

A review of the taxonomy of the European Colubrid snake genera *Natrix* and *Coronella*, with the creation of three new monotypic genera (Serpentes:Colubridae).

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ABSTRACT

There have been several phylogenetic studies involving the Keeled Snakes of genus *Natrix* and Smooth Snakes of genus *Coronella* as recognized at start 2012.

The exact status of each genus in terms of species composition has been the subject of argument among taxonomists, including whether or not well-recognized species such as *N. tessellata*, *N. natrix* and *C. girondica* are actually composites of several similar species. Within the last decade, several studies have shown the divergence between the three members of the genus *Natrix* to be from 12 to 27 million years ago (Guicking et. al. 2006), and probably further back for the three extant members of the genus *Coronella* (see comparative results in Pyron et. al. 2011).

As a result each genus is subdivided three ways.

Natrix natrix remains as the sole taxon in that genus. *N. maura* is placed within a new genus *Jackyhosernatrix* gen. nov. and *N. tessellata* is placed in the new genus *Guystebbinsus* gen. nov.

Coronella austriaca remains as the sole taxon in that genus, while *C. brachyura* is placed in the genus *Wallophis* Werner, 1929, and *C. girondica* is placed in the genus *Sharonhoserea* gen. nov.

Keywords: Taxonomic revision; new genera; genus; species; *Coronella*; *Natrix*; *Wallophis*; *Jackyhosernatrix*; *Sharonhoserea*; *Guystebbinsus*; *tessellata*; *maura*; *girondica*; *austriaca*; *brachyura*.

INTRODUCTION

Numerous studies have been completed in terms of the Keeled Snakes currently placed in the genus *Natrix*, and the Smooth Snakes, currently placed in the genus *Coronella*.

The three species remaining within each genus as of 2012, have had a fairly stable taxonomic history in recent years, following the partitioning of the relevant genera (e.g. Rossman and Eberle 1977) and the placement of component species in various other genera including those identified by Rossman and Eberle (1977).

While the remaining snakes in each genus are physically very similar, recent phylogenetic studies have shown them to have

histories far more divergent than their obvious morphologies would suggest.

Most recent taxonomic studies on these snakes have concentrated on the divergences of scattered European populations in the recent geological past, with a view to managing ongoing conservation issues caused by human overpopulation.

Alternatively they have been conducted with a view to the resolution of disputes in terms of alleged species and subspecies.

As another alternative, the genera themselves have been scrutinized from the perspective of their positions in higher taxonomic hierarchies at the family level or even higher (e.g. Lawson et. al. 2005, Pyron et. al. 2011).

However no recent authors have investigated the possibility that in the light of this new molecular data, whether or not snakes are appropriately placed within given genera which have been previously assigned.

The results published by Pyron et. al. (2011) in terms of a global review of the Colubroidea in particular shows that the continued treatment of snake species within each genus (*Natrix* and *Coronella*) as monotypic is inconsistent when compared to other colubrid genera as recognized, including for example *Pituophis* and *Pantherophis* being divided into two genera when the more divergent members of *Coronella* are not.

Recent papers dealing with the phylogeny and taxonomy of *Natrix* and/or *Coronella* include: Bagherian and Kami (2009), Guicking et. al. (2006), Guicking et. al. (2009), Guicking and Joger (2011) and Pyron et. al. (2011).

Studies and publications dealing with relevant aspects in terms of *Natrix* include: Abo-Eleneen et. al. (2011), Ahmadzadeh et. al. (2011), Ananjeva et. al. (2006), Anonymous (1992), Baier and Wiedl (2010), Bar and Haimovich (2012), Barata et. al. (2008), Bassu et. al. (2008), Bergmans (1976), Billings and Langford (1991), Böhme and Wiedl (1994), Borczyk (2007), Boulenger (1891), Boulenger (1893), Boulenger (1913), Brecko et. al. (2011), Cortés (1982), Engelmann (1993), Frotzler et. al. (2011), Günther (1866), Hutinek et. al. (2011), Ingle and Sarsavan (2011), Schleich et. al. (1996), Jandzic (2005), Joger et. al. (2007), Klesius (2009), Kühnel (2002), Lantermann and Lantermann (2007), Lantermann and Lantermann (2011), Laurent (1935), Leviton et. al. (1992), Linnaeus (1758), Liu et. al. (2011), Orlov and Tuniyev (1987), Orlov, et. al. (1992), Santos et. al. (2005), Santos et. al. (2011), Schätti (1982), Schlüter (2009), Schlüter (2012), Sindaco et. al. (2007), Sos (2008), Thorpe (1975a, 1975b, 1979, 1980a, 1980b, 1981, 1984), Tuniyev (1990), Venchi and Sindaco (2006), Willsch (1984) and Wirth and Hähnelin (2009).

Studies and publications dealing with relevant aspects in terms of *Coronella* include: Bombi et. al. (2009), Boulenger (1889), Daudin (1802), Dusej (1993), Najbar (2006), Pernetta and Reading (2009), Santos et. al. (2008), Schlüter (2004, 2009, 2012), Sharma (2004), Smith (1943) and Vyas and Patel (2007).

As composites, these studies also yield a compelling argument for the division of the relevant genera as currently recognized.

Therefore the two genera are herein subdivided as follows:

Natrix natrix remains as the sole taxon in that genus. *N. maura* is placed within a new genus *Jackyhosernatrix* gen. nov and *N. tessellata* is placed in the new genus *Guystebbinsus* gen. nov..

Coronella austriaca remains as the sole taxon in that genus, while *C. brachyura* is placed in the resurrected genus *Wallopis* Werner, 1929, and *C. girondica* is placed in the genus *Sharonhoserea* gen. nov..

GENUS *NATRIX* LAURENTI, 1768

Type species: *Coluber natrix* Linnaeus, 1766

Diagnosis: The genus as recognized as of early 2012 consisted of three species of medium to large snakes with clearly keeled body scales, large scales on the head and round pupils. The belly pattern is often chequered. There are 19-23 dorsal mid body rows, 7-8 upper labials, 1-2 pre-oculars, 2 internasals, 2-4 postoculars, nostrils pointing laterally.

In terms of this paper, the genus *Natrix* (species *natrix*) is herein separated from the other two species formerly placed in the genus by having seven supralabials and three postoculars, versus two postoculars in the species *maura* (genus *Jackyhosernatrix* gen. nov) or 8 upper labials in the species *tessellata* (genus *Guystebbinsus* gen. nov.).

They are usually found in moist places or in or near water.

THE DIVISION OF *NATRIX*

Evidence and reasons for the division of the genus *Natrix* as known in early 2012 have come from several sources.

One was Guicking et. al. 2006.

They wrote in their abstract:

"Some aspects of the natural history of snakes of the colubrid genus *Natrix* have been well studied. With their extensive European distribution and relative abundance, their ecology, reproduction and behaviour are well known. Yet other facets of their biology remain poorly understood. These include knowledge of *Natrix* phylogeny, hypotheses explaining the current distribution of the three extant

members of the genus, and their evolution and relationships. In this study we used molecular data, the nucleotide sequences of four protein-coding mitochondrial genes (3806 bp total), to provide a well-supported phylogeny for the genus *Natrix*. With these molecular data, evidence from the fossil record, and knowledge of palaeogeological events, we used two approaches in designing a time scale which we used to date the major events in *Natrix* speciation and intraspecific variation. Our data strongly support a phylogeny for the genus in which *N. maura* is basal with *N. natrix* and *N. tessellata* being sister species. The calibrated molecular clock suggests that *N. maura* diverged from the common ancestor of the three species 18-27 mya and that *N. natrix* and *N. tessellata* diverged 13-22 mya. Although the ranges of these estimates are large they support an early Miocene to late Oligocene origin for the three species. Intraspecific divergence is estimated to have commenced 5.3, 6.0 and 6.7 mya with evolutionary rates of 1 : 1.25 : 1.35% per million years for *N. maura*, *N. natrix* and *N. tessellata*, respectively."

The time frame for divergence puts all three species sufficiently apart to be reasonably placed in separate genera.

Furthermore the so-called intra-specific divergences within the three named taxa supports the likelihood that one or more of these is in fact composite.

Notwithstanding this, the species described as *Natrix megaloccephala* Orlov and Tuniyev, 1987, has been questioned by several authors, including Venchi and Sindaco 2006 and Bohme 2009, who have treated it as synonymous with *N. natrix scutatus*. However other authors including, Engelmann et. al. 1993 and Ananjeva et. al. 2006 have regarded *megaloccephala* as a valid species.

Notable is that the published results of Pyron et. al. (2011) showed the three species of *Natrix* as recognized in early 2012 to have diverged at a point comparable to that where other taxa are placed in separate genera.

The species *maura* was found to have diverged from the common ancestor prior to *natrix* and *tessellata*, which concurs with the results of Guicking et. al. 2006, who also found this taxon as the first to diverge.

With obvious morphological differences between the taxa as well as clear and defined habitat partitioning between species when they are sympatric, it is clear that generic division between the taxa is warranted and hence this is done according to the Zoological Code (Ride et. al. 1999), below.

GENUS *JACKYHOSERNATRIX* GEN. NOV.

Type species: *Coluber maurus* Linnaeus, 1758

Diagnosis: The genus *Natrix* (species *natrix*) is herein separated from the other two species formerly placed in the genus by having seven supralabials and three postoculars, versus two postoculars in the species *maura* (this genus *Jackyhosernatrix* gen. nov.) or 8 upper labials in the species *tessellata* (genus *Guystebbinsus* gen. nov.).

Snakes in this genus have seven supralabials, with numbers 3 and 4 entering the eye and two postoculars. In snakes of both genus *Guystebbinsus* gen. nov. and *Natrix* there are three postoculars.

The species within this genus (*Jackyhosernatrix* gen. nov.) are medium to large snakes with clearly keeled body scales, large scales on the head and round pupils. The belly pattern is often chequered. There are 19-23 (usually 21) dorsal mid body rows, 7 upper labials, 2 pre-oculars, 2 internasals, 2 postoculars, nostrils pointing laterally.

These snakes grow up to 100 cm in total length, but most adults are less than 70 cm.

Females are the larger sex.

Coloration varies, but dorsally is usually brown or grayish but may be tinged with yellow, red or olive. Typically there are two rows of staggered dark blotches running down the mid-back that may merge to produce bars or a well-defined zig-zag stripe. Flanks have dark blotches or more commonly large light-centered ocelli. Some specimens have two narrow, light yellow or reddish stripes running along the back. Usually the head is boldly marked often with one or two "A"-shaped marks on the crown and neck that may be joined by a central blotch. The light supralabials have conspicuous dark borders. The belly is whitish, yellow, red or brown chequered with dark brown.

While these snakes are often confused with vipers (Viperidae), they are readily separated by the fact that vipers have elliptical pupils, smaller head shields and obvious hollow fangs that fold up when the mouth closes.

These snakes are more thick-set than *Natrix* and *Guystebbinsus* gen. nov. (see below). In this genus the head is also usually broader and the snout is more rounded.

Distribution: Iberia, most of France except the far north, South-west Switzerland, North-west Italy, Balearic Islands, Iles d'Hyeres, Mallorca, Menorca and Sicily and north-west Africa, including Morocco, Algeria, Tunisia and Galita Island.

Common name: Viperine Water Snake.

Etymology: Named in honor of my daughter Jacky Hoser for more than ten years of valuable service to reptile education.

GENUS *GUYSTEBBINSUS* GEN. NOV.

Type species: *Coronella tessellata* Laurenti, 1768.

Diagnosis: Snakes within this genus, *Guystebbinsus* gen. nov. are separated from *Natrix* and *Jackyhosematrix* gen. nov. by having 8 supralabials and only the fourth upper labial entering the eye.

In genera *Natrix* and *Jackyhosematrix* gen. nov. there are 7 labials and the third and fourth both enter the eye.

Snakes within *Guystebbinsus* gen. nov. have three or more postoculars, versus just two in *Jackyhosematrix* gen. nov..

The species within this genus (*Guystebbinsus* gen. nov.) are medium to large snakes with clearly keeled body scales, large scales on the head and round pupils. The belly is whitish, yellowish, pink or red, with a chequered pattern or with one or two irregular dark stripes or almost entirely black. There are 19-23 (usually 21) dorsal mid body rows, 8 upper labials, 3 or more pre-oculars, 2 internasals, 2 postoculars, nostrils pointing laterally.

These snakes grow up to 100 cm in total length, but most adults are less than 70 cm.

Females are the larger sex.

Coloration varies, but dorsally is usually brown or grayish but may be yellowish or greenish often with a pattern of regular dark spots evenly dispersed over the body. These spots may be large, small or sometimes completely absent, or they may fuse to form dark bars on the back and flanks. Those on flanks often alternate with narrower light bars. Sometimes there is an "A"-shaped mark on the nape, but often head markings are obscure.

These snakes are even more aquatic than *Jackyhosematrix* gen. nov., often spending considerable time in the water and able to remain submerged for considerable periods. The diet is dominantly fish.

Distribution: Most of the Balkans, Italy (except the extreme south), north to South Switzerland, East Austria, Czechoslovakia and south Russia. Isolated populations are known from West Austria, North-east Switzerland, on mid-Rhine and Elbe, the islands of Crete and Kithera and eastwards to south-west and central Asia.

Common name: Dice Snake.

Etymology: Named in honour of Guy Stebbins of Ascot Vale, Melbourne, Australia, for services to herpetology, including many hours of unpaid work building reptile cages and the like for Snakebusters - Australia's best reptiles shows.

GENUS *CORONELLA* LAURENTI, 1768

Type species: *Coronella austriaca* Laurenti, 1768

Diagnosis: As recognized up to the beginning of 2012 snakes of this genus are relatively small species, rarely growing to more than 60 cm in total length. The head is only slightly distinct from the neck and the pupils round. The teeth of the upper jaw increase in size towards the back. The body is almost cylindrical and covered with smooth scales. The subcaudals are paired.

They are terrestrial and rather secretive, spending much of their time under cover.

The only species remaining within the genus *Coronella* as defined herein is *C. austriaca*. It is separated from the species *girondica* (now placed in the genus *Sharonhoserea* gen. nov.) and the species *brachyura* (now placed in the genus *Wallopis* Werner, 1929) by having 19 dorsal mid body rows.

The number is 21 in *Sharonhoserea* gen. nov. and 23 in *Wallopis*. *Coronella* as defined herein is further separated from the genera *Sharonhoserea* gen. nov. and *Wallopis* by having 7 supralabials, versus 8 in the other two genera.

Snakes in *Coronella* as defined herein are small (up about 60 cm in total length), rarely over 80 cm. The color is usually variable, but usually grayish or brownish, pinkish or even reddish, sometimes more intense on each side of the midline giving the effect of two often vague streaks. Usually small dark blotches are present on the back and usually clearest on the neck where there are often two dark stripes, and often form irregular transverse bars or are arranged in two lines. There is nearly always a dark stripe from the side of the neck to the nostril and sometimes a vague "brindle" on the snout as well. The venter is usually darkish red, orange, grey or blackish, generally with some mottling or fine spotting.

These snakes feed mainly on other reptiles, which are held in coils when attacked.

They are live-bearing.

Distribution: Found in isolated pockets in southern England, France, North Iberia, east to South Scandinavia and Russia and south to Italy, Sicily and Greece. Also found in north Asia Minor to North Iran.

GENUS *WALLOPHIS* WERNER, 1929

Type species: *Zamenis brachyura* Gu'nther, 1866

Diagnosis: *Wallopis* is a monotypic genus containing the species *brachyura*. The genus name *Wallopis* has not been used widely in recent years, with the relevant taxon being placed in the genus *Coronella*.

The morphology and habits of the species *brachyura* are sufficiently different to warrant its placement in a separate genus, for which the name *Wallopis* is available and herein used.

The diagnosis for the monotypic genus follows: It is separated from all other species recently referred to in the genus *Coronella*, namely *austriaca* and *girondica*, now placed in the genus *Sharonhoserea* gen. nov. (see below), by having 23 dorsal mid body scale rows. In *Sharonhoserea* gen. nov. it is 21 mid body rows, whereas in *Coronella* it is 19 mid body rows.

Wallopis is also separated from the genera *Coronella* and *Sharonhoserea* gen. nov. by the fact that its frontal shield is triangular in shape, which is not the case in the other genera.

Wallopis is best specifically diagnosed referring to the following suite of characters:

Nostril large, between two nasals; internasals 0.3 to 0.5 as long as the prefrontals; frontal nearly as broad as long, in contact with a large preocular; loreal longer than high; 2 postoculars; temporals 2+2; 8 supralabials, 4th and 5th touching the eye; anterior genials larger than the posterior, the latter separated by two or three series of small scales. Scales in 23:23:19 rows; ventrals large, rounded; tail rather short. Ventrals 200-224; subcaudals 46-53; Anal is single.

Hemipenis extends to the 13th caudal plate, is not forked. The distal half is calyculate, the cups being large and with scalloped edges; the proximal half is spinose, two or three spines at the base being much larger than the others.

The dorsal color is olive-brown, with indistinct light variegations on the anterior half of the body and head; lower parts are whitish. Total body length in adult males is 515 mm, tail 75 mm; females 460 mm, tail 55 mm.

Distribution: Found only in Northern India, namely the Poona district and Visapur, near Bombay and South-east Berar.

Distribution alone separates this genus from *Coronella* and *Sharonhoserea* gen. nov..

GENUS *SHARONHOSEREA* GEN. NOV.

Type species: *Coluber girondicus* Daudin, 1803

Diagnosis: *Sharonhoserea* gen. nov. is a monotypic genus containing the species *girondicus*.

It is separated from all species formerly placed in *Coronella* by the fact that it has 21 mid body scale rows, versus 19 in *Coronella austriaca* and 23 in *Wallopis brachyura* (formerly *Coronella brachyura*).

Wallopis is also separated from the genera *Coronella* and *Sharonhoserea* gen. nov. by the fact that its frontal shield is triangular in shape, which is not the case in the other genera.

Wallopis is most easily separated from the genera *Coronella* and *Sharonhoserea* gen. nov. by distribution, being the only species known from India. The other two genera have their distributions centered on Europe and adjacent regions.

Sharonhoserea gen. nov. in particular is found mainly in Western

Europe and nearby parts of Africa, some thousands of kilometers from where *Wallophis* is found.

See also the diagnosis for *Wallophis* above.

This genus *Sharonhoserea* gen. nov. is similar in appearance to *Coronella*, but is differentiated by its slightly smaller average adult size of 50 cm total length, versus 60 cm in *Coronella*. Snakes in this genus, *Sharonhoserea* gen. nov. are also noticeably more slender in build and with a more rounded snout.

Separated from *Coronella* by the belly coloration, in that it is often yellow, orange or red overlaid with black in a bold diced pattern. Sometimes forming two lines, but not more-or-less uniform as seen in *Coronella austriaca*. The belly of *Wallophis* separates this genus from the other two. In *Wallophis* the belly is brownish, each scale with a yellowish posterior edge, while near the tail, the venter is immaculate.

In *Sharonhoserea* gen. nov. the rostral scale is not as large as in *Coronella* and does not extend between the supranasals.

In *Coronella* and *Wallophis*, when viewed from above the head, part the rostral scale is clearly visible dorsally as a triangle shape. This is not the case in *Sharonhoserea* gen. nov. where the rostral is barely visible and presents only as an elongate stripe on the margin of the snout.

Sharonhoserea gen. nov. differs from *Coronella austriaca* in habits. Compared to *Coronella*, *Sharonhoserea* gen. nov. is generally more a lowland species, although sometimes being found in hilly areas up to about 1,500 metres. In contrast to *Coronella* which is dominantly diurnal, *Sharonhoserea* gen. nov. is often crepuscular.

Sharonhoserea gen. nov. is noticeably more docile than *Coronella* and rarely bites when handled.

Distribution: Iberia, South France, Italy, Sicily and North-west Africa, including Morocco, Algeria and Tunisia.

Etymology: Named in honor of my cousin, Sharon Hoser for various services to herpetology.

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