoser, 2013
Macrocerastes wellingtoni Hoser, 2013
Macrovipera razii Oraie, Rastegar-Pouyani, Khosravani, Moradi, Akbari, Sehhatiasabet, Shafiei, Stumpel and Joger, 2018
Matteoea dorosioi Hoser, 2020
Matteoea matteoae Hoser, 2020
Matteoea sommerichi Hoser, 2020
Matteoea polisi (Meik, Schaack, Flores-Villela and Streicher, 2018)
Matteoea thalassoporus (Meik, Schaack, Flores-Villela and Streicher, 2018)
Montivipera europa Hoser, 2016
Montivipera snakebustersorum Hoser, 2016
Montivipera yeomansi Hoser, 2016
Ophryacus smaragdinus Grunwald, Jones, Franz-Chavez and Ahumada-Carillo, 2015
Pelias sakoi Tuniyev, Avci, Tuniyev, Ilgaz, Olgun, Petrova, Bodrov, Geniez and Teynie, 2018
Pelias walser (Ghielmi, Menegon, Marsden, Laddaga and Urtenbacher, 2016)
Piersonus bartletti Hoser, 2020
Protobothrops dabieshanensis Huang, Pan, Han, Zhang, Hou, Yu, Zheng and Zhang, 2012
Protobothrops himalayanus Pan, Chettri, Yang, Jiang, Wang, Zhang and Vogel, 2013
Protobothrops kelomohy Sumontha, Vasaruchapong, Chomngam, Suntrarachun, Pawangkhanant, Sompan, Smits, and Kunya Chanhome, 2020
Sayersus wellingtoni Hoser, 2020
Sayersus wellsii Hoser, 2020
Smythus smythi Hoser, 2020
Smythus teesi Hoser, 2020
Trimeresurus ashokcaptaini Hoser, 2022
Trimeresurus arunachalensis Captain, Deepak, Pandit, Bhatt and Athreya, 2019
Trimeresurus caudornatus Chen, Ding, Vogel and Shi, 2020
Trimeresurus davidi Chandramouli, Campbell and Vogel, 2020
Trimeresurus gunaleni Vogel, David and Sidik, 2014
Trimeresurus guoi Chen, Shi, Vogel and Ding, 2021
Trimeresurus kuiburi Sumontha, Suntrarachun, Pauwels, Pawan-Ngkhanant, Chomngam, Iamwiriyakul and Chanhome, 2021
Trimeresurus mayaae Rathee, Purkayastha, Lalremsanga, Dalal, Biakzuala, Muansanga and Mirza, 2022
Trimeresurus paracaeruleus Hoser, 2022
Trimeresurus salazar MIRZA, BHOSALE, PHANSALKAR, SAWANT, GOWANDE & PATEL, 2020
Trimeresurus yingjiangensis CHEN, ZHANG, SHI, TANG, GUO, SONG & DING, 2019
Uropsophus campbelli (Bryson Jnr, Linkem, Dorcas, Lathrop, Jones, Alvarado-Diaz, Grunwald and Murphy, 2014)
Uropsophus elfakhariorum Hoser, 2020
Uropsophus euanedwardsi Hoser, 2020
Uropsophus hammondi Hoser, 2020
Uropsophus oxyi Hoser, 2020
Uropsophus strimplei Hoser, 2020
Uropsophus swileorum Hoser, 2020
Uropsophus tlooci (Bryson Jnr, Linkem, Dorcas, Lathrop, Jones, Alvarado-Diaz, Grunwald and Murphy, 2014)
Uropsophus valentici Hoser, 2020
Vipera britoi Hoser, 2015
Vipera hoseri Hoser, 2015
Vipera veloantoni Hoser, 2015
Vipera wellingtoni Hoser, 2015
Vipera wellsii Hoser, 2015
- (The species in the above list and relevant publications they were first published in can be found at <http://www.zoobank.org>, with most relevant full papers available for download as pdfs at <http://www.herp.net>).
- Members of the Wolfgang Wüster gang of thieves as detailed in Hoser (2015a-f) have coined non-ICZN names for some of the preceding viper taxa and these illegal names are not listed here. They are listed in various synonyms lists.
- The International Commission on Zoological Nomenclature (ICZN) has published scathing rulings against the Wüster gang of thieves several times (ICZN 1991, 2001, 2021).

For many years it has been known that the so-called Meadow Viper, generally known in herpetology as *Vipera ursinii* (Bonaparte, 1835), but herein placed in *Pelias* Merrem, 1820 (along with all closely related viper species subject of this paper), mainly from southern Europe, consists of several morphologically distinct forms.

Numerous names have been coined, for the various localized forms as listed by McDiarmid *et al.* (1999), with some of these being generally recognized as subspecies.

Others have been synonymised.

While the consensus among herpetologists has been that the viperidae, including *P. ursinii* has been over-split by herpetologists *sensu* Freitas *et al.* (2020) the results of the phylogeny they produced revealed that while over-splitting had certainly occurred, there remained a number of potentially unnamed species and/or subspecies.

Included among these were a population of putative *P. ursinii* (type locality Abruzzi, Ascole Province, Italy), from Croatia, for which there was no available name, as well as populations of putative "*Vipera ammodytes* (Linnaeus, 1758)" (type locality Zadar, Croatia) from other parts of eastern Europe, in particular southern Greece.

This paper deals primarily with the taxon from Croatia, most similar to *P. ursinii*.

Five unnamed species and 8 previously unnamed subspecies in the "*Vipera ammodytes* (Linnaeus, 1758)" complex are formally named in a separate paper published at the same time as this one.

As of 2022, most publishing authors agree with Freitas *et al.* (2020) in recognizing nominate *P. ursinii* as a full species as well as each of *Vipera ursinii rakosiensis* Mehely, 1893 (type locality near Budapest, Hungary), *Vipera ursinii macrops* Mehely, 1911 (type locality Korita, Herzegovina) and *Vipera ursinii moldavica* Nilson, Andren and Joger, 1993 (type locality Valeui de David, Jasi, Romania) as subspecies, but there being no other valid subspecies.

The divergent "*Vipera ursinii graeca* Nilson and Andren, 1988" has most recently been treated by most herpetologists as a separate species and is also herein treated as in the genus *Pelias*.

(*Pelias* Merrem, 1820 has the type species of *Coluber berus* Linnaeus, 1758)

Other subspecies have been proposed by various authors, (as listed by McDiarmid *et al.* 1999), but not generally accepted or used in herpetology.

The phylogenies of Gvozdík *et al.* (2011), Ferchaud *et al.* (2011, 2012) and Freitas *et al.* (2020), assumed here to be accurate, showed three divergent species-level lineages in the complex, these being lineages with a divergence of 2 MYA or more. These were *P. ursinii*, another listed as *Vipera ursinii ssp.* (being a population until now usually treated as putative "*Vipera ursinii macrops* Mehely, 1911", to which it is geographically proximal to and morphologically similar to), and a group of three closely related putative taxa being, "*Vipera ursinii rakosiensis* Mehely, 1893" (type locality near Budapest, Hungary), "*Vipera ursinii macrops* Mehely, 1911" (type locality Korita, Herzegovina) and "*Vipera ursinii moldavica* Nilson, Andren and Joger, 1993" (type locality Valeui de David, Jasi, Romania) all having diverged from one another less than 1 MYA, meaning that all these should best be treated as a single species.

Gvozdík *et al.* (2011) got similar results, although their putative "*Vipera ursinii macrops*" was in fact the unnamed taxon from the Velebit Mountains, Croatia as opposed to type form of "*V. ursinii macrops*" from further south in Herzegovina.

With the Croatian form of putative *Pelias ursinii* twice flagged as being divergent at the species-level a decade apart and with no one indicating an intention to formally name this taxon, the primary purpose of this paper is to formally name it so that:

1/ Science can progress, and,

2/ Wildlife conservation agencies and NGO's can manage and conserve this species.

At the same time divergent populations of French *V. ursinii* were inspected to see if more than one subspecies occurred there as inferred by morphologically divergent populations on either side of the Durance River in south-eastern France and recently published studies of Ferchaud *et al.* (2011, 2012).

Furthermore, *V. graeca* were also inspected across their relatively small range to see if any subpopulations warranted taxonomic recognition.

MATERIALS AND METHODS

All relevant literature was reviewed to confirm that the putative taxon from Croatia was in fact an unnamed species, via checks of potentially available synonyms and to confirm the taxonomy shown by Freitas *et al.* (2020) and Gvozdík *et al.* (2011) via their phylogenies. Specimens were inspected to confirm morphological divergence, including via comparison with other putative *P. ursinii* and other putative subspecies of *P. ursinii*. That is including specimens from across the known range of the species complex.

Specimens of closely related species such as *Pelias renardi* Christoph, 1861, including putative subspecies and *P. graeca* (Nilson and Andren, 1988) were also inspected and compared with the Croatian form.

Literature relevant to the taxonomy, nomenclature and conclusions within this paper included

Balija *et al.* (2020), Baron *et al.* (1993), Benyr (2016), Beshkov and Nanev (2006), Billing (1985), Billing *et al.* (1990), Bodon (2009), Böhme and Joger (1984), Bonaparte (1835), Boulenger (1893, 1896, 1913), Cabela and Tiedemann (1985), Christoph (1861), Cogălniceanu *et al.* (2013), Console *et al.* (2020), Crnobrnja-Isailovic (2001), Dely and Stohl (1989a, 1989b), Di Nicola (2019), Eiselt and Baran (1970), Ferchaud *et al.* (2011, 2012), Freitas *et al.* (2020), Garanin *et al.* (2004), Garrigues *et al.* (2005), Gebhart (2020), Gemel *et al.* (2019), Ghira (2007), Golay *et al.* (1993), Grillitsch (2010), Gruber (2009), Gvozdík (2011), Hallmen (2015), Halpern and Péchy (2010), Ride *et al.* (1999), Jelić *et al.* (2013), Joger *et al.* (1992, 2007), Kabisch (1966), Kabisch and Belter (1968), Kammel (1992a, 1992b), Knoepffler and Sochurek (1955), Korsós *et al.* (2008), Kramer (1961), Krecsak (2007), Krecsák and Tóth (2009), Krecsák and Zamfirescu (2001), Kucharzewski (2011), Kukuskin (2009), Kunz (2015), Kwet (2010), Kwet and Trapp (2014a, 2014b), Lambert (2002), Lantermann and Lantermann (2010), Linnaeus (1758), Luef (2014), Mallow *et al.* (2013), Martínez-Freiria *et al.* (2020), McDiarmid *et al.* (1999), Méhely (1893, 1894, 1911), Merrem (1820), Mizsei *et al.* (2016, 2017), Naulleau (1987), Nilson and Andrén (1988, 2001), Nilson *et al.* (1988, 1993, 1995), Phelps (2010), Reading *et al.* (2010), Reuss (1924, 1927a, 1927, 1929, 1933), Ride *et al.* (1999), Schlüter (2009), Schwederski and Trutnau (2017), Schweiger (2009, 2012), Shine and Madsen (1994), Sigg (1987, 1990), Sindaco *et al.* (2000, 2013), Sos (2008), Sterijovski (2006), Strugariu (2008), Tabachishina *et al.* (2002), Tiedemann and Grillitsch (1999), Tomović *et al.* (2004, 2008), Török (2007), Tóth *et al.* (2005), Trapp (2006, 2007, 2011, 2014), Trutnau (1975), Tuniyev *et al.* (2010), Újvári *et al.* (2000, 2005), Úveges *et al.* (2012), Vancea *et al.* (1985), Vedmederja *et al.* (1986), Veith (1991), Venchi and Sindaco (2006), Wagner *et al.* (2015), Wallach *et al.* (2014), Werner (1894), Woerkom (1987), Zinenko *et al.* (2015) and sources cited therein.

RESULTS

The relevant species in the *P. ursinii* complex are all retained in the genus *Pelias* Merrem, 1820 (type species *Coluber berus* Linnaeus, 1758) based on a divergence from *Vipera* Laurenti, 1768 (type species *Vipera francisci redi* Laurenti, 1768 = *Vipera aspis* (Linnaeus, 1758)) of about 15 MYA based on the phylogeny published by Frietas *et al.* (2020).

The Croatian population of putative *P. ursinii* is not just genetically divergent from all other named forms, but also morphologically divergent and separable from the others.

With a divergence of about 2 MYA from the nearest relative, being the type form of *P. ursinii* from Italy, I have had no hesitation in formally naming the Croatian population as a new species, being *P. cathrynmatteoae* sp. nov..

That new species is formally described below in this paper.

As mentioned in the introduction, I agree with the concept put that within the immediate *P. ursinii* complex, there are just three species, being *P. ursinii*, *P. cathrynmatteoae* sp. nov. and as the third species, the cluster of putative *P. ursinii* *rakosiensis*, *P. ursinii* *macrops* and *P. ursinii* *moldavica*.

As *P. ursinii* *rakosiensis* is the oldest of the three relevant and available names, it is the name that carries the species.

The latter two names are applied to their respective populations as subspecies of *P. rakosiensis* as a species distinct, separate and divergent from *P. ursinii*.

This means *P. ursinii* is now confined to Italy and nearby south east France.

Pelias renardi Christoph, 1861 with a type locality of Sarepta, Russia is recognized as a single species, with the subspecies *P. renardi eriwanensis* (Reuss, 1933), *P. renardi lotievi* (Nilson, Tuniyev, Orlov, Hoggren and Andren, 1995), *P. renardi tienshanica* (Nilson and Andren, 2001), *P. renardi puzanovi* (Kukuskin, 2009) and *P. renardi bashkirovi* Garanin, Pavlov and Bakiev, 2004 also recognized as valid, based on estimated divergences of 1 MYA or less based on the published phylogenies of Gvozdík *et al.* (2011) and Freitas *et al.* (2020).

P. eriwanensis (Reuss, 1933) with a type locality in Armenia and *P. graeca* (Nilson and Andren, 1988) with a type locality of Lakmos Mountains in the southern Pindos Mountain Range in Greece are both regarded as a full species based on significant divergence from all others.

The species *P. ebneri* (Knoepffler and Sochurek, 1955) (type locality Elbrus Mountains, between Rhema and Demawend in the Elbrus Mountains, Iran) is believed to have diverged from *P. eriwanensis* about 1.4 MYA and so is also regarded as a full species.

Pelias cathrynmatteoae sp. nov. is split into two subspecies, the nominate form being from the Velebit range and the other *P. cathrynmatteoae kapelaensis* subsp. nov. from the Kapela Range (part of the northern Dinaric Alps), the two populations believed to have diverged about 500K years prior based on the phylogeny published by Ferchaud *et al.* (2012).

Not recognized at either species or subspecies level are, *P. ursinii rudolphi* (Reuss, 1924), herein treated as a synonym of *P. rakosiensis macrops* or *P. uralensis* Reuss, (1929), herein treated as a synonym of *P. renardi*,

P. ursinii wettsteini Knoepffler and Sochurek, 1955, with a type locality of den Montagne de Lure, Bases Alpes, south-east France with a divergence estimated by Ferchaud *et al.* (2012) of 0.6 MYA from the Italian population is regarded as a valid subspecies, being from the French Alps and near Alps, near the Italian border, with a type locality west of the Durance River, France.

Specimens from east of the Durance River, within France and with a similar divergence from both Italian and the other French specimens from further west (about 500K prior) are herein formally named as a morphologically diagnosable new subspecies *P. ursinii alpesdehautensis* subsp. nov..

In terms of *P. graeca* Nilson and Andren, 1988, the southern population from around Vandusia, Greece is sufficiently divergent from those in northern Greece and south Albania to warrant being recognized as a new subspecies, *P. graeca vardusiaensis* subsp. nov..

P. anatolica Eiselt and Baran, 1970 with a type locality of Antalya,

South-west Turkey is also regarded as a valid species.

The name *Acridophaga* Reuss, 1927 is available for the group at the genus level, either as a genus or subgenus, but based on divergences between other vipers and these estimated at less than 10 MYA, the name *Pelias* Merrem, 1820 (type species: *Coluber berus* Linnaeus, 1758), also available is used for the relevant species at the genus level for the purposes of this paper.

NOTES ON THE FORMAL DESCRIPTIONS THAT FOLLOW

In terms of the descriptions that follow, the following should be noted:

There is no conflict of interest in terms of this paper or the conclusions arrived at herein.

Several people including anonymous peer reviewers who revised the manuscript prior to publication are also thanked as are relevant staff at museums who made specimens and records available in line with international obligations.

In terms of the following formal descriptions, spellings should not be altered in any way for any purpose unless expressly and exclusively called for by the rules governing Zoological Nomenclature as administered by the International Commission on Zoological Nomenclature (ICZN) as published in the *International Code of Zoological Nomenclature* (Ride *et al.* 1999) ("The Code") as amended online since (ICZN 2012).

This includes if gender assignment of suffixes seems incorrect, Latinisation is wrong, apparent spelling mistakes and so on (see Article 32.5.1 of the Code).

In the unlikely event two or more newly named taxa are deemed to be the same by a first reviser, then the name to be used and retained is that which first appears in this paper by way of page priority and as listed in the abstract keywords.

Some material in descriptions for taxa may be repeated for other taxa in this paper and this is necessary to ensure each fully complies with the provisions of the *International Code of Zoological Nomenclature* (fourth edition) (Ride *et al.* 1999) as amended online since (ICZN 2012).

Material downloaded from the internet and cited anywhere in this paper was downloaded and checked most recently as of 10 August 2022 (including if also viewed prior), unless otherwise stated and was accurate in terms of the content cited herein as of that date.

Any online citations within this paper, including copied emails and the like, are not necessarily cited in the references part of this paper and have the same most recent viewing date as just given.

Unless otherwise stated explicitly, colour and other descriptions apply to living and **fully mature adult male specimens** of generally good health, as seen by day, and not under any form of stress by means such as excessive cool, heat, dehydration, excessive ageing, abnormal skin or reaction to chemical or other input.

SVL or SV means snout-vent length, TL means tail length.

While numerous texts and references were consulted prior to publication of this paper, the criteria used to separate the relevant genera, subgenera, species or subspecies has already been spelt out and/or is done so within each formal description and does not rely on material within publications not explicitly cited herein.

PELIAS CATHRYNMATTEOAE SP. NOV.

LSIDurn:lsid:zoobank.org:act:B49BED6A-8649-4D41-8DD0-BE037CA442BB

Holotype: A live specimen depicted in Figure 1 of Baliija *et al.* (2020) on page 2 of 16, from southern Velebit, Croatia.

(Baliija, M. L., Leonardi, A., Brgles, M., Sviben, D., Kurtovic, T., Halassy, B. and Krizaj, I. 2020. Biological Activities and Proteomic Profile of the Venom of *Vipera ursinii* ssp., a very Rare Karst Viper from Croatia. *Toxins* 2020(12)187:16 pp.)

Diagnosis: *Pelias cathrynmatteoae* sp. nov. from the Velebit Range, near the west coast of Croatia has until now been treated as a population of putative *P. ursinii* (Bonaparte, 1835), or alternatively the putative taxon *Pelias ursinii macrops* Mehely, 1911 herein treated as a subspecies of *Pelias rakosiensis* (Mehely, 1893), both of which it is proximally distributed with and morphologically similar to.

P. ursinii is herein restricted to central Italy and nearby parts of south-east France, while *P. rakosiensis* (as defined herein) is found in disjunct populations in Bosnia and Herzegovina, Montenegro, Albania, Macedonia, Hungary, Bulgaria, Moldavia and Romania.

The subspecies *Pelias rakosiensis macrops* (Mehely, 1911) is found in most parts of the Dinaric Alps within Bosnia and Herzegovina, as well as Montenegro and south to Albania.

In the Kapela Range (part of the northern Dinaric Alps), the subspecies *Pelias cathrynmatteoae kapelaensis* subsp. nov. occurs, while nominate *P. cathrynmatteoae* sp. nov. is confined to the Velebit Range.

The following diagnostic information applies to adult male specimens unless otherwise stated.

Pelias cathrynmatteoae sp. nov. of both subspecies are readily separated from morphologically similar *P. ursinii* (all subspecies) and *P. rakosiensis* by the following unique combination of characters:

Tiny black barring on the posterior of the two upper labials below and behind the eye is thin and not always extending the length of the scale (upwards). Prominent blotches on either side of the flank of the body. Beige dorsum with dark brown to blackish-grey blotches, joined anteriorly and running down the midline, becoming broken posteriorly, this often forming the typical viper zig-zag configuration. On the midbody these blotches are large and circular, either merging or just broken, these becoming thinner posteriorly and elongate, becoming a zig-zag or broken zig zag.

Iris light orange.

The subspecies *Pelias cathrynmatteoae kapelaensis* subsp. nov. is separated from the nominate subspecies *P. cathrynmatteoae cathrynmatteoae* subsp. nov. by having prominent thin dark etching on the lower labials, versus not so in the nominate subspecies. The iris is also dull orange, versus bright orange. The supralabials below the eye are expanded to make the two suboculars flattened and reduced in overall size (as compared to the nominate subspecies).

In the nominate subspecies, the side blotches are usually mainly one colour only, versus obviously two colour in *P. cathrynmatteoae kapelaensis* subsp. nov.

The nominate subspecies of *P. cathrynmatteoae* sp. nov. is depicted in life online at:

<https://www.agefotostock.com/age/en/details-photo/meadow-viper-orsini-s-viper-Pelias-ursinii-lying-on-a-rock-croatia-velebit/BWI-BS265733>

and

<https://www.alamy.com/stock-photo-meadow-viper-orsinis-viper-Pelias-ursinii-on-the-feed-croatia-velebit-47915807.html>

P. cathrynmatteoae kapelaensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/126674083>

The morphologically similar *P. ursinii* (Bonaparte, 1835) of the nominate subspecies from central Italy is separated from the preceding species by having heavy brown pigmentation in the iris, a beige to grey dorsal colouration (background colour) with some dark peppering. This being overlain with the dark viperine markings along the mid-dorsal line; thick dark bars or triangles at the posterior edge of the two upper labials below and behind the eye, these extending up to the top of the scale; these bars join below with equally thick dark bars on the lower labials and two

over-sized suboculars. The side blotches are also prominent.

The two French subspecies of *P. ursinii* are readily separated from the nominate Italian form by having an obvious whitish-grey background colour. The side blotches are also fragmented in nature as opposed to being more-or-less squarish in the nominate subspecies.

The newly named subspecies *P. ursinii alpesdehautensis* subsp. nov. found east of the Durance River, France is separated from *P. ursinii wettsteini* Knoch and Sochurek, 1955 from west of the Durance River, France by having reduced blotching along the midline and narrow mid-dorsal blotches, meaning that on the mid-body these are broken up, whereas in *P. ursinii wettsteini* the same blotches are mostly broad and thick and mainly, but not always, joined to form a continuum.

Adult *P. ursinii alpesdehautensis* subsp. nov. also usually have yellowish flaring around the dark dorsal blotches, that runs into the grey background colouration, versus not so in adult *P. ursinii wettsteini*.

There is sometimes brown flaring of the blotches in adult *P. ursinii wettsteini*.

P. ursinii alpesdehautensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/109925430>

and

<https://www.inaturalist.org/observations/57009602>

P. ursinii wettsteini is depicted in life online at:

<https://www.inaturalist.org/observations/29586>

and

<https://www.inaturalist.org/observations/38419741>

and

<https://www.inaturalist.org/observations/122462979>

Pelias rakosiensis (Mehely, 1893) of all subspecies are separated from the two preceding species by having side blotches that are either indistinct or absent, or otherwise faded, and no prominent etching on the two upper labials below and behind the eye. Dorsum is usually beige or with a light brownish rinse through it, rather than grey and the mid-dorsal blotches are brown to dark brown, rather than black. Blotches on the mid-line of the upper and mid body are more triangular than circular as seen in both *P. cathrynmatteoae* sp. nov. and *P. ursinii*.

P. rakosiensis macrops is depicted in life online at:

<https://www.inaturalist.org/observations/110557742>

and

<https://www.inaturalist.org/observations/24983835>

P. rakosiensis rakosiensis Mehely, 1893 of the nominate subspecies from Hungary are characterised by relatively small and narrow blotches running down the midline of the dorsum, dark brown in the centres, blackish on the outer edged and with yellow flaring on the otherwise beige background. Side blotches appear as dark smudges.

The dark coloured underlying skin is particularly pronounced in this subspecies and more so than compared to all other subspecies as well as all forms of *P. ursinii*.

P. rakosiensis rakosiensis is depicted in life online at:

<https://www.inaturalist.org/observations/42404735>

P. rakosiensis moldavica (Nilson, Andren and Joger, 1993) is similar to *P. rakosiensis rakosiensis* as just described but has a dorsum with a whitish-grey background colour as opposed to beige.

P. rakosiensis moldavica is depicted in life online at:

<https://www.inaturalist.org/observations/118043961>

and

<https://www.inaturalist.org/observations/96766514>

The morphologically similar species, *P. graeca* Nilson and

Andren, 1988 is separated from all the preceding species by having a purplish-brown iris and by subcaudal counts. In males it is 20-27 and females is 18-21. This contrasts with 27-41 in males and 20-32 in the other preceding species.

It is further separated by having a white or pale brown venter, parietals frequently fragmented, generally fewer than 17 scale rows on posterior part of the body, 7 or 6 supralabials on each side, with the third always under the eye, posterior supralabials are noticeably smaller than the anterior ones, nasal plate often partly divided.

The two subspecies are separated as follows: There is no dark upper labial etching in the northern form being nominate *P. graeca graeca*. Southern specimens of the newly named subspecies *P. graeca vardusiaensis subsp. nov.* are separated from the nominate form by having obvious brown triangles rising from the lip in the 2 labials below and behind the eye. In the subspecies *P. graeca vardusiaensis subsp. nov.* the rear upper labials are only slightly smaller than the anterior and mid ones, versus significantly smaller in *P. graeca graeca*.

P. graeca of the nominate subspecies is depicted in life online at: <https://www.inaturalist.org/observations/20192192>

and

<https://www.inaturalist.org/observations/26665951>

and in Nilson and Andren (1988) on pages 312 and 313.

P. graeca vardusiaensis subsp. nov. is depicted in life online at: <https://www.inaturalist.org/observations/26109978>

All the preceding species and subspecies are separated from all other Vipers from Europe or elsewhere, by the following unique suite of characters: Scales on crown and snout are smooth or faintly keeled; nostril in a single or irregularly divided nasal, which is separated from the rostral by a naso-rostral; rostral usually in contact with a single apical scale; supraocular large and usually extending posteriorly beyond the vertical of the posterior border of the eye; frontal and parietal shields usually well developed; a single series of scales between the eye and the labials. Snout obtusely pointed, flat above, or with the canthus slightly raised but not obviously turned up or with any kind of appendage at the end; 6 to 9 upper labials, usually 7 or 8; 19 midbody scale rows, 120-142 ventrals; 18-41 subcaudals.

The molecular phylogeny of Ferchaud *et al.* (2012) found that *P. cathrynmatteoae sp. nov.* diverged from its nearest living relative, type *P. ursinii* just under 2 MYA confirming species-level recognition as being most appropriate.

The molecular phylogeny of Ferchaud *et al.* (2012) found that *P. cathrynmatteoae kapelaensis subsp. nov.* diverged from the nominate subspecies *P. cathrynmatteoae cathrynmatteoae subsp. nov.* about 0.7 MYA confirming subspecies-level recognition as being most appropriate for that taxon.

Distribution: Nominate *Pelias cathrynmatteoae sp. nov.* is confined to the Velebit Range, near the west coast of Croatia. The subspecies *Pelias cathrynmatteoae kapelaensis subsp. nov.* occurs in the Kapela Range (part of the northern Dinaric Alps) and is believed to be confined to this area.

Etymology: *Pelias cathrynmatteoae sp. nov.* is named in honour of Cathryn Matteo of Hawthorn, Victoria, Australia in recognition of her services to herpetology spanning nearly 4 decades. She is also of southern European ancestry (Italian parents), reflecting the general area these vipers occur.

PELIAS CATHRYNMATTEOAE KAPALAENSIS SUBSP. NOV.
LSIDurn:lsid:zoobank.org:act:4D335234-33C8-4C70-81DB-26ACFA917617

Holotype: A specimen depicted in an image taken by Thomas Lindner in September 2017, collected from Velika Popina and posted in July 2022 on the website at:

<https://www.inaturalist.org/observations/126674083>

Diagnosis: *Pelias cathrynmatteoae sp. nov.* from the Velebit

Range, near the west coast of Croatia has until now been treated as a population of putative *P. ursinii* (Bonaparte, 1835), or alternatively the putative taxon *Pelias ursinii macrops* Mehely, 1911 herein treated as a subspecies of *Pelias rakosiensis* (Mehely, 1893), both of which it is proximally distributed with and morphologically similar to.

P. ursinii is herein restricted to central Italy and nearby parts of south-east France, while *P. rakosiensis* (as defined herein) is found in disjunct populations in Bosnia and Herzegovina, Montenegro, Albania, Macedonia, Hungary, Bulgaria, Moldavia and Romania.

The subspecies *Pelias rakosiensis macrops* (Mehely, 1911) is found in most parts of the Dinaric Alps within Bosnia and Herzegovina, as well as Montenegro and south to Albania.

In the Kapela Range (part of the northern Dinaric Alps), the subspecies *Pelias cathrynmatteoae kapelaensis subsp. nov.* occurs, while nominate *P. cathrynmatteoae sp. nov.* is confined to the Velebit Range.

The following diagnostic information applies to adult male specimens unless otherwise stated.

Pelias cathrynmatteoae sp. nov. of both subspecies are readily separated from morphologically similar *P. ursinii* (all subspecies) and *P. rakosiensis* by the following unique combination of characters:

Tiny black barring on the posterior of the two upper labials below and behind the eye is thin and not always extending the length of the scale (upwards). Prominent blotches on either side of the flank of the body. Beige dorsum with dark brown to blackish-grey blotches, joined anteriorly and running down the midline, becoming broken posteriorly, this often forming the typical viper zig-zag configuration. On the midbody these blotches are large and circular, either merging or just broken, these becoming thinner posteriorly and elongate, becoming a zig-zag or broken zig zag.

Iris light orange.

The subspecies *Pelias cathrynmatteoae kapelaensis subsp. nov.* is separated from the nominate subspecies *P. cathrynmatteoae cathrynmatteoae subsp. nov.* by having prominent thin dark etching on the lower labials, versus not so in the nominate subspecies. The iris is also dull orange, versus bright orange. The supralabials below the eye are expanded to make the two suboculars flattened and reduced in overall size (as compared to the nominate subspecies).

In the nominate subspecies, the side blotches are usually mainly one colour only, versus obviously two colour in *P. cathrynmatteoae kapelaensis subsp. nov.*

The nominate subspecies of *P. cathrynmatteoae sp. nov.* is depicted in life online at:

<https://www.agefotostock.com/age/en/details-photo/meadow-viper-orsini-s-viper-Pelias-ursinii-lying-on-a-rock-croatia-velebit/BW1-BS265733>

and

<https://www.alamy.com/stock-photo-meadow-viper-orsinis-viper-Pelias-ursinii-on-the-feed-croatia-velebit-47915807.html>

P. cathrynmatteoae kapelaensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/126674083>

The morphologically similar *P. ursinii* (Bonaparte, 1835) of the nominate subspecies from central Italy is separated from the preceding species by having heavy brown pigmentation in the iris, a beige to grey dorsal colouration (background colour) with some dark peppering. This being overlain with the dark viperine markings along the mid-dorsal line; thick dark bars or triangles at the posterior edge of the two upper labials below and behind the eye, these extending up to the top of the scale; these bars join below with equally thick dark bars on the lower labials and two over-sized suboculars. The side blotches are also prominent.

The two French subspecies of *P. ursinii* are readily separated from the nominate Italian form by having an obvious whitish-grey background colour. The side blotches are also fragmented in nature as opposed to being more-or-less squarish in the nominate subspecies.

The newly named subspecies *P. ursinii alpesdehautensis subsp. nov.* found east of the Durance River, France is separated from *P. ursinii wettsteini* Knoepffler and Sochurek, 1955 from west of the Durance River, France by having reduced blotching along the midline and narrow mid-dorsal blotches, meaning that on the mid-body these are broken up, whereas in *P. ursinii wettsteini* the same blotches are mostly broad and thick and mainly, but not always, joined to form a continuum.

Adult *P. ursinii alpesdehautensis subsp. nov.* also usually have yellowish flaring around the dark dorsal blotches, that runs into the grey background colouration, versus not so in adult *P. ursinii wettsteini*.

There is sometimes brown flaring of the blotches in adult *P. ursinii wettsteini*.

P. ursinii alpesdehautensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/109925430>
and

<https://www.inaturalist.org/observations/57009602>

P. ursinii wettsteini is depicted in life online at:

<https://www.inaturalist.org/observations/29586>

and

<https://www.inaturalist.org/observations/38419741>

and

<https://www.inaturalist.org/observations/122462979>

Pelias rakosiensis (Mehely, 1893) of all subspecies are separated from the two preceding species by having side blotches that are either indistinct or absent, or otherwise faded, and no prominent etching on the two upper labials below and behind the eye. Dorsum is usually beige or with a light brownish rinse through it, rather than grey and the mid-dorsal blotches are brown to dark brown, rather than black. Blotches on the mid-line of the upper and mid body are more triangular than circular as seen in both *P. cathrynmatteoae sp. nov.* and *P. ursinii*.

P. rakosiensis macrops is depicted in life online at:

<https://www.inaturalist.org/observations/110557742>

and

<https://www.inaturalist.org/observations/24983835>

P. rakosiensis rakosiensis Mehely, 1893 of the nominate subspecies from Hungary are characterised by relatively small and narrow blotches running down the midline of the dorsum, dark brown in the centres, blackish on the outer edged and with yellow flaring on the otherwise beige background. Side blotches appear as dark smudges.

The dark coloured underlying skin is particularly pronounced in this subspecies and more so than compared to all other subspecies as well as all forms of *P. ursinii*.

P. rakosiensis rakosiensis is depicted in life online at:

<https://www.inaturalist.org/observations/42404735>

P. rakosiensis moldavica (Nilson, Andren and Joger, 1993) is similar to *P. rakosiensis rakosiensis* as just described but has a dorsum with a whitish-grey background colour as opposed to beige.

P. rakosiensis moldavica is depicted in life online at:

<https://www.inaturalist.org/observations/118043961>

and

<https://www.inaturalist.org/observations/96766514>

The morphologically similar species, *P. graeca* Nilson and Andren, 1988 is separated from all the preceding species by having a purplish-brown iris and by subcaudal counts. In males it

is 20-27 and females is 18-21. This contrasts with 27-41 in males and 20-32 in the other preceding species.

It is further separated by having a white or pale brown venter, parietals frequently fragmented, generally fewer than 17 scale rows on posterior part of the body, 7 or 6 supralabials on each side, with the third always under the eye, posterior supralabials are noticeably smaller than the anterior ones, nasal plate often partly divided.

The two subspecies are separated as follows: There is no dark upper labial etching in the northern form being nominate *P. graeca graeca*. Southern specimens of the newly named subspecies *P. graeca vardusiaensis subsp. nov.* are separated from the nominate form by having obvious brown triangles rising from the lip in the 2 labials below and behind the eye. In the subspecies *P. graeca vardusiaensis subsp. nov.* the rear upper labials are only slightly smaller than the anterior and mid ones, versus significantly smaller in *P. graeca graeca*.

P. graeca of the nominate subspecies is depicted in life online at:

<https://www.inaturalist.org/observations/20192192>

and

<https://www.inaturalist.org/observations/26665951>

and in Nilson and Andren (1988) on pages 312 and 313.

P. graeca vardusiaensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/26109978>

All the preceding species and subspecies are separated from all other Vipers from Europe or elsewhere, by the following unique suite of characters: Scales on crown and snout are smooth or faintly keeled; nostril in a single or irregularly divided nasal, which is separated from the rostral by a naso-rostral; rostral usually in contact with a single apical scale; supraocular large and usually extending posteriorly beyond the vertical of the posterior border of the eye; frontal and parietal shields usually well developed; a single series of scales between the eye and the labials. Snout obtusely pointed, flat above, or with the canthus slightly raised but not obviously turned up or with any kind of appendage at the end; 6 to 9 upper labials, usually 7 or 8; 19 midbody scale rows, 120-142 ventrals; 18-41 subcaudals.

The molecular phylogeny of Ferchaud *et al.* (2012) found that *P. cathrynmatteoae sp. nov.* diverged from its nearest living relative, type *P. ursinii* just under 2 MYA confirming species-level recognition as being most appropriate.

The molecular phylogeny of Ferchaud *et al.* (2012) found that the nominate subspecies *P. cathrynmatteoae kapelaensis subsp. nov.* diverged from the nominate subspecies *P. cathrynmatteoae cathrynmatteoae subsp. nov.* about 0.7 MYA confirming subspecies-level recognition as being most appropriate for that taxon.

Distribution: Nominate *Pelias cathrynmatteoae sp. nov.* is confined to the Velebit Range, near the west coast of Croatia. The subspecies *Pelias cathrynmatteoae kapelaensis subsp. nov.* occurs in the Kapela Range (part of the northern Dinaric Alps) and is believed to be confined to this area.

Etymology: *Pelias cathrynmatteoae kapelaensis subsp. nov.* is named in reflection of where this subspecies occurs.

PELIAS URSINII ALPESDEHAUTENSIS SUBSP. NOV.

LSIDurn:lsid:zoobank.org:act:C2AD6FEF-5737-4837-ADB0-7133D0C2CD7B

Holotype: A preserved juvenile specimen at the Reptiles and Amphibians collection of the Museum national d'Histoire naturelle, Paris, France, specimen number MNHN RA 1978.457 collected from Lac de Lignins, at an elevation of 2100 m ASL, in Alpes-de-Haute-Provence, France.

This facility allows access to its holdings.

Paratypes: Three preserved juvenile specimens at the Reptiles and Amphibians collection of the Museum national d'Histoire naturelle, Paris, France, specimen numbers MNHN RA 1978.458, MNHN RA 1978.459 and MNHN RA 1978.460 all

collected from Lac de Lignins, at an elevation of 2100 m ASL, in Alpes-de-Haute-Provence, France.

Diagnosis: *P. ursinii* is herein restricted to central Italy and nearby parts of south-east France, while the closely related *P. rakosiensis* (as defined herein) is found in disjunct populations in Bosnia and Herzegovina, Montenegro, Albania, Macedonia, Hungary, Bulgaria, Moldavia and Romania.

Pelias cathrynmatteoae sp. nov. from the Velebit Range, near the west coast of Croatia has until now been treated as a population of putative *P. ursinii* (Bonaparte, 1835), or alternatively the putative taxon *Pelias ursinii macrops* Mehely, 1911 herein treated as a subspecies of *Pelias rakosiensis* (Mehely, 1893), both of which it is proximally distributed with and morphologically similar to.

Pelias cathrynmatteoae sp. nov. is morphologically most similar to *P. ursinii* and also most closely related to it, having diverged just under 2 MYA according to Ferchaud *et al.* (2012).

The subspecies *Pelias rakosiensis macrops* (Mehely, 1911) is found in most parts of the Dinaric Alps within Bosnia and Herzegovina, as well as Montenegro and south to Albania.

In the Kapela Range (part of the northern Dinaric Alps), the subspecies *Pelias cathrynmatteoae kapelaensis* subsp. nov. occurs, while nominate *P. cathrynmatteoae* sp. nov. is confined to the Velebit Range.

The following diagnostic information applies to adult male specimens unless otherwise stated.

Pelias cathrynmatteoae sp. nov. of both subspecies are readily separated from morphologically similar *P. ursinii* (all subspecies) and *P. rakosiensis* by the following unique combination of characters:

Tiny black barring on the posterior of the two upper labials below and behind the eye is thin and not always extending the length of the scale (upwards). Prominent blotches on either side of the flank of the body. Beige dorsum with dark brown to blackish-grey blotches, joined anteriorly and running down the midline, becoming broken posteriorly, this often forming the typical viper zig-zag configuration. On the midbody these blotches are large and circular, either merging or just broken, these becoming thinner posteriorly and elongate, becoming a zig-zag or broken zig zag.

Iris light orange.

The subspecies *Pelias cathrynmatteoae kapelaensis* subsp. nov. is separated from the nominate subspecies *P. cathrynmatteoae cathrynmatteoae* subsp. nov. by having prominent thin dark etching on the lower labials, versus not so in the nominate subspecies. The iris is also dull orange, versus bright orange. The supralabials below the eye are expanded to make the two suboculars flattened and reduced in overall size (as compared to the nominate subspecies).

In the nominate subspecies, the side blotches are usually mainly one colour only, versus obviously two colour in *P. cathrynmatteoae kapelaensis* subsp. nov.

The nominate subspecies of *P. cathrynmatteoae* sp. nov. is depicted in life online at:

<https://www.agefotostock.com/age/en/details-photo/meadow-viper-orsini-s-viper-Pelias-ursinii-lying-on-a-rock-croatia-velebit/BWI-BS265733>

and

<https://www.alamy.com/stock-photo-meadow-viper-orsinis-viper-Pelias-ursinii-on-the-feed-croatia-velebit-47915807.html>

P. cathrynmatteoae kapelaensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/126674083>

The morphologically similar *P. ursinii* (Bonaparte, 1835) of the nominate subspecies from central Italy is separated from the preceding species by having heavy brown pigmentation in the

iris, a beige to grey dorsal colouration (background colour) with some dark peppering. This being overlain with the dark viperine markings along the mid-dorsal line; thick dark bars or triangles at the posterior edge of the two upper labials below and behind the eye, these extending up to the top of the scale; these bars join below with equally thick dark bars on the lower labials and two over-sized suboculars. The side blotches are also prominent.

The two French subspecies of *P. ursinii* are readily separated from the nominate Italian form as described above, by having an obvious whitish-grey background colour. The side blotches are also fragmented in nature as opposed to being more-or-less squarish in the nominate subspecies.

The newly named subspecies *P. ursinii alpesdehautensis* subsp. nov. found east of the Durance River, France is separated from *P. ursinii wettsteini* Knoepfler and Sochurek, 1955 from west of the Durance River, France by having reduced blotching along the midline and narrow mid-dorsal blotches, meaning that on the mid-body these are broken up, whereas in *P. ursinii wettsteini* the same blotches are mostly broad and thick and mainly, but not always, joined to form a continuum.

Adult *P. ursinii alpesdehautensis* subsp. nov. also usually have yellowish flaring around the dark dorsal blotches, that runs into the grey background colouration, versus not so in adult *P. ursinii wettsteini*.

There is sometimes brown flaring of the blotches in adult *P. ursinii wettsteini*.

P. ursinii alpesdehautensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/109925430>

and

<https://www.inaturalist.org/observations/57009602>

P. ursinii wettsteini is depicted in life online at:

<https://www.inaturalist.org/observations/29586>

and

<https://www.inaturalist.org/observations/38419741>

and

<https://www.inaturalist.org/observations/122462979>

Pelias rakosiensis (Mehely, 1893) of all subspecies are separated from the two preceding species by having side blotches that are either indistinct or absent, or otherwise faded, and no prominent etching on the two upper labials below and behind the eye. Dorsum is usually beige or with a light brownish rinse through it, rather than grey and the mid-dorsal blotches are brown to dark brown, rather than black. Blotches on the mid-line of the upper and mid body are more triangular than circular as seen in both *P. cathrynmatteoae* sp. nov. and *P. ursinii*.

P. rakosiensis macrops is depicted in life online at:

<https://www.inaturalist.org/observations/110557742>

and

<https://www.inaturalist.org/observations/24983835>

P. rakosiensis rakosiensis Mehely, 1893 of the nominate subspecies from Hungary are characterised by relatively small and narrow blotches running down the midline of the dorsum, dark brown in the centres, blackish on the outer edged and with yellow flaring on the otherwise beige background. Side blotches appear as dark smudges.

The dark coloured underlying skin is particularly pronounced in this subspecies and more so than compared to all other subspecies as well as all forms of *P. ursinii*.

P. rakosiensis rakosiensis is depicted in life online at:

<https://www.inaturalist.org/observations/42404735>

P. rakosiensis moldavica (Nilson, Andren and Joger, 1993) is similar to *P. rakosiensis rakosiensis* as just described but has a dorsum with a whitish-grey background colour as opposed to beige.

P. rakosiensis moldavica is depicted in life online at:

<https://www.inaturalist.org/observations/118043961>

and

<https://www.inaturalist.org/observations/96766514>

The morphologically similar species, *P. graeca* Nilson and Andren, 1988 is separated from all the preceding species by having a purplish-brown iris and by subcaudal counts. In males it is 20-27 and females is 18-21. This contrasts with 27-41 in males and 20-32 in the other preceding species.

It is further separated by having a white or pale brown venter, parietals frequently fragmented, generally fewer than 17 scale rows on posterior part of the body, 7 or 6 supralabials on each side, with the third always under the eye, posterior supralabials are noticeably smaller than the anterior ones, nasal plate often partly divided.

The two subspecies are separated as follows: There is no dark upper labial etching in the northern form being nominate *P. graeca graeca*. Southern specimens of the newly named subspecies *P. graeca vardusiaensis subsp. nov.* are separated from the nominate form by having obvious brown triangles rising from the lip in the 2 labials below and behind the eye. In the subspecies *P. graeca vardusiaensis subsp. nov.* the rear upper labials are only slightly smaller than the anterior and mid ones, versus significantly smaller in *P. graeca graeca*.

P. graeca of the nominate subspecies is depicted in life online at:

<https://www.inaturalist.org/observations/20192192>

and

<https://www.inaturalist.org/observations/26665951>

and in Nilson and Andren (1988) on pages 312 and 313.

P. graeca vardusiaensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/26109978>

All the preceding species and subspecies are separated from all other Vipers from Europe or elsewhere, by the following unique suite of characters: Scales on crown and snout are smooth or faintly keeled; nostril in a single or irregularly divided nasal, which is separated from the rostral by a naso-rostral; rostral usually in contact with a single apical scale; supraocular large and usually extending posteriorly beyond the vertical of the posterior border of the eye; frontal and parietal shields usually well developed; a single series of scales between the eye and the labials. Snout obtusely pointed, flat above, or with the canthus slightly raised but not obviously turned up or with any kind of appendage at the end; 6 to 9 upper labials, usually 7 or 8; 19 midbody scale rows, 120-142 ventrals; 18-41 subcaudals.

The molecular phylogeny of Ferchaud *et al.* (2012) found that *P. cathrynmatteoae sp. nov.* diverged from its nearest living relative, type *P. ursinii* just under 2 MYA confirming species-level recognition as being most appropriate.

The molecular phylogeny of Ferchaud *et al.* (2012) found that *P. cathrynmatteoae kapelaensis subsp. nov.* diverged from the nominate subspecies *P. cathrynmatteoae cathrynmatteoae subsp. nov.* about 0.7 MYA confirming subspecies-level recognition as being most appropriate for that taxon.

The molecular phylogeny of Ferchaud *et al.* (2012), following on from Ferchaud *et al.* (2011), found that the two French populations of *P. ursinii* diverged from one another about 0.5 MYA and about 0.6 MYA from the nominate Italian form, confirming subspecies-level recognition as being most appropriate for these taxa.

Distribution: The newly named subspecies *P. ursinii alpesdehautensis subsp. nov.* is found east of the Durance River, France and within France, while *P. ursinii wettsteini* Knoepffler and Sochurek, 1955 is found in a small area generally west of the Durance River, France.

Etymology: The newly named subspecies *P. ursinii alpesdehautensis subsp. nov.* is named in reflection of the type locality and where it occurs.

PELIAS GRAECA VARDOUSIAENSIS SUBSP. NOV.

LSIDDurn:lsid:zoobank.org:act:A164BD7F-F600-4D66-8D1E-B12A601FB25D

Holotype: A specimen collected from about 15 km north-west of Mount Giona, Greece, depicted in an image posted online by Balázs Bozóki at:

<https://www.inaturalist.org/observations/26109978>

Diagnosis: *Pelias graeca* Nilson and Andren, 1988 is separated from all other species and subspecies in the *Pelias ursinii* Bonaparte, 1835 species complex by having a purplish-brown iris and by subcaudal counts. In males it is 20-27 and females is 18-21. This contrasts with 27-41 in males and 20-32 in all the other species.

It is further separated by having a white or pale brown venter, parietals frequently fragmented, generally fewer than 17 scale rows on the posterior part of the body, 7 or 6 supralabials on each side, with the third always under the eye, posterior supralabials are noticeably smaller than the anterior ones, nasal plate often partly divided.

The two subspecies are separated as follows: There is no dark upper labial etching in the northern form being nominate *P. graeca graeca*. Southern specimens of the newly named subspecies *P. graeca vardusiaensis subsp. nov.* are separated from the nominate form by having obvious brown triangles rising from the lip in the 2 labials below and behind the eye. In the subspecies *P. graeca vardusiaensis subsp. nov.* the rear upper labials are only slightly smaller than the anterior and mid ones (being the largest), versus significantly smaller in *P. graeca graeca*.

P. graeca of the nominate subspecies is depicted in life online at:

<https://www.inaturalist.org/observations/20192192>

and

<https://www.inaturalist.org/observations/26665951>

and in Nilson and Andren (1988) on pages 312 and 313.

P. graeca vardusiaensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/26109978>

P. ursinii the species-level taxon to which *P. graeca* was originally assigned, is herein restricted to central Italy and nearby parts of south-east France, while the closely related *P. rakosiensis* (as defined herein) is found in disjunct populations in Bosnia and Herzegovina, Montenegro, Albania, Macedonia, Hungary, Bulgaria, Moldavia and Romania.

Pelias cathrynmatteoae sp. nov. from the Velebit Range, near the west coast of Croatia has until now been treated as a population of putative *P. ursinii* (Bonaparte, 1835), or alternatively the putative taxon *Pelias ursinii macrops* Mehely, 1911 herein treated as a subspecies of *Pelias rakosiensis* (Mehely, 1893), both of which it is proximally distributed with and morphologically similar to.

Pelias cathrynmatteoae sp. nov. is morphologically most similar to *P. ursinii* and also most closely related to it, having diverged just under 2 MYA according to Ferchaud *et al.* (2012).

The subspecies *Pelias rakosiensis macrops* (Mehely, 1911) is found in most parts of the Dinaric Alps within Bosnia and Herzegovina, as well as Montenegro and south to Albania.

In the Kapela Range (part of the northern Dinaric Alps), the subspecies *Pelias cathrynmatteoae kapelaensis subsp. nov.* occurs, while nominate *P. cathrynmatteoae sp. nov.* is confined to the Velebit Range.

The following diagnostic information applies to adult male specimens unless otherwise stated.

Pelias cathrynmatteoae sp. nov. of both subspecies are readily separated from morphologically similar *P. ursinii* (all subspecies) and *P. rakosiensis* by the following unique combination of characters:

Tiny black barring on the posterior of the two upper labials below

and behind the eye is thin and not always extending the length of the scale (upwards). Prominent blotches on either side of the flank of the body. Beige dorsum with dark brown to blackish-grey blotches, joined anteriorly and running down the midline, becoming broken posteriorly, this often forming the typical viper zig-zag configuration. On the midbody these blotches are large and circular, either merging or just broken, these becoming thinner posteriorly and elongate, becoming a zig-zag or broken zig zag.

Iris light orange.

The subspecies *Pelias cathrynmatteoae kapelaensis subsp. nov.* is separated from the nominate subspecies *P. cathrynmatteoae cathrynmatteoae subsp. nov.* by having prominent thin dark etching on the lower labials, versus not so in the nominate subspecies. The iris is also dull orange, versus bright orange. The supralabials below the eye are expanded to make the two suboculars flattened and reduced in overall size (as compared to the nominate subspecies).

In the nominate subspecies, the side blotches are usually mainly one colour only, versus obviously two colour in *P. cathrynmatteoae kapelaensis subsp. nov.*

The nominate subspecies of *P. cathrynmatteoae sp. nov.* is depicted in life online at:

<https://www.agefotostock.com/age/en/details-photo/meadow-viper-orsini-s-viper-Pelias-ursinii-lying-on-a-rock-croatia-velebit/BWI-BS265733>

and

<https://www.alamy.com/stock-photo-meadow-viper-orsinis-viper-Pelias-ursinii-on-the-feed-croatia-velebit-47915807.html>

P. cathrynmatteoae kapelaensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/126674083>

The morphologically similar *P. ursinii* (Bonaparte, 1835) of the nominate subspecies from central Italy is separated from the preceding species by having heavy brown pigmentation in the iris, a beige to grey dorsal colouration (background colour) with some dark peppering. This being overlain with the dark viperine markings along the mid-dorsal line; thick dark bars or triangles at the posterior edge of the two upper labials below and behind the eye, these extending up to the top of the scale; these bars join below with equally thick dark bars on the lower labials and two over-sized suboculars. The side blotches are also prominent.

The two French subspecies of *P. ursinii* are readily separated from the nominate Italian form as described above, by having an obvious whitish-grey background colour. The side blotches are also fragmented in nature as opposed to being more-or-less squarish in the nominate subspecies.

The newly named subspecies *P. ursinii alpesdehautensis subsp. nov.* found east of the Durance River, France is separated from *P. ursinii wettsteini* Knoepffler and Sochurek, 1955 from west of the Durance River, France by having reduced blotching along the midline and narrow mid-dorsal blotches, meaning that on the mid-body these are broken up, whereas in *P. ursinii wettsteini* the same blotches are mostly broad and thick and mainly, but not always, joined to form a continuum.

Adult *P. ursinii alpesdehautensis subsp. nov.* also usually have yellowish flaring around the dark dorsal blotches, that runs into the grey background colouration, versus not so in adult *P. ursinii wettsteini*.

There is sometimes brown flaring of the blotches in adult *P. ursinii wettsteini*.

P. ursinii alpesdehautensis subsp. nov. is depicted in life online at:

<https://www.inaturalist.org/observations/109925430>

and

<https://www.inaturalist.org/observations/57009602>

P. ursinii wettsteini is depicted in life online at:

<https://www.inaturalist.org/observations/29586>

and

<https://www.inaturalist.org/observations/38419741>

and

<https://www.inaturalist.org/observations/122462979>

Pelias rakosiensis (Mehely, 1893) of all subspecies are separated from the two preceding species by having side blotches that are either indistinct or absent, or otherwise faded, and no prominent etching on the two upper labials below and behind the eye. Dorsum is usually beige or with a light brownish rinse through it, rather than grey and the mid-dorsal blotches are brown to dark brown, rather than black. Blotches on the mid-line of the upper and mid body are more triangular than circular as seen in both *P. cathrynmatteoae sp. nov.* and *P. ursinii*.

P. rakosiensis macrops is depicted in life online at:

<https://www.inaturalist.org/observations/110557742>

and

<https://www.inaturalist.org/observations/24983835>

P. rakosiensis rakosiensis Mehely, 1893 of the nominate subspecies from Hungary are characterised by relatively small and narrow blotches running down the midline of the dorsum, dark brown in the centres, blackish on the outer edged and with yellow flaring on the otherwise beige background. Side blotches appear as dark smudges.

The dark coloured underlying skin is particularly pronounced in this subspecies and more so than compared to all other subspecies as well as all forms of *P. ursinii*.

P. rakosiensis rakosiensis is depicted in life online at:

<https://www.inaturalist.org/observations/42404735>

P. rakosiensis moldavica (Nilson, Andren and Joger, 1993) is similar to *P. rakosiensis rakosiensis* as just described but has a dorsum with a whitish-grey background colour as opposed to beige.

P. rakosiensis moldavica is depicted in life online at:

<https://www.inaturalist.org/observations/118043961>

and

<https://www.inaturalist.org/observations/96766514>

All the preceding species and subspecies are separated from all other Vipers from Europe or elsewhere, by the following unique suite of characters: Scales on crown and snout are smooth or faintly keeled; nostril in a single or irregularly divided nasal, which is separated from the rostral by a naso-rostral; rostral usually in contact with a single apical scale; supraocular large and usually extending posteriorly beyond the vertical of the posterior border of the eye; frontal and parietal shields usually well developed; a single series of scales between the eye and the labials. Snout obtusely pointed, flat above, or with the canthus slightly raised but not obviously turned up or with any kind of appendage at the end; 6 to 9 upper labials, usually 7 or 8; 19 midbody scale rows, 120-142 ventrals; 18-41 subcaudals.

There has not yet been a molecular analysis of specimens of the new subspecies *P. graeca vardusiaensis subsp. nov.* to compare with the nominate form.

Distribution: The subspecies is believed to be restricted to the area of Vardousia, southern Greece.

Etymology: The subspecies is named in reflection of where it occurs in Greece.

CONSERVATION

The four newly named Viper taxa are all range restricted species or subspecies and self-evidently should be managed as separate conservation units.

While their known habitats are largely within relatively undisturbed and protected habitats, direct human pressures and human created problems and risks remain and likely to increase into the future as the world human population increases and

demand for resources from currently less intensively utilized areas is likely to increase.

In recent years, seemingly secure populations of vertebrate species have declined and sometimes expired, often quickly and without any immediately obvious reason.

With this in mind, it makes sense that specimens of each species of subspecies of European viper should be brought into captivity and bred as an insurance against some unforeseen calamity in wild populations.

Because of the popularity of snakes and herpetoculture as a hobby, the most expedient way to solve the problem is to allow private individuals to bring specimens into captivity and to trade them legally.

The small adult size of the relevant species (average 50 cm total length in adults) does not make them a popular exhibit in large government-owned zoos and commercially oriented fauna parks, but does make them highly suitable for hobbyists to keep in private homes.

A captive population of each relevant taxon named herein could be maintained by hobbyists at no costs to taxpayers and enabling government conservation dollars to be spent on other pressing needs, for which private citizen involvement is not a viable option.

The relevant comments of Cogger (2014), Cotton (2014), Hawkeswood (2021), Hoser (1989, 1991, 1993, 1996, 2001a-b, 2007, 2009, 2012a-b, 2013, 2015a-f, 2017, 2019a-b), ICZN (1991, 2001, 2021) and Wellington (2015) all apply with respect of these three taxa.

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CONFLICT OF INTEREST - NONE.