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The history of the Illyrian Nose-horned Viper, *Vipera ammodytes illyrica* (Laurenti, 1768), with designation of a neotype

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Abstract. Krecsák et al. (2024) recently restricted the type locality of *Vipera ammodytes ammodytes* (Linnaeus, 1758) to Belgrad Forest (Belgrad Ormanı), Belgrad village, Istanbul Metropolitan Municipality, Türkiye. This meant that the name of the nominotypical subspecies must be applied to populations formerly known as *V. a. montandoni* Boulenger, 1904 that inhabit southern Albania, northern Greece, most of Bulgaria (except the northwestern part), eastern Romania, the Republic of North Macedonia, and the southernmost part of Serbia. As a consequence, the name *V. a. illyrica* (Laurenti, 1768) is valid for the Nose-horned Viper populations from Italy, Austria, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, northern Albania, Serbia (except the southernmost part), as well as the northwestern part of Bulgaria. In this paper we evaluate the history of *V. a. illyrica*, assess the status of type material, provide a complete list of synonyms and chresonyms, and designate as the neotype the specimen NHMW 25274:6 collected at Trieste, Friuli Venezia Giulia region, NE Italy.

Key words. Squamata, Serpentes, Viperidae, *montandoni*, Museum Turrianum, historical collections, type locality, Trieste, Italy.

Introduction

In a recent publication Krecsák et al. (2024) assessed the origin of the Linnaean type material of the Nose-horned Viper, *Vipera ammodytes* (Linnaeus, 1758), and restricted the type locality of the nominotypical subspecies to Belgrad Forest [Turkish: Belgrad Ormanı], Belgrad Village, Istanbul Metropolitan Municipality, Türkiye. Thus, *V. a. montandoni* Boulenger, 1904 became a junior synonym of *V. a. ammodytes* (Linnaeus, 1758), and populations from the northwestern and central parts of the species' range, which were previously regarded as nominotypical, needed to be referred to *V. a. illyrica* (Laurenti, 1768), the oldest name applicable to Nose-horned Vipers from this region.

We follow the recognition of four subspecific taxa within *V. ammodytes*, sensu Tomović (2006) and Hempel et al. (2018), but because of the findings by Krecsák et al. (2024) the allocation of names has been modified. The subspecific taxa recognized include *V. a. ammodytes* for populations in southern Albania, northern Greece, most of Bulgaria (except the northwestern part), eastern Romania, the Republic of North Macedonia, the southernmost part of Serbia and European Türkiye; *V. a. meridionalis* for populations inhabiting the Peloponnese, the Cyclades Islands, and central Greece; *V. a. transcaucasiana*, comprising populations found in northeastern Türkiye and Georgia; and *V. a. illyrica* (formerly regarded as a junior synonym of *V. a. ammodytes*, as then construed), distributed in Italy, Austria, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro, northern Albania, Serbia (except the southernmost part), and northwestern Bulgaria (Krecsák et al. 2024).

We here discuss the history of *V. a. illyrica*, assess the status of type material and take taxonomic and nomenclatural decisions based on the results.

Original description and type series of *Vipera illyrica*

This species name was coined by the Austrian physician Josephus Nicolaus Laurenti (1735–1805) in one of the oldest post-Linnaean herpetological monographs, 'Specimen Medicum, Exhibens Synopsin Reptilium Emendatam cum Experimentis circa Venena et Antidota Reptilium Austriacorum' (Laurenti 1768a, b), a book of substantial relevance from the perspective of herpetological nomenclature (Stejneger 1936, Kuzmin 2005, Ohler et al. 2018). Laurenti was a Viennese physician and passionate herpetologist. The few details that are available about him were discussed by Adler (1989), Bischoff & Hallmann (2001), Kuzmin (2005), and Ohler et al. (2018). He was born to a working-class family on 5 December 1735 in Sankt Ulrich, a suburb of Vienna, and attended a secondary school affiliated with the University of Vienna, from which he graduated in 1745. Thereafter, in line with the standard practice of the times, Laurenti acted as 'Feldarzt' [field surgeon] without any higher medical education. In 1768 he obtained his medical degree with 'Specimen Medicum' as his inaugural dissertation. Presumably, the Seven Years' War (1756–1763) was the reason for the long period that passed before he was able to complete his degree. Between 1769–1805 he was a member of the Medical Faculty of the University of Vienna. In 1772 Laurenti passed the specialty examination in obstetrics. He worked as a general practitioner and gynaecologist in Sankt Ulrich, where he died, aged 70, on 17 February 1805.

'Specimen Medicum', Laurenti's inaugural dissertation in medicine, was initially published in March of 1768 as a dissertation (Laurenti 1768a) and thereafter as a separate book (Laurenti 1768b) (Fig. 1). The versions differ primarily by 11 additional pages in the book that contain no relevant information from a nomenclatural perspective (Ohler et al. 2018). Russian and English translations of the book were issued by Kuzmin (2005a, 2005b).

The book is divided into two parts. The first, entitled 'Classis Reptilium' (pp. 19–110), is a systematic catalogue of 242 amphibian and reptile species, all included in the single class Reptilium, while the second part, entitled 'Historia Reptilium Austriacorum, continens singulae speciei differentiam, descriptionem et instituta circa venena experimenta' (pp. 111–214), is a summary of experimental observations on amphibians and reptiles, their venom, and the treatment of envenomings. The content of the book was discussed in detail by Stejneger (1936), Adler (1989) and Ohler et al. (2018).

In genus XXXI. *Vipera* Laurenti itemized ten species, including *Vipera Illyrica*. We provide in Table 1 a translation with comments of the description on page 101 of 'Specimen Medicum' (Laurenti 1768b) (Fig. 2).

'Aldrovand. serp. 169' is a reference to a figure on page 169 of the book 'Serpentum et Draconū Historiæ Libri Duo' by Aldrovandi (1640), depicting a *Vipera ammodytes* individual. In his book, Aldrovandi (1640) provided a general description of the Nose-horned Viper, without specifying specimen(s). He reported that the snake was called the horned viper of Illyria by some, since it was frequently seen in that region (Aldrovandi 1640: 168). Citing Matthioli (1565), Aldrovandi (1640: 170) reported the range of the taxon to include 'Italy, & Illyrian places, especially in the Gorizia Municipality, & the mountains of Iapidia' [Iapodia/Japidia = Istria].

'Museum Turrianum' refers to the Viennese private collection of the Count Franciscus Annibal Turrianus or Franz Anton Hannibal von Thurn und Valsassina (1699–1768), official and vicar general to the Bishop of Passau. The Passau diocese held rights to the Passauer Hof enclave in Vienna, and as the official resident there Thurn was on an equal footing with the Bishop of Passau (Ohler et al. 2018). The Thurn Collection in Vienna was known for its reptiles (Ohler et al. 2018) and not only functioned as the source of knowledge for Laurenti's group Reptilium but included a large ornithological collection with the types of several new taxa described by Scopoli (1769). After the count's death in 1768, his collection probably came into possession of the Jesuits, who were managing the University of Vienna at that time (Fitzinger 1856: 443). Fitzinger believed that after the abolition of the Jesuit order, part of the Thurn Collection remained with the university's natural history collection. The Jesuit order and several other monastic orders were banned by a Secularization Decree issued on 12 January 1782 for Austria and Hungary by Joseph II (1741–1790), Holy Roman Emperor from 1765–1790 and ruler of the Habsburg lands from 1780–1790. The fate of the specimens from the collection is unknown (Stresemann 1923, Klaver & Böhme 1997, McDiarmid et al. 1999, Steinheimer 2005, Fritz & Schmidtler 2020) and are probably lost (Hartert 1923, Gregori 2008, Hanžel 2016, Bauer & Lavilla 2022).

A part of the collection from the university is said to have become part of the first Vienna collection the Kaiserliche Hof-Naturalienkabinette [Imperial Court Cabinet of Natural Objects] (Fitzinger 1856), which existed from 1748–1889 and was transferred to the newly built Natural History Museum, but there is no clear correspondence between the specimens seen by Laurenti in the Thurn Collection and material in the current collection of the Naturhistorisches Museum Wien (NHMW). Similarly, the *Vipera* specimens from the Aldrovandi collection are no longer extant (Bauer et al. 2013).

Taking into account that all syntype specimens must be considered lost, the designation of a neotype was considered necessary in order to ensure the stabilization of the nomen *Vipera ammodytes illyrica* Laurenti, 1768 (see below).

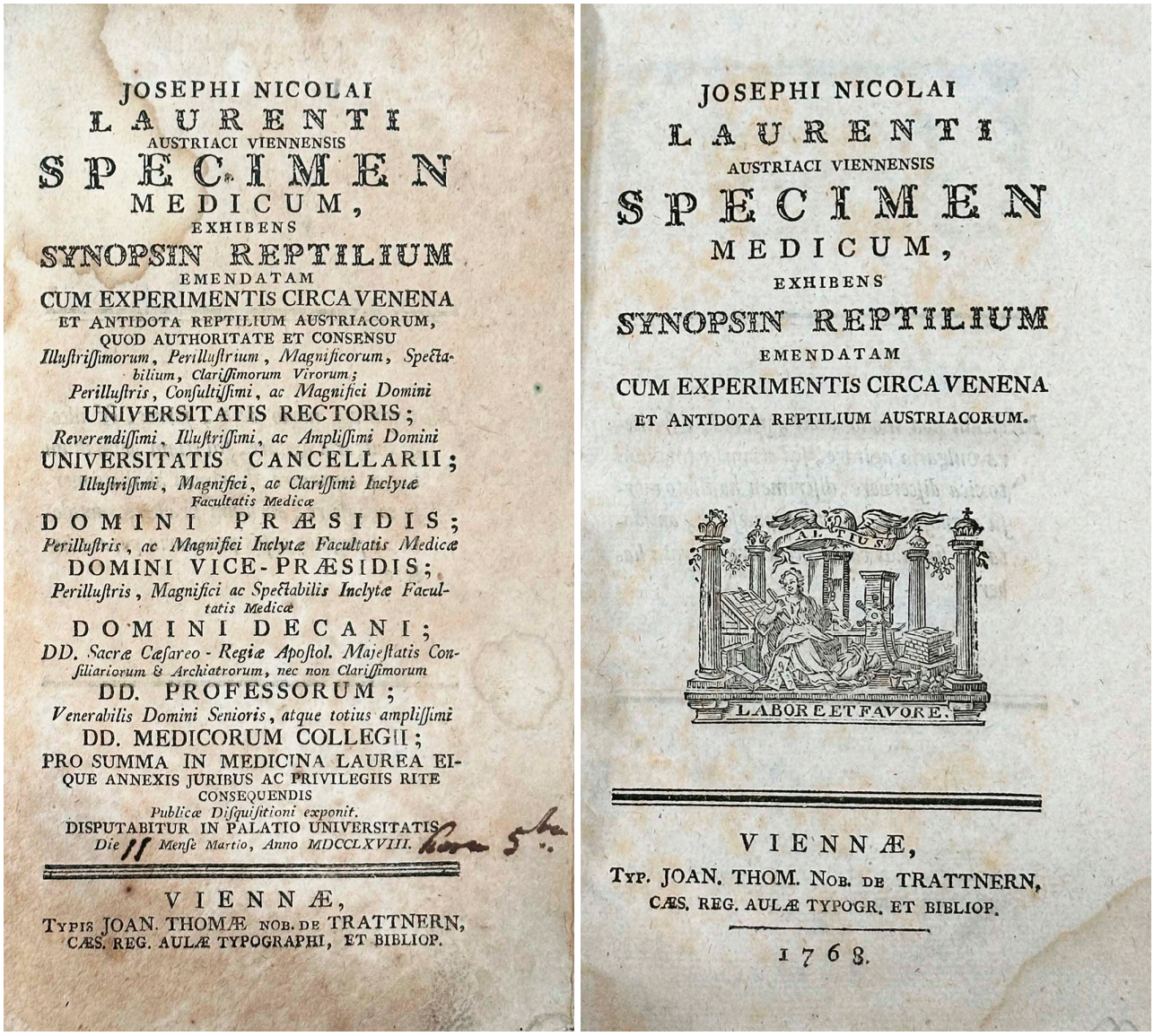
Etymology of *illyrica*

The species name *illyrica* originates from the word 'Illyricum' (from Ancient Greek Ἰλλυρία = Illyría), denoting the geographical region in the western Balkan Peninsula in-

habited by numerous smaller tribes, known collectively as Illyrians. Illyria was a Roman province from 27 BC to 69–79 AD (Wilkes 1992) and included the eastern shoreline of the Adriatic Sea and the inland mountains of the same region, later called Dalmatia, as well as areas further inland in what was called Pannonia. As such, the region stretched from the Drin River in the south to Istria and the Sava River in the north and encompasses parts or all of the territories of present-day Albania, Kosovo, Montenegro, Serbia, Bosnia and Herzegovina, Croatia, and Slovenia. However, we believe that the term 'Illyria' as used by Aldrovandi and later adopted by Laurenti does not refer to the geographical area encompassed by the Roman province of Illyria, but rather to the geographic region inhabited by Illyrian tribes. The Gulf of Trieste, where the original type locality Castel de Duino (Duino-Aurisina Municipality, Friuli-Venezia Giulia Region, Italy) is located, was inhabited by the Iron Age tribe known as the Histri (or Istri), in Ancient Greek Ἴστροι, a purely Illyric tribe or Venetic tribe with Illyric ties (Wilkes 1992).

Synonyms and chresonyms

We here provide a listing of the synonyms and chresonyms for *Vipera ammodytes illyrica*. Readers should note that several names in the list were coined by the German amateur herpetologist Albert Franz Theodor Reuss (1879–1958), who was known for some unusual names given to dozens of new viperid taxa described without proper sci-


JOSEPHI NICOLAI
LAURENTI
AUSTRIACI VIENNENSIS
SPECIMEN
MEDICUM,
EXHIBENS
SYNOPSIN REPTILIUM
EMENDATAM
CUM EXPERIMENTIS CIRCA VENENA
ET ANTIDOTA REPTILIUM AUSTRIACORUM,
QUOD AUTHORITATE ET CONSENSU
Illustrissimorum, Perillustrium, Magnificorum, Spectabilium, Clarissimorum Virorum;
Perillustris, Consultissimi, ac Magnifici Domini
UNIVERSITATIS RECTORIS;
Reverendissimi, Illustrissimi, ac Amplissimi Domini
UNIVERSITATIS CANCELLARII;
Illustrissimi, Magnifici, ac Clarissimi Inclytæ Facultatis Medicæ
DOMINI PRÆSIDIS;
Perillustris, ac Magnifici Inclytæ Facultatis Medicæ
DOMINI VICE-PRÆSIDIS;
Perillustris, Magnifici ac Spectabilis Inclytæ Facultatis Medicæ
DOMINI DECANI;
DD. Sacræ Cæsareo-Regiæ Apostol. Majestatis Consiliariorum & Archiatrorum, nec non Clarissimorum
DD. PROFESSORUM;
Venerabilis Domini Senioris, atque totius amplissimi
DD. MEDICORUM COLLEGII;
PRO SUMMA IN MEDICINA LAUREA EIQUE ANNEXIS JURIBUS AC PRIVILEGIIS RITE CONSEQUENDIS
Publicæ Disquisitioni exponit.
DISPUTABITUR IN PALATIO UNIVERSITATIS
Die 11 Mense Martio, Anno MDCCLXVIII.
VIENNÆ,
TYPIS JOAN. THOMÆ NOB. DE TRATTNERN,
CÆS. REG. AULÆ TYPOGRAPHI, ET BIBLIOP.

JOSEPHI NICOLAI
LAURENTI
AUSTRIACI VIENNENSIS
SPECIMEN
MEDICUM,
EXHIBENS
SYNOPSIN REPTILIUM
EMENDATAM
CUM EXPERIMENTIS CIRCA VENENA
ET ANTIDOTA REPTILIUM AUSTRIACORUM.
ALTIUS
LABORE ET FAVORE.
VIENNÆ,
TYP. JOAN. THOM. NOB. DE TRATTNERN,
CÆS. REG. AULÆ TYPOGR. ET BIBLIOP.
1768.

Figure 1. Title pages of 'Specimen Medicum', both as the inaugural dissertation (Laurenti 1768a) (left) and a book (Laurenti 1768b) (right).

Table 1. Translation of the description of *Vipera Illyrica* Laurenti, 1768b.

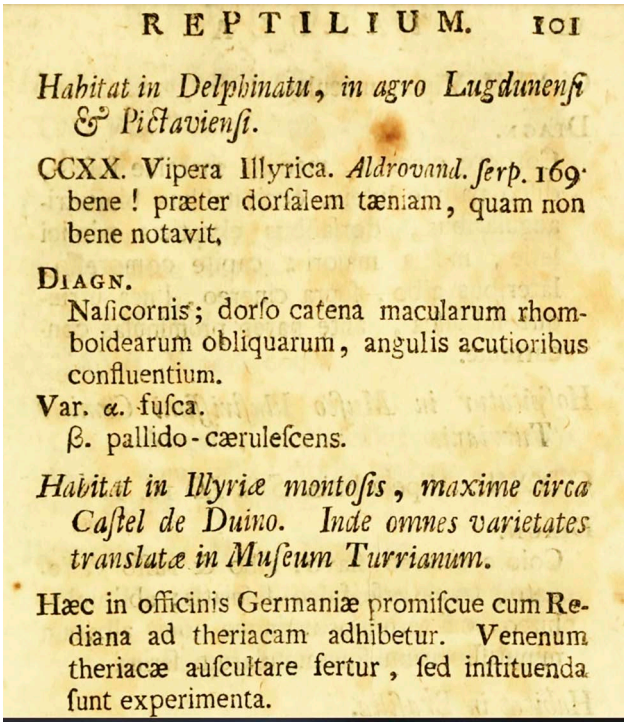
Description by Laurenti	Translation	Comments
CCXX. Vipera Illyrica. *Aldrovand. serp.* 169 bene! præter dorsalem tæniam, quam non bene notavit.	220. Vipera Illyrica. *Aldrovand. serp.* 169 good! except for the dorsal band, of which he did not well take note.	220 = species number without any further connotation; taxa numbered consecutively in the book. *Aldrovand. serp.* 169 =reference to Aldrovandi 1640.
DIAGN. Nasicornis; dorso catena macularum rhomboidearum obliquarum, angulis acutioribus confluentium.	DIAGN[OSIS]: Horned nose; on the back a chain of oblique rhomboid spots, meeting at sharper angles.	
Var. α. fusca. β. pallido-cærulescens.	Var[ietas] α fusca β. pallido-caerulescens	fusca = brown variety. pallido-caerulescens =pale blueish variety.
Habitat in Illyriæmontosis, maxime circa Castel de Duino. Inde omnes varietates translatæ in Museum Turrianum.	Lives in the mountainous places of Illyria, mostly around the Castel de Duino. All varieties were brought from there to the Museum Turrianum.	
Hæc in officini Germaniæ promiscue cum Rediana ad theriacam adhibetur. Venenum theriacæ auscultare sertur, sed instituenda sunt experimenta.	It is used, together with the Redian, in apothecary shops in Germany for theriac. There are rumours on the venom of theriac, but experiments should be instituted.	Redian = *Vipera Francisci Redi* in Laurenti 1768: 99. theriac = multi-ingredient preparation used as an antidote to all known poisons including snakebite envenoming.

entific work (for a review see Krecsák 2007, Krecsák & Bohle 2008). His taxa within the synonymy of *V. a. illyrica* are highly questionable. Reference to the relevant articles of the 'International Code of Zoological Nomenclature' (hereafter Code) (ICZN 1999) are provided for emendations, incorrect and unavailable names.

Vipera Illyrica Laurenti, 1768b: 101.
[*Vipera Illyrica*] var. *fusca* Laurenti, 1768b: 101
[*Vipera Illyrica*] var. *pallido-caerulescens* Laurenti, 1768b: 101 [justified emendation as per Article 33.2.2 of the Code (ICZN 1999) *Vipera illyrica pallidocaerulescens*.]
Vipera ammodytes – Sonnini & Latreille (1801: 306)
[*Vipera* (*Echidna*)] *Ammodytes* (part.) – Merrem (1820: 151)
C.[*obra*] *Ammodytes* – Fitzinger (1826: 62)
[*Pelias*] *C.*[*oluber*] *ammodytes* – Boie (1827: 558)
Vip.[*era*] (*Rhinechis*) *Ammodytes* – Fitzinger (1843: 28)
V.[*ipera*] (*Vipera*) *ammodytes* (part.) – Jan (1863: 121)
Vipera amodytes – Erber 1863: 130 [incorrect subsequent spelling of *ammodytes*, hence unavailable as per Article 33.3 of the Code (ICZN 1999)]
Vipera ammodytes (part.) – Boulenger (1893: 485)
[*Vipera ammodytes*] var. *steindachneri* Werner, 1897: 84
Vipera ammodytes (*ammodytes*) – Boulenger, 1903: 185
Teleovipera ammodytes – Reuss 1927: 125 [unavailable name as per Article 11.6 of the Code (ICZN 1999); Krecsák 2007]
Teleovipera transversovirgata Reuss 1927: 125 [unavailable name as per Article 11.6 of the Code (ICZN 1999); Krecsák 2007]
Vipera ammodytes ammodytes – Mertens & Müller, 1928: 51
Rhinaspis ammodytes – Reuss, 1930: 61 [nomen nudum, failing to comply with Article 12 of the Code (ICZN 1999); Krecsák 2007]
Rhinaspis ammodytes velebitensis Reuss, 1932: 5
Rhinaspis ammodytes littoralis Reuss, 1933a: 284 [nomen nudum, failing to comply with Article 12 of the Code (ICZN 1999); Krecsák 2007]
Rhinaspis illyrica – Reuss, 1933b: 349
Rh[*inaspis*]. *illyrica velebitensis* Reuss, 1935: 513
Rh[*inaspis*]. *illyrica illyrica* Reuss, 1935: 513
Rh[*inaspis*]. *illyrica litoralis* Reuss, 1935: 513
Rh[*inaspis*]. *illyrica littoralis* – Reuss, 1937: 1795 [incorrect subsequent spelling of *litoralis*, hence unavailable as per Article 33.3 of the Code (ICZN 1999)]
Rhinaspis illyrica forma *melanura* Reuss, 1937: 1789 [justified emendation as per Article 33.2.2 of the Code (ICZN 1999) *Rhinaspis illyrica melanura*; Krecsák 2007]
Vipera ammodytes ammodytes – Schwarz, 1936: 166
[*Vipera illyrica*] var. B *pallido-coerulescens* – Schwarz, 1936: 225 [incorrect subsequent spelling of *pallidocaerulescens*, hence unavailable as per Article 33.3 of the Code (ICZN 1999)]
Vipera illyrica pallidocoerulescens – Bruno, 1968: 294 [incorrect subsequent spelling of *pallidocaerulescens*, hence unavailable as per Article 33.3 of the Code (ICZN 1999)]
Vipera ammodytes ruffoi Bruno, 1968: 295
Vipera ammodytes ammodytes – Bruno, 1968: 294
Vipera ammodytes gregorwallneri Sochurek, 1974: 3
Vipera [(*Rhinaspis*)] *ammodytes ammodytes* – Obst, 1983: 232

Table 2. Taxa in the synonymy of *Vipera ammodytes illyrica* and the location of the type material.

Taxon	Type locality	Location of the specimen	Comments
Vipera ammodytes steindachneri Werner, 1897	Banat, Romania	NMW 23397	Exact collection locality not known. Purchased by Franz Werner from a collector and dealer. Locality outside the geographic area of Illyria sensu Aldrovandi/Laurenti.
Rhinaspis ammodytes velebitensis Reuss, 1932	Velebit Mountains, Croatia	SMF 56627	According to the description the specimen was born in captivity in 1928.
Rhinaspis illyrica litoralis Reuss, 1935	Dalmatian coast	Not designated.	According to Schwarz (1936), this taxon was based on specimens from the surrounding of Zadar, Croatia.
Rhinaspis illyrica melanura Reuss, 1937	Region of Castel de Duino, Trieste, Italy	Unlocated.	The holotype is unlocated (Krecsák 2007).
Vipera ammodytes ruffoi Bruno, 1968	Monte Pozza, Bolzano, Italy	Holotype and allotype unlocated. The collection of Silvio Bruno is stored I the Fondazione Museo Civico di Rovereto, Rovereto (Italy) but the type material is not present (G. Stancher, pers. comm.).	Locality outside the the geographic area of Illyria sensu Aldrovandi/ Laurenti.
Vipera ammodytes gregorwallneri Sochurek, 1974	Friesach, Carinthia, Austria	Syntypes: ZMB 43556 and ZMB 43557.	Locality outside the geographic area of Illyria sensu Aldrovandi/Laurenti.



REPTILIUM. 101

Habitat in Delphinatu, in agro Lugdunenſi & Pictavienſi.

CCXX. Vipera Illyrica. *Aldrovand. ſerp.* 169· bene! præter dorſalem tæniam, quam non bene notavit.

Diagn.
Naſicornis; dorſo catena macularum rhomboidearum obliquarum, angulis acutioribus confluentium.

Var. α. fuſca.
β. pallido-cæruleſcens.

Habitat in Illyriæ montoſis, maxime circa Caſtel de Duino. Inde omnes varietates translatæ in Muſeum Turrianum.

Hæc in officinis Germaniæ promiſcue cum Rediana ad theriacam adhibetur. Venenum theriacæ auſcultare fertur, ſed inſtituenda ſunt experimenta.

Figure 2. The original description of *Vipera illyrica* from the book by Laurenti (1768b).

Considerations on the neotype designation

We initially considered designating a neotype (arguments supporting the designation itemized below) from the type material of taxa in the synonymy of *V. a. illyrica*. Therefore, we critically assessed the existing type material to comply with the following four criteria: (1) its origin could be appropriately validated, (2) the locality was known specifically, (3) specimens are housed in a widely accessible collection, and (4) collection data are consistent with the geographic term Illyria as used by Aldrovandi and later adopted by Laurenti. Table 2 summarizes the taxa in the synonymy of *V. a. illyrica* with remarks on the location of the type material and comments on the origin on the specimens. Following a thorough assessment of the available type material, we were unable to select a neotype from the type material of taxa in the synonymy of *V. a. illyrica* since they have not met the requirements of the Code due to the following reasons:

1. The types of *Vipera ammodytes steindachneri* Werner, 1897 and *Rhinaspis ammodytes velebitensis* Reuss, 1932 have questionable, unverifiable origins and, in addition, the type locality for *V. a. steindachneri* (Banat, Romania) lies outside the geographic area of Illyria sensu Aldrovandi/Laurenti and might intersect with the range for *V. a. ammodytes*.

2. The type material of *Rhinaspis illyrica litoralis* Reuss, 1935 and *Rhinaspis illyrica melanura* Reuss, 1937 is unlocated, most probably lost.

3. The type localities of *Vipera ammodytes ruffoi* Bruno, 1968 (Monte Pozza, Bolzano, Italy) and *Vipera ammodytes gregorwallneri* Sochurek, 1974 (Friesach, Carinthia, Austria) lie outside the the geographic area of Illyria sensu Aldrovandi/Laurenti.

Arguments supporting the designation of the neotype include:

1. no name-bearing type specimens from the Laurenti type series (i.e., the primary syntypes from the Thurn Collection and secondary syntypes from the Aldrovandi collection) are believed to be extant [Article 75.1 of the Code (ICZN 1999)] as shown in the 'Original description and type series of *Vipera illyrica*' section above [Article 75.3.4 of the Code (ICZN 1999)];

2. the former range and multiple type locality restrictions of the Nose-horned Viper populations that are to be referred as *V. a. illyrica* (Laurenti, 1768) necessitate the designation of a name-bearing type in order to exclusively and objectively define the nominal taxon [Article 75.1 of the Code (ICZN 1999)];

3. a neotype is designated to stabilize the usage of the species name *illyrica* and the type locality of the taxon [Article 75.3.1 of the Code (ICZN 1999)];

4. characters differentiating *V. illyrica* from the other taxa in the species-group are summarized under 'Results of the statistical analysis' section below [Article 75.3.2 of the Code (ICZN 1999)];

5. the neotype is described under the 'Description of the neotype' section below [Article 75.3.3 of the Code (ICZN 1999)];

6. the selected specimen is consistent with the species-group formerly described as *Vipera illyrica* as summarized under the 'Results of the statistical analysis' section below [Article 75.3.5 of the Code (ICZN 1999)];

7. the neotype selected was collected at Trieste on the Gulf of Trieste, a locality in the immediate vicinity of Duino (the single precise locality in the description by Laurenti), both part of the same large Nose-horned Viper metapopulation, as discussed in the 'Results of the statistical analysis' section below [Article 75.3.6 of the Code (ICZN 1999)];

8. the neotype selected is housed of one the oldest and most prestigious natural history collections, the Natural History Museum Vienna [Article 75.3.7 of the Code (ICZN 1999)].

In order to stabilize the usage of the species name *illyrica* as used for a Nose-horned Viper we here designate specimen NHMW 25274:6 in the Natural History Museum Vienna, collected at Trieste, Friuli Venezia Giulia autonomous region, NE Italy the neotype for the taxon in compliance with the Articles 72.2 and 75 of the Code (ICZN 1999).

Materials and methods

We added morphological data of the proposed neotype to an extensive dataset from Tomović (2006) to evaluate morphological evidence for its placement among populations from throughout the range of the species. The following measurements were recorded to the nearest 0.1 mm. Characters marked with an asterisk were measured/counted on both sides (left/right).

Morphometric characters included snout–vent length (SVL), tail length (TL), body length without head (L cor), body width (Lt cor), body height (Alt cor), head length (L cap), head width (Lt cap), eye diameter (Do*), distance between the eye and upper labial (Dols*), horn height (Alt corni), snout height (Alt r), height of rostral plate (L scr), width of rostral plate (Lt scr). Scalation characters included number of preventrals (PreV), number of ventrals (Ventr), number of dorsal scale rows on the neck (DorsN), number of dorsal scale rows at midbody (DorsMb), number of dorsal scale rows at the tail (DorsT), number of subcaudals (Scd*), number of supralabials (SupL*), number of sublabials (SubL*), number of scales forming the horn (Horn), number of canthals (Canth*), number of apicals (Apic*), number of loreals (Lor), number of circumoculars (CircO*), number of scales in second row of circumoculars (CircO2*), second circumocular row complete (1) or incomplete (2) (CircO2C*), number of sublabials contacting one inframaxillary scale (IM/SL), number of gulars (Gul*). Coloration: colour of dorsal and ventral parts of the trunk, colour of the tip of the tail, number of zigzags on the body dorsum from the head to the level of the vent (ZZW*), number of zigzags on the tail (ZZW2*). Qualitative traits (Tomović 2006): number of suprarostral plates (I), connection of nasorostral plates with canthus rostralis (II), nasorostral plates (III), rostral height/width ratio (IV), relation between the rostral and nasorostral plates (V), type of dorsal trunk pattern (VI), type of head pattern (VII), type of lower lip spots (VIII) and presence of large scales on the dorsal side of the head (IX).

For a more detailed description of the characters, see Tomović (2006) and Krecsák & Wahlgren (2008).

Statistical analyses of morphometric, meristic, and qualitative traits were done following the procedures described in Tomović (2006). In total, we used 452 males (+ neotype specimen), but for analyses of morphometric and meristic traits, we used 400 males (+ neotype specimen). Discriminant canonical analysis was performed on size-adjusted morphometric and meristic data in order to clarify the relative importance of characters as discriminators between a priori groups (taxa), and the relative positions of individual specimens into projection of the first and the second canonical axes (Manly 1986). The neotype specimen was added to previously established OTUs a posteriori, based on the initial Discriminant Function analysis. Correspondence analysis (Rohlf 1988) was used in order to clarify which qualitative characters (and states) define the taxonomic units. The output of such an analysis was the coordinates of the row (subspecies) and column (character states) on correspondence axes displayed on the scatter plot. Statistical analyses were performed with statistical package Statistica v12.

Results

Description of the neotype

Specimen: NHMW 25274:6; collected in Trieste, Friuli Venezia Giulia region, northeastern Italy, 22 April 1902 (presumably donation date), leg. Dr. Eduard Heinrich Gräffe (1833–1916). Nota bene: the original label bears the name of 'Dr. Greiffe' (Fig. 3a, b).

Adult male. Morphometric characters: SVL 526, TL 68, L cor 500, Lt cor 19, Alt cor 16, L cap 26, Lt cap 18, Do 2.6, Dols 3.5, Alt corni 3.7, Alt r 3.7, L scr 3.4, Lt scr 4.1. Scalation characters: PreV 5, Ventr 153, 2 DorsMb 22, Scd 34/34, SupL 9/9, SubL 12/10, Horn 17, Cant 2/2, Apic 2/2, Lor 6/6, CircO 12/10, CircO2 3/5, CircO2C 2/1, Im/SL 4/4, Gul 3/3. Colour pattern and qualitative characters: ground colour greyish-brown, with a black zig-zag

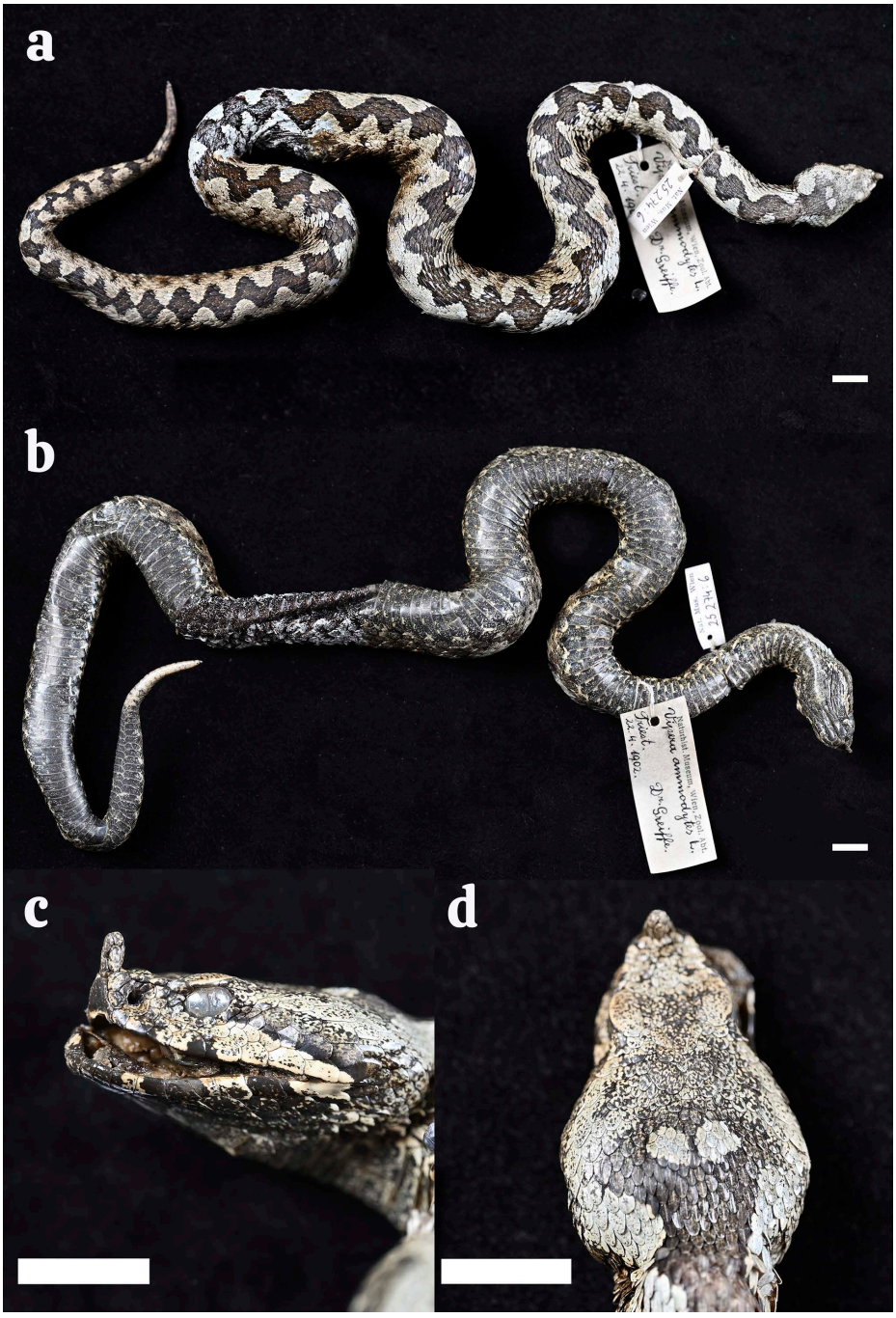


Figure 3. Dorsal (a) and ventral (b) view of the whole specimen; lateral left (c) and top (d) view of the head of the designated neotype of *Vipera ammodytes illyrica* (Laurenti, 1768), specimen NHMW 25274:6. Bar on each image accounts for 50 mm.

pattern; belly and subcaudal surface black or bluish grey, with white flecks. ZZW 46/46, ZZW2 11/11. Belly and subcaudal surface light beige. I:1, II:1, III:2, IV:2, V:2, VI:3, VII:3, VIII:1, IX:0.

Results of the statistical analysis

Morphometric and meristic characters: Results of Discriminant Canonical Analysis on 12 size-adjusted morphometric and meristic characters showed that, in the projection of the first and second canonical axes, the neotype falls within the 95% confidence intervals of the multivariate variability of the subspecies *V. a. illyrica* (Fig. 4). Qualitative characters: Frequencies of qualitative traits of the subspecies and neotype are given in Table 3. Correspondence analysis of four taxonomically informative qualitative characters (sensu Tomović 2006) showed that in the projection of the first and the second correspondence axes the neotype specimen fits with the specimens of the subspecies *V. a. illyrica* (Fig. 5). Specimens from the range of the *V. a. illyrica* are characterized by the more frequent presence of the following characters and combination of states: I:1 (one suprarostral plate), II:1 (both nasorostral plates in contact with canthus rostralis) and II:2 (asymmetry – one nasorostral plate in contact with canthus rostralis, the other not), IV:2 (greater width than height of rostral plate) and V:2 (greater height of nasorostral plates than of rostral plate) (Table 3).

The occurrence of the species in the region around the Gulf of Trieste is extensively documented (Küster 1842, Werner 1897, Schwarz 1936, Bruno 1968, Dolce & Lapini 1989, Heckes et al. 2005, Dall'Asta & Dolce 2006, Corti et al. 2011, Lapini et al. 2018).

Trieste is located in the vicinity of Duino (the distance between Trieste and Duino is ca. 25 km), both localities being located on the Gulf of Trieste. A homogenous karstic area in the Gulf of Trieste, a suitable habitat for the species, intimates the existence of a large metapopulation in the region. Morphological analysis conducted on the population in the Trieste Karst and the Monfalcone Karst (6 km N of Castelo Nuevo de Duino) showed the existence of a homogenous population (Dobrilla & Dolce 1996).

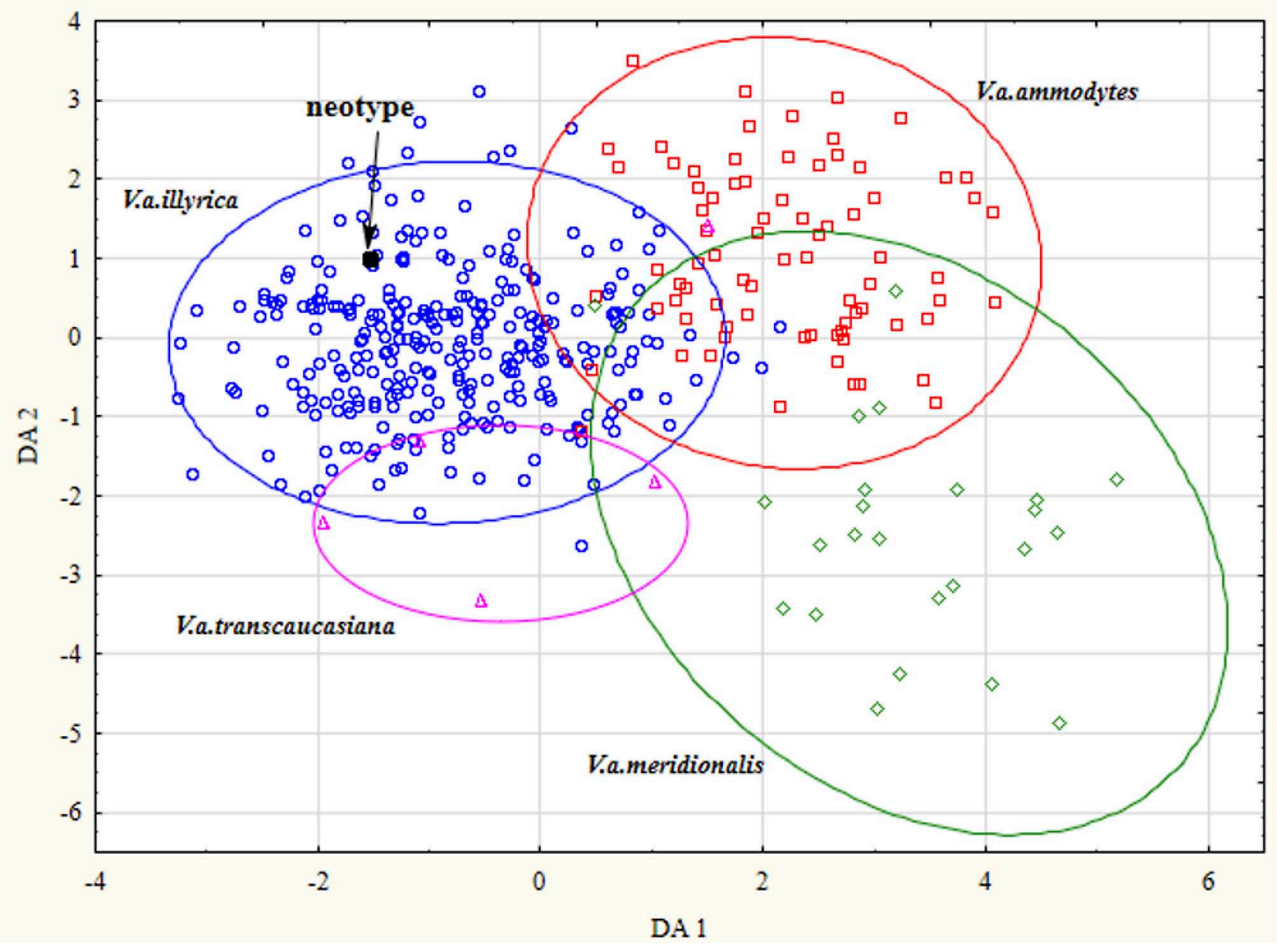


Figure 4. Relative position of the neotype (specimen NHMW 25274:6) in the projection of the first and the second canonical axes (size-adjusted morphometric and meristic data). Ellipsoids denote 95% variability of the subspecies.

Table 3. Frequencies of the states of the qualitative characters in four subspecies and the neotype (specimen NHMW 25274:6) of *Vipera ammodytes*. * = state of qualitative traits in the neotype.

Trait (Tomović 2006)	Neotype NHMW 5274:6	*V. a. illyrica* (n=332)	*V. a. ammodytes* (n=85)	*V. a. meridionalis* (n=29)	*V. a. transcaucasiana* (n=5)
I:0		3	32	1	1
I:1	*	237	5	1	4
I:2		75	43	14	0
I:3		17	5	13	0
II:0		58	84	28	5
II:1	*	243	0	0	0
II:2		31	1	1	0
IV:0		9	6	4	0
IV:1		8	59	15	1
IV:2	*	315	20	10	4
V:0		35	7	7	0
V:1		15	76	21	2
V:2	*	282	2	1	3

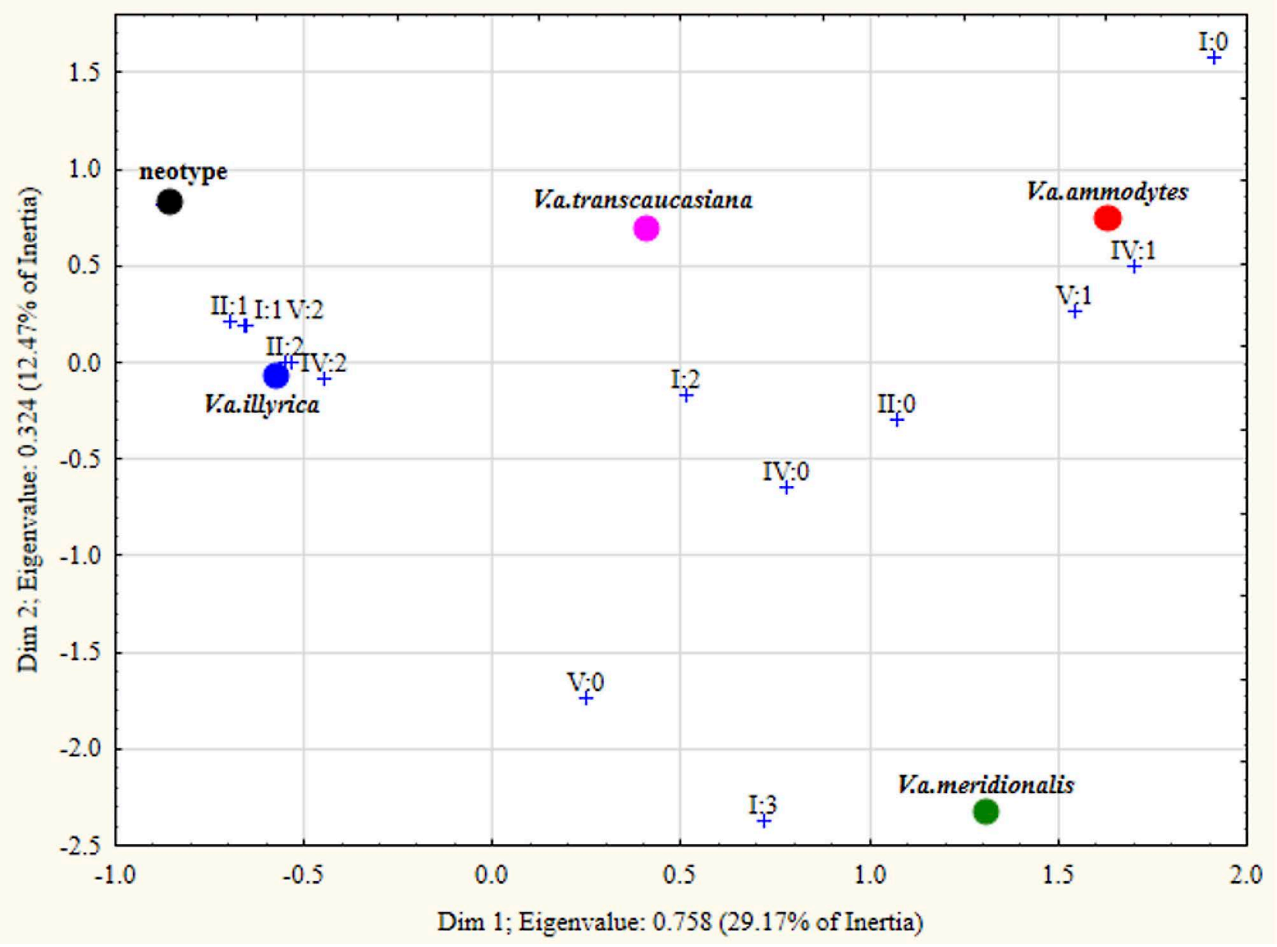


Figure 5. Relative position of the neotype (specimen NHMW 25274:6) in the projection of the first and the second correspondence axes (qualitative data).

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