Sinostoma yunnanicum, the first nemastomatine harvestman in China (Arachnida: Opiliones: Nemastomatidae)

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Abstract

The easternmost Nemastomatinae species, Sinostoma yunnanicum n. gen., n. sp., from northern Yunnan, China is described. It extends the geographic distribution of Nemastomatinae by roughly 3000 km southeastwards. Within Nemastomatinae Sinostoma displays plesiomorphic characters, including the long, basic bulb of the truncus shaft and the extremely short glans of penis, armed with short robust spines. Sinostoma may represent a relict line in the early evolution of nemastomatine harvestmen.

Key words: Nemastomatinae, taxonomy, new genus, new species

Introduction

The subfamily Nemastomatinae of the family Nemastomatidae is an entirely palaeartic group of small to tiny soil-dwelling harvestmen. Their core distribution is in West, Central and Southeast Europe and extends to the Caucasus, where a genus- and species-rich fauna occurs. The eastern outlying areas in the Pamirs and in Kyrgyzstan have so far yielded only one species each. No nemastomatines have been known to occur in areas east of the Urals (Farzalieva & Esyunin 1999) bordering West Siberia and East of Kyrgyzstan (Snegovaya 2010) and the Tadjik Pamirs (Staręga 1986). Consequently, the discovery of a single minute specimen from Southwest Chinese Yunnan was quite unexpected and belongs to a new genus and species.

Material and methods

Original line drawings were produced using a camera lucida attached to a Carl Zeiss study microscope. Measurements were taken by means of a micrometer disc attached to a Leitz stereomicroscope. Measurements of the penis were taken from the original drawing. The photograph was taken by a Leica Z6 APO A.

Abbreviations used: Apo apophysis, Cx coxa, Fe femur, Mt metatarsus, Op gen Operculum genitale, Pt patella, Ta tarsus, Ti tibia, Tu oc Tuber oculorum, ocularium, Tr trochanter. All measurements are given in mm.

Genus level systematics

The Nemastomatidae is divided into two subfamilies, the Nemastomatine in the West Palaeartic with hitherto only two geographically isolated species in Central Asia, and the Ortholasmatinae in North and Central America, with a few strictly localized and isolated species in East Asia (Shear & Gruber 1983, Shear 2010, Schwendinger & Gruber 1992). Genera in Nemastomatinae are distinguished using mainly genital and cheliceral morphology and are relatively stable. The successive papers of Kratochvil (1958), Šilhavý (1966), Martens (1978, 2006), Staręga (1976), Gruber & Martens (1968) and Gruber (1976, 1979, 2007) contributed much to our understanding. A first, still incomplete molecular-genetic analysis corroborated the current taxonomy and systematics and underlines that...
the characters used thus far are suitable for generic divisions and placement of species (Schönhofer & Martens 2010). Presently, the subfamily comprises 16 genera (Schönhofer 2013) with the most complex species composition occurring in the Iberian Peninsula (Prieto 2008), the Alps (Martens 1978), the Balkan Peninsula (Kratochvíl 1958, Staręga 1976), and the Caucasus (Martens 2006).

**Taxonomy**

**Sinostoma** n. gen.

Type species: *Sinostoma yunnanicum* n. sp. (by original designation).

A genus of Nemastomatidae within the subfamily Nemastomatinae as here defined and comprising one species. Gender of name is neuter.

Genital morphology: Penis characterized by rather unspecialized truncus, moderately slender, slightly inflated distally; the muscle-bearing basal bulb large, markedly inflated but rather compact, truncus a straight continuation of bulb, the latter not incised medially. Glans small, inconspicuous, short, not well separated from truncus; armament of glans simple with a few stiff spines in a dorsally and ventrally symmetrical arrangement, stylus short and straight.

Cheliceral apophysis of basal article well-marked but low with a distal-directed hook, secretion area a bowl-like excavation on the medial side of the apophysis.

Body armed with rows of anvil-like tubercles on the dorsal side.

**Distribution.** Only one species known from a single locality in northern Yunnan, SW China and described below.

**Name.** *Sin-* refers to China, *stoma* Greek mouth; this combination alludes to *Nemastoma*, the name-giving genus of Nemastomatidae; *nema* Greek thread, refers to the longish unarmed pedipalps of most species of this family which originate close to the mouth.

**Relations.** Rows of anvil-like tubercles forming lines and encircling the dorsal scutum magnum and all or parts of the dorsal scutal areas, probably corresponding to “segments”, are present in several nemastomatine genera and have been documented in *Mitostoma* Roewer, 1951, *Carinostoma* Kratochvíl, 1958 (Martens 1978) and *Acromitostoma* Roewer, 1951 (Rambla 1983) and are excessively developed in all New World ortholasmatines. Apparently, these dorsal ornaments represent independent developments, at least when following the (still incomplete) molecular-genetic results of Schönhofer & Martens (2012). Two of the relevant genera analyzed are placed at different branches of the molecular-genetic tree and are not closely related.

Alternatively, this dorsal armament may have been lost at various stages of nemastomatine evolution. This view is backed by the fact that nearly all ortholasmatine genera and species exhibit rich and even more elaborate scutal ornamentation, which is much reduced or even lacking in the few Asian species except for *Cladolasma damingshan* Zhang & Zhang, 2013 (Shear & Gruber 1983, Shear 2010, Zhang & Zhang 2013). Thus, rows of anvil-shaped tubercles may represent a plesiomorphic character of nemastomatid morphology. In addition, equally shaped thorns turn up as coxal-rim denticles in most species. Consequently, this character is not useful to infer phylogenetic relationships.

**Species account**

**Sinostoma yunnanicum** n. sp.

Figs 1–13

Holotype ♂ (SMF): CHINA, North Yunnan, Zhongdian County (now Shangri-La County), 55 km north of Zhongdian (now Shangri-La City), 3800m, 28°19.8′N 99°45.7′E, primary mixed forest, *Rhododendron*, dead wood, leaf litter, mushrooms, moss; from soil litter, D.W. Wrase leg. 18.8.2003.

**Diagnosis.** The sole species of *Sinostoma* with the characters of the genus.
**Measurements.** ♂: body-L: 1.7, only dorsal scutum: 1.5; Leg II: Fe 1.2, Pt 0.4, Ti 0.8, Mt 1.6 Ta 1.3; Penis-L: 0.9. ♀ unknown.

**Description.** Body (Figs 1–3): Dorsal side; scutum uniformly dark brown, without any golden or silvery markings. Margins of scutum from anterior to posterior part with a continuous row of narrowly positioned anvil-shaped low tubercles, partly fused into a low uninterrupted wall or line.

**FIGURES 1–3.** Body, ♂ holotype, 1: lateral side, 2–3: dorsal side. Scale bar 0.5 mm.

Second thoracic segment and segments (areae) I–V of scutum separated by lines of anvil-shaped tubercles similar to those on peripheral margins of the scutum, this line bent forward on area I, bent backward on areas III, IV and V caudally forming a distinct network encircling the dorsal scutal plate and separating the five dorsal areas from each other. Areas I–V with para-median pairs of low pegs, slightly inflated distally, rounded at upper end,
from area I to area V lengths of pegs slightly increasing, lacking on area II. Beside the pegs areas I–V with few additional scattered low tubercles, several of them anvil-shaped. Tu oc low, touching front of scutum and densely covered by large anvil-shaped tubercles.

**Ventral side:** Cx I–IV each with a pro- and retro-lateral row of strong anvil-shaped tubercles, rear and front row of consecutive Cx touching each other. Op gen covered by scattered low rounded tubercles; free sternites with few tubercles at margins; all light brown.

**Legs:** Short and stout (in terms of nemastomatid morphology); Fe, Pt and Ti of leg I slightly inflated, Fe, Pt and Ti of all legs densely covered by stiff, short bristles, partly with small spines, less so on Mt and Ta, there few scattered long hairs. There are no “comb-teeth” (Kammzähnchen) as figured by Gruber (1976) for Mediostoma.

**Pedipalp** (Fig. 13): Moderately short, Fe slightly swollen distally, Pt slightly enlarged ventrally, Ti slightly tapering distally; Ta short and rounded; all members bearing clavate setae, most conspicuous on Pt, Ti and Ta. No article with special armament.

**Chelicera** (Figs 4–7): Rather stout; basal article with a bulky frontad-directed Apo slightly surpassing the front margin of basal article; Apo with a broad basis, longer than high (lateral view), upper side smoothly rounded and dorso-distally projected in a pointed hook. In dorsal view Apo less pointed, markedly directed to medial side. Medially, the Apo is excavated nearly over its total length forming a bowl-like excavation or hole. Its inner wall is perforated by a multitude of minute pores, apparently the secretion area of the cheliceral gland. Second cheliceral article moderately inflated with few long scattered bristles.

**Genital morphology** (Figs 8–12): Truncus penis (Figs 8–9) moderately slender; the basis forming a large inflated bulb well separated from the remainder of the truncus; bulb compact, not incised on its median plane, completely filled by the two penial muscles, their tendons spanning truncus longitudinally to base of glans. Truncus narrowest above the bulb (dorsal/ventral views), slightly enlarging to the distal third, then inflated slightly more strongly to form a symmetrical blade which finally tapers to the glans. Glans (Figs 10–12) only inconspically marked, short, starting where the two tendons touch and insert on the inner truncus wall; stylus short, a continuation of the glans tapering to the distal asymmetrical opening of the seminal duct. Glans armed with short, stiff and unspecialized spines, arranged symmetrically in dorsal and ventral views, six on the dorsal, five on the ventral side.

**FIGURES 4–7.** ♂ right chelicera, 4: medial side; 5–7: apophysis of ♂ chelicera from 5: lateral, 6: medial and 7: dorsal side. Scale bars: Fig. 4 0.1 mm, Figs 5–7 0.05 mm.
FIGURES 8–13. Genitalia and pedipalp. 8–9: truncus penis, dorsal and lateral views, 10–12: glans penis from 10: lateral, 11: dorsal and 12 ventral views. 13: ♂ pedipalp, medial view. Scale bars: Figs 8–9 0.2 mm, Figs 10–12 0.05 mm, Fig.13 0.2 mm.

Name. It refers to the Chinese province Yunnan, the origin of this species.

Distribution. The species is known only from the type locality, where it was collected in an old-growth coniferous forest at 3800 m with dense understory including a Rhododendron layer.

Discussion. As proposed by Gruber & Shear (1983) the Nemastomatidae are divided into two subfamilies,
Nemastomatinae and Ortholasmatinae. The former is restricted to the Palaearctic Realm with a strong bias to the western Palaearctic, especially in mountainous areas in south-western, central and western Europe. The Balkan Peninsula, Pyrenees and Cantabric Mts., the Caucasus and Turkey are centres of nemastomatin diversity. Several of these areas, especially the Caucasus (Martens 2006), harbor endemic genera and, additionally, display remarkable radiations of small-range species (Schönhofer 2013).

In *Sinostoma yunnanicum* only one distinct morphological character is prominent, the short glans of penis. Generally, its proximal part is demarcated by the insertions of the penial tendons along the truncus. These extend from the two basal muscles along the truncus to the glans. In addition, the glans in turn is marked by the scanty but obvious armament of robust spines. Accordingly, a similar short glans is characteristic of the genus *Starengovia* Snegovaya, 2010, but it is more slender in comparison and the stylus rather long and it represents also an East Palaearctic genus (one species in Kyrgyzstan and the Northwest Himalaya each, the latter undescribed). *Starengovia* in turn is unique by its broad foliate alate structure of distal part of truncus (Snegovaya 2010), which is lacking in *Sinostoma*. Both genera may represent a common phylogenetically and geographically isolated evolutionary line within Nemastomatinae. With respect to an evolutionary tree based on molecular genetics (Schönhofer & Martens 2012) they may have diverged near the base of the tree.

A distinctive bowl-like medial excavation on the male cheliceral apophysis occurs in several nemastomatine genera and may have developed independently several times. This can be inferred from the placement of the relevant genera on the molecular tree (Schönhofer & Martens 2012). *Nemastomella* and *Mediostoma*, genera screened so far, are not closely related and are restricted to the Iberian Peninsula or range from the Balkans to the Caucasus, respectively. A very similar apophysis form in *Sinostoma* possibly represents another parallel development rather than indicating close relationship. The placement of the secretion area on the male cheliceral apophysis varies among species and strongly varies among genera of nemastomatines. The secretion plays a role during courtship (Martens 1969, Martens & Schawaller 1977).

*Sinostoma yunnanicum* is the easternmost representative of Nemastomatinae. The nearest nemastomatine localities to the west are the Central Asian Tadjik Pamir Mts. (“*Mediostoma* pamiricum” Starega, 1986) and the Nature Reserve Sari-Tshelek in Kyrgyzstan (*Starengovia kirgisicum* Snegovaya, 2010), both apparently extremely localized endemics known from a single locality each. However, in Himalayan Northwest Pakistan an undescribed *Starengovia* species is present (J.M. unpublished). The latter locality reduces the distance to the *Sinostoma* locality to about 3000 km. Despite intensive sampling of small soil arthropods by workers of the Geneva Natural History Museum and the Mainz Institute of Zoology in many parts of the western and central Himalayas, no nemastomatids have turned up except for the sole Pakistan location. The only former mention of nemastomatids on the Indian Subcontinent was presented by Roewer (1959), long since identified as a false record not to be mentioned further (Schönhofer 2013). Though more Nemastomatinae species will certainly be discovered in China, the group seems to be rare and locally distributed, probably confined to mountainous old-growth forests as relicts. According to its distribution in Southwest China, a core area of many old endemic animal groups, *Sinostoma* may be a basally derived member of the nemastomatine phylogenetic tree opposite *Mitostoma*.

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