

THE SECOND SPECIES OF *STENOGYROPSIS* (MÖLLENDORFF, 1899) FROM GANSU PROVINCE, CHINA (GASTROPODA: PULMONATA: CAMAENIDAE)

BARNA PÁLL-GERGELY¹ & ANDRÁS HUNYADI²

¹Department of Biology, Shinshu University, Matsumoto 390–8621, Japan,

²Adria sétány 10G 2/5., Budapest 1148, Hungary

Abstract *Stenogyropsis cocoa* n. sp., which is the second species of its genus, is described from the Chinese Gansu Province. The new species differs from *S. potanini* by the more slender, chocolate brown shell and the strong basal keel. The genital and urinary anatomy as well as the jaw and radular morphology of the new species is described.

Key words Taxonomy, systematics, anatomy, new species, high-spined shell.

INTRODUCTION

The superfamily Helicoidea is mostly characterised by flat or globular shells. Only a small proportion of the genera are known to have high-spined shells (Asami *et al.*, 1998). The, so far, monotypic *Stenogyropsis* Möllendorff, 1899 is known from the Chinese Gansu Province, and is characterised by a high conical, strongly ribbed shell. Recent investigation resulted in the discovery of many populations of *S. potanini*, as well as a hitherto undescribed *Stenogyropsis* species from a single locality. The new species, which is being described here, possesses a slender turritiform, chocolate brown, strongly ribbed shell, and a strong basal keel.

MATERIALS AND METHODS

Determination of number of shell whorls (precision to 0.25 whorl) follows Kerney and Cameron (1979: 13). Shells and radulae were directly observed without coating under a low vacuum SEM (Miniscope TM-1000, Hitachi High-Technologies, Tokyo). Buccal mass was removed and soaked in 2M KOH solution for 5 hours before extracting the radula, which was preserved in 70% ethanol. We use the terms “proximal” and “distal” in relation to the centre of the body.

Locality codes of *Stenogyropsis potanini* are marked at each population. The codes are referred to in figure captions.

ABBREVIATIONS

EZP: collection Zoltán Péter Erőss (Budapest, Hungary)
 HA: collection András Hunyadi (Budapest, Hungary)
 PGB: collection Barna Páll-Gergely (Mosonmagyaróvár, Hungary)
 HNHM: Hungarian Natural History Museum Budapest (Hungary)
 NHM: The Natural History Museum (London, UK)
 NHMUK: When citing NHM registered specimens
 SMF: Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt am Main (Germany)

SYSTEMATICS

FAMILY CAMAENIDAE

Remarks Camaenidae and Bradybaenidae are traditionally distinguished on the basis of the absence of the dart sac and mucous glands in the former and the presence in latter. Based on the phylogeny of Wade *et al.* (2006, 2007), Gittenberger *et al.* (2012) formally treated the Bradybaenidae as a junior synonym of Camaenidae, because the dart sac was lost multiple times during the evolution of the Camaenidae. Consequently, *Stenogyropsis* Möllendorff, 1899 is classified in the family Camaenidae herewith.

Genus *Stenogyropsis* Möllendorff, 1899

Stenogyropsis (as a section of *Buliminopsis*) Möllendorff, 1899: 139.



Figure 1 Shells of *Stenogyropsis cocoa* n. sp. (A: holotype; B: paratype, coll. PGB) and *Stenogyropsis potanini* (B: 2016/88; C: 2016/84; D: 2016/67). Scale represents 10mm.

Stenogyropsis — Yen, 1939: 152.

Stenogyropsis— Schileyko, 2004: 1689.

Type species *Buliminopsis potanini* Möllendorff, 1899, by original designation.

Remarks *Stenogyropsis* has been used as an independent genus by Yen (1939) and Schileyko (2004), and a subgenus of *Pseudobuliminus* Gredler, 1887 by Zilch (1960). According to Wu (2004) *Pseudobuliminus piligerus* (Möllendorff, 1899) has a penial sheath covering approximately the distal half of the penis, and its two mucous glands enter the dart sac together. In contrast, *Stenogyropsis* lack a penial sheath, and both glands enter the dart sac independently (see Schileyko, 2004 and this study). These differences, together with the strongly ribbed shell are sufficient to distinguish *Stenogyropsis* on a generic level.

Stenogyropsis cocoa n. sp.

Figs 1A–B, 2A, 3, 4A–I.

Type material China, Gansu Province, Longnan Shi, Wenxian, Jianshan Xiang, 1200m south of Hekou Cun, eastern bank of the Bailong Jiang (river), 810m, 33°01.703'N, 104°53.602'E, leg. Hunyadi, A., 29.05.2016, HNHM 99900 (holotype=shell), HNHM 99901 (2 ethanol-preserved specimens; additional 3 ethanol-preserved, anatomically examined bodies: the corresponding shells are in coll. HA all paratypes); EZP/1 paratype; HA/35 paratypes (shells)+6 juvenile shells (not paratypes)+1 broken shell (not paratype), PGB/1 paratype (shell); SMF 349032/1 (ethanol-preserved paratype); NHMUK 20160457/1 (ethanol-preserved paratype).

Type locality China, Gansu Province, Longnan Shi, Wenxian, Jianshan Xiang, 1200m south of

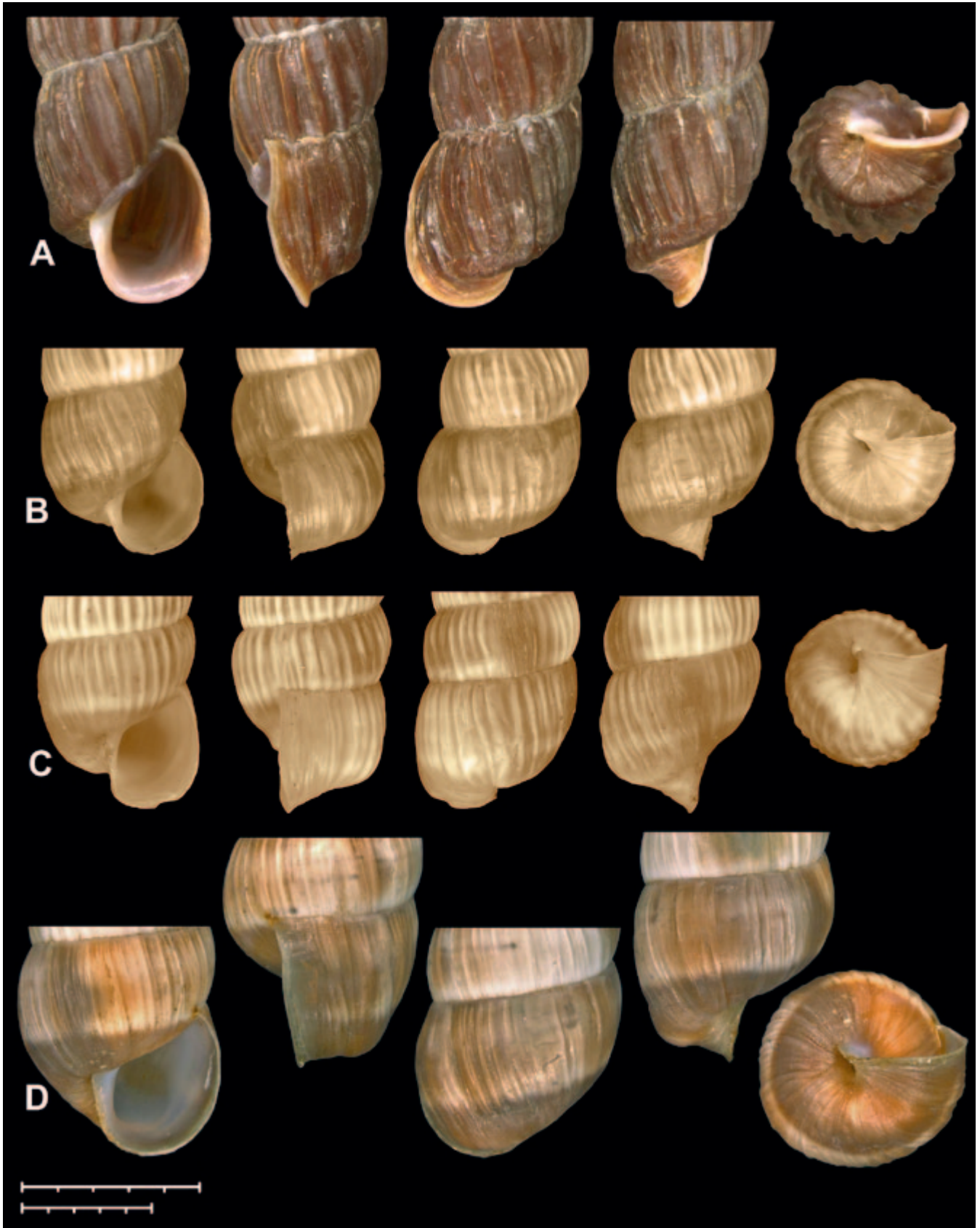


Figure 2 Last whorls of the holotype of *Stenogyropsis cocoa* n. sp. (A) and *Stenogyropsis potanini* specimens from three different populations (B: 2016/88; C: 2016/84; D: 2016/67). Scales represent 5mm. Upper scale refers to Fig. A, lower scale refers to Figs B–D.

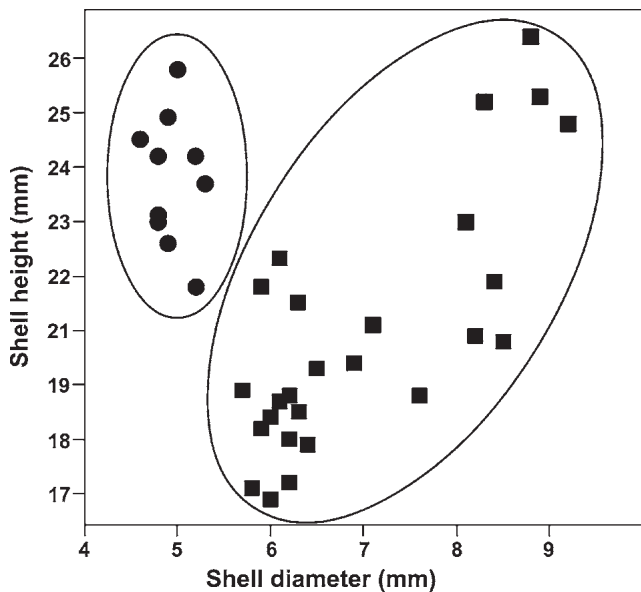


Figure 3 Plot of shell height against shell width (diameter) for 10 adults of *Stenogyropsis cocoa* n. sp. (circles) and 26 adults of *S. potanini* (squares). Ellipses drawn manually.

Hekou Cun, eastern bank of the Bailong Jiang (river), 810m, 33°01.703'N, 104°53.602'E.

Measurements Shell height: 22.6–24.9 (mean: 23.8); shell width: 4.6–5.3 (mean: 5) (n=10). See also Fig. 3.

Diagnosis A slender turritiform, chocolate brown species with glossy, strongly ribbed shell, and a strong basal keel.

Description of the shell (Figs 1A–B, 2A) Shell dextral, chocolate brown to greyish or sometimes yellowish (especially on the first whorls); slender turritiform, widest at its base; apex blunt; protoconch matt, without notable sculpture (practically smooth, but extremely finely granulated in higher magnification), consists of 1.5 whorls; the whole shell consists of 12.75–13.25, slowly, regularly increasing whorls; whorls moderately bulging, separated by a moderately deep suture; lower whorls “climb up” to previous whorls resulting in a whitish-greyish thickened line inside the suture; teleoconch surface glossy; strongly, rather regularly ribbed, no spiral or additional radial sculpture visible; the regular ribs gradually change to a rather irregularly, extremely strongly ribbed area on the last ca. half whorl; aperture teardrop-shaped with pointed palatal-parietal incision; base of aperture rounded; callus present

but weak, only slightly lighter than the other parts of the teleoconch; peristome purple-light brown, slightly thickened and expanded, not reflexed; the palatal side somewhat thickened (from lateral view the middle part of the parietal side is protruding anteriorly); umbilicus open but narrow, partly enfolded by the expanded columellar lip; there is a strong basal keel starting from just above the umbilicus and ending a bit behind the peristome on the dorsal side; ribs stop at the base of the keel, which is nearly smooth on its back; the strong ribs result in a wavy surface inside the aperture.

Description of the genital anatomy (Figs 4A–C, I) Two specimens were anatomically examined. Atrium conspicuously long, slender; penis long, flattened, internally with numerous low, horizontal folds; these folded area changes gradually to an obliquely folded area at the proximal end of the penis; no epiphallic differentiation observed; vas deferens enters penis terminally; retractor muscle short, slender, inserts on vas deferens close to its junction with penis; vas deferens slender and cylindrical all along its length; whole vagina and major part of dart sacs covered by a sheath; there is a main, well developed dart sac with a transparent, hard, slightly curved dart; accessory sac undivided, rudimentary, situated on the lateral side of the main sac (accessory sac not covered by the sheath); the two mucous glands enter independently at the base of accessory sac; both glands with multiple, short, thick branches; vagina short, almost entirely covered by sheath; stalk of bursa copulatrix long, slender; bursa ovoid, relatively small; spermoviduct long and thin in the examined specimens; albumen gland also long, curved, relatively slender, talon well-developed.

Description of the urinary system (Fig. 4D) The urinary system of one animal was examined. Urinary system typical sigmurethran. Heart (auricle and ventricle) located left of kidney (on right in Fig. 4D); pulmonary vein well developed; kidney elongated and relatively wide; ureter sigmoid, closed tube arising from apex of kidney, extending along right side of kidney, recurving adjacent to rectum; entire width of ureter situated beneath the rectum along the kidney, and gradually becomes partly visible anterior to that region.

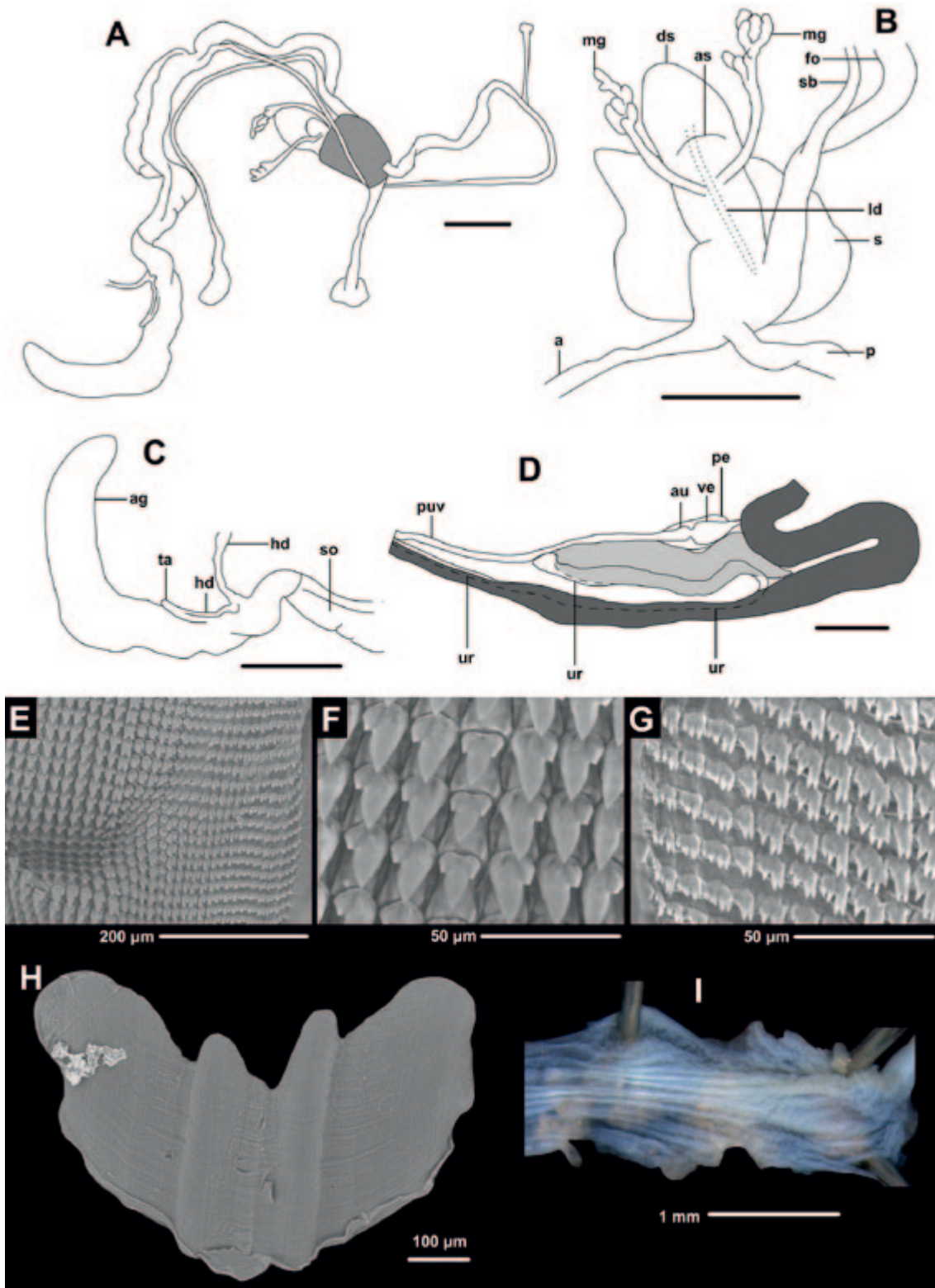


Figure 4 Anatomy of *Stenogyropsis cocoa* n. sp. A: whole genitalia (grey indicates the penial sheath); B: penial sheath removed; C: albumen gland and talon area; D: pallial region (light grey area: kidney; dark grey area: rectum); E: half of the radula; F: central and first lateral teeth; G: marginal teeth; H: jaw; I: inner surface of the penis (distal side site=atrium situated leftwards). Abbreviations: A: atrium; AG: albumen gland; AR: arrow; AS: accessory sac; AU: auricle; DS: dart sac; FO: free oviduct; HD: hermaphroditic duct; LD: love dart; MG: mucous gland; P: penis; PE: pericardium; PUV: pulmonary vein; S: sheath; SO: spermoviduct; TA: talon; VE: ventricle. Scales of Figs A–D represent 2mm.

Description of the jaw and radula (Figs 4E–H) The jaw and radula of a single specimen was observed. Jaw odontognathous, with two strong ribs in its middle portion, and fine transverse striation. Central tooth present, it is symmetric, tricuspid, with a pointed rhomboid endocone and two much smaller, pointed, triangular ectocones; central tooth slightly, but conspicuously smaller than the first laterals; laterals 10–11, with pointed, triangular endocone and a smaller, pointed, triangular ectocone; the 7th row of the right half radula has duplicated endocones; 8th and 9th rows of the right half radula with blunt endocones; marginals 18, with both the endocone and the ectocone being divided in their middle, resulting in altogether four cusps.

Derivation of name The species epithet “cocoa” (used as a noun) refers to the brown, glossy shell, which resembles the surface of a chocolate candy.

Habitat *Stenogyropsis cocoa* n. sp. inhabits limestone rocks, usually under and among xerotolerant rock-dwelling plants, mostly in aggregations (individuals attach on each other’s shell).

Geographic range This new species is known from the type locality only, which is situated approximately 600 meters from a population (2016/67) of *S. potanini*.

Comparisons *Stenogyropsis cocoa* n. sp. differs from *S. potanini* by the more slender (Fig. 3), darker shell, and the sharper and longer basal keel. Anatomically, the very long atrium is unique to the new species, whereas it is of normal length in *S. potanini* (see Schileyko, 2004). The new species might resemble some species of the also rock-dwelling, high-spined camaenid genera *Buliminopsis* and *Buliminidius* Heude, 1890. They are, however, never strongly ribbed, but possess rather smooth, sometimes hairy shells. Most species of Enidae inhabiting Gansu Province have smooth shells. However, *Clausiliopsis clathratus* (Möllendorff, 1902) and *C. senckenbergianus* Yen, 1939 have ribbed shells, which might be superficially similar to *Stenogyropsis cocoa* n. sp. These enids, however, can be easily distinguished from *S. cocoa* n. sp. on the basis of the rather spindle-shaped shell, rounded aperture and much thicker peristome.

Remarks Most specimens of the new species are seemingly subadult due to the lack of a

well-developed expanded peristome; shells with a well-developed peristome, such as the holotype are very rare. The genitalia of the anatomically examined specimens were fully mature, but their peristomes were sharp (not thickened or expanded). This indicates that the animals reach complete sexual maturation before they complete their peristomes.

Stenogyropsis potanini (Möllendorff, 1899)
Figs 1C–E, 2B–D.

Buliminopsis (Stenogyropsis) potanini Möllendorff, 1899: 139–140, Plate 8, Fig. 9.

Stenogyropsis potanini — Yen, 1939: 152, Plate 15, Fig. 59.

Stenogyropsis potanini — Schileyko, 2004: 1689, Fig 2180.

Material examined 2016/67 Gansu, Longnan Shi, Wenxian, Jianshan Xiang, southern edge of Hekou Cun, western bank of Bailong Jiang (river), 800m, 33°02.014'N, 104°53.478'E, leg Hunyadi, A., 29.05.2016., H/20 (some of them are subadult); **2016/71** Gansu, Longnan Shi, Wenxian, Jianshan Xiang, 200m north from Lujiaba, right side of road no. 212, 905m, 33°03.712'N, 104°50.209'E, leg Hunyadi, A., 29.05.2016., HA/4 adult +1 juvenile; **2016/84** Gansu, Longnan Shi, Wudu Xian, Hanwang Zhen, Wanxiangdong, serpentine road towards the cave, 1010m, 33°20.383'N, 104°59.876'E, leg Hunyadi, A., 01.06.2016., HA/4+2 subadult; **2016/86** Gansu, Longnan Shi, Wudu Xian, Chengguan Zhen, northwest of Jiezhou Botanical Garden, mountain above the town, 1035m, 33°23.809'N, 104°55.524'E, leg Hunyadi, A., 01.06.2016., HA/1+3 juveniles; **2016/88** Gansu, Longnan Shi, Dangchang Xian, Guanting Zhen, 1.5km from Guanting towards Dangchang, 1815m, 33°50.803'N, 104°32.470'E, leg Hunyadi, A., 02.06.2016., HA/1+2 subadult; **2016/90** Gansu, Longnan Shi, Dangchang Xian, Lianghekou Xiang, eastern edge of Lianghekou Cun, 33°41.587'N, 104°29.379'E, leg Hunyadi, A., 02.06.2016., HA/2+4 juvenile/subadult; **2016/91** Gansu, Gannan Zhou, Zhugqu Xian, approx. 2.5km west of Suoertou Cun, northern bank of Bailong Jiang (river), right side of the road, 1235m, 33°46.906'N, 104°20.106'E, leg Hunyadi, A., 03.06.2016., HA/2+1 juvenile; **2016/94** Gansu, Gannan Zhou, Zhugqu Xian, Sanjiaoping Xiang, Hujiaya Cun, rock wall above the village, 1350m, 33°44.553'N, 104°24.485'E, leg Hunyadi, A.,

03.06.2016., HA/3 +3 juveniles; **2016/95** Gansu, Longnan Shi, Wudu Xian, Jiaogong Zhen, 1.5km west of Chenjiaba Cun, Zhaoyangdong, under the cave, 1175m, 33°31.924'N, 104°39.286'E, leg Hunyadi, A., 04.06.2016., HA/4+1 adult freak specimen.

Habitat *Stenogyropsis potanini* seems to be less selective in terms of preferred habitat than *S. cocoa* n. sp., namely, specimens often found on barks of living trees in gardens, house walls, concrete fences etc.

Remarks Möllendorff (1899) reports this species from several sites in Gansu Province. We also examined 9 recently collected populations. Accordingly, *Stenogyropsis potanini* seems to be a relatively widespread and common species in southern Gansu Province.

The shell shape and the position of a short basal keel of *S. potanini* are variable across and within populations as well. We see no reason to allow any subspecific subdivision of this species based on conchological information.

ACKNOWLEDGEMENTS

We are grateful to Dominika Páll-Gergely and Josef Harl for their help in making the shell plates, and to an anonymous reviewer for comments on the manuscript.

REFERENCES

ASAMI T, COWIE RH & OHBAYASHI K 1998 Evolution of Mirror Images by Sexual Asymmetric Mating Behavior in Hermaphroditic Snails *American Naturalist* **152**(2): 225–236.
 GITTENBERGER E, HAMANN TD & ASAMI T 2012 Chiral Speciation in Terrestrial Pulmonate Snails *PLoS ONE* **7**(4): e34005.
 GREDLER V 1887 Zur Conchylien-Fauna von China, IX. Stück *Malakozoologische Blätter* **9**: 1–20.

HEUDE RPM 1890 *Mémoires concernant l'histoire naturelle de l'empire chinois par des pères de la Compagnie de Jésus. Notes sur les Mollusques terrestres de la vallée du Fleuve Bleu*; Mision Catholique, Chang-Hai, **IV**: 125–188 pp.
 KERNEY MP & CAMERON RAD 1979 *A Field Guide to the Land Snails of Britain and Northwest Europe* Collins, London, 288 pp.
 MÖLLENDORFF OF VON 1899 Binnen-Mollusken aus Westchina und Central-Asien *Ezhegodnik Zoologicheskago muzeia (Annals of the Zoological Museum of the Saint Petersburg Academy of Sciences)* **4**(1): 46–144.
 MÖLLENDORFF OF VON 1902 Binnen-Mollusken aus Westchina und Central-Asien II. Nach den Sammlungen von Przewalski, Potanin, Beresowski, Gnum-GRSHIMAILO u. a. im Zoologischen Museum der Kaiserl. Alrademie der Wissenschaften zu St. Petersburg *Sanktpeterburg (Annuaire du Musée Zoologique de l'Académie Impériale des Sciences de St.-Petersbourg)* 300–412, 12–17 plates.
 SCHILEYKO AA 2004 Treatise on Recent terrestrial pulmonate molluscs. Part 12. Bradybaenidae, Monadeniidae, Xanthonychidae, Epiphragmophoridae, Helminthoglyptidae, Elonidae, Humboldtianidae, Sphincterochilidae, Cochlicellidae *Ruthenica* Suppl. **2**: 1627–1763.
 WADE CM, MORDAN PB & NAGGS F 2006 Evolutionary relationships among the Pulmonate land snails and slugs (Pulmonata, Stylommatophora) *Biological Journal of the Linnean Society* **87**: 593–610.
 WADE CM, HUDELLOT C, DAVISON A, NAGGS F & MORDAN PB 2007 Molecular phylogeny of the helicoid land snails (Pulmonata: Stylommatophora: Helicoidea), with special emphasis on the Camaenidae *Journal of Molluscan Studies* **73**: 411–415.
 WU M 2004 Preliminary phylogenetic study of Bradybaenidae (Gastropoda: Stylommatophora: Helicoidea) *Malacologica* **46**: 79–125.
 YEN T-C 1939 *Die Chinesischen Land-und Süßwasser-Gastropoden des Natur-Museums Senckenberg. Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft, Frankfurt am Main*, 234 pp.
 ZILCH A 1959–1960 *Handbuch der Paleozoologie*, 6 (2) *Euthyneura* Gebrüder Borntraeger, Berlin, 834 pp.

