

A NEW SPECIES FROM THE GENUS *GEORISSA* BLANFORD, 1864 (GASTROPODA, NERITIMORPHA, HYDROCENIDAE) FROM A LIMESTONE CAVE OF MEGHALAYA, NORTHEAST INDIA

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Abstract In this paper we describe a new species, *Georissa mawsmiensis* sp. nov., from Mawsmmai cave, a limestone cave of Mawsmmai village, Meghalaya, Northeast India. It is compared with its closest congener, *Georissa saritta* (Benson, 1851), which was also collected and described from the same area (Musmai [Present Mawsmmai] valley, near Cherrapunjee). Unlike *G. saritta*, however, the new species is found to be distinct in its conchological features which include prominent spiral striation and few spiral striae on the body whorl (i.e., 4 in the new species and 7 in *G. saritta*). A detailed morphological comparison with the other congeners is also provided here.

Key words *Georissa mawsmiensis*, Land snails, Micro snail, Endemism, Mawsmmai Cave, Taxonomy

INTRODUCTION

The genus *Georissa* Blanford, 1864, belongs to the operculated terrestrial micro snail family Hydrocenidae. *Georissa* is known for its distinctive feature – a calcareous peg – which emerges from the inner surface of the operculum (Thompson & Dance, 1983). Members of this genus are widely distributed and reported across Africa, Asia, and the Pacific regions but are confined to micro-habitats comprising of limestone caves or karsts regions. Until now only one *Georissa* species was known from India, *G. saritta*, Benson 1851 from Khasi hills of Meghalaya state (Preston, 1915). Here, we describe a new species of *Georissa* from a limestone cave.

Previously, the genus *Georissa* was placed within the genus *Hydrocena* Parreyss, 1846 by Parreyss (Herrmannsen, 1846). However, Benson (between 1851 to 1860) later described and placed several minute specimens within *Hydrocena* collected from the Khasi Hills (Meghalaya state, India) and locations in Burma (present-day Myanmar) (Blanford, 1864; Preston, 1915). In 1864, Blanford observed differences in tentacles and operculum features in specimens from the type species and eventually assigned *Georissa* as a separate genus to *Hydrocena* (Blanford 1864). Many species were described solely based on shell morphology, rarely using anatomical

characters or the operculum, with its characteristic peg (Thiele 1910; Berry, 1965; Bernasconi, 1995). Extensive studies have been carried out on *Georissa* in Malaysia, focused on taxonomy, speciation, molecular biology, and evolution (Thompson and Dance, 1983; Schilthuizen *et al.*, 2004; Haase and Schilthuizen, 2007; Khalik *et al.*, 2018). However, *Georissa* is still poorly known due to their minute shell size and highly cryptic nature (Thomson & Dance, 1983).

MATERIAL AND METHODS

The Mawsmmai cave is situated in a small village of Mawsmmai, around four kilometers from Cherrapunjee (=Sohra) in the East Khasi Hills district of Meghalaya, northeast India. The term 'Mawsmmai' means 'Oath Stone' in the Khasi language, spoken by the indigenous Khasi tribe of this region. The Khasi people use the local term 'Krem' for the cave. Mawsmmai cave is located at 25.245° N, 91.724° E, and at an altitude of 1195m amsl. and is indirectly influenced by the streams of Kynshi River (=Jadukata) basin originating from the East Khasi Hills. The cave region also harbours several small streamlets that flow over the roof and percolate through it (Jha & Bairagya, 2011). The region experiences very high rainfall, approx. 12,000mm annually, which is why this region is also known as the wettest place on the Earth. In winters, the temperature of this region

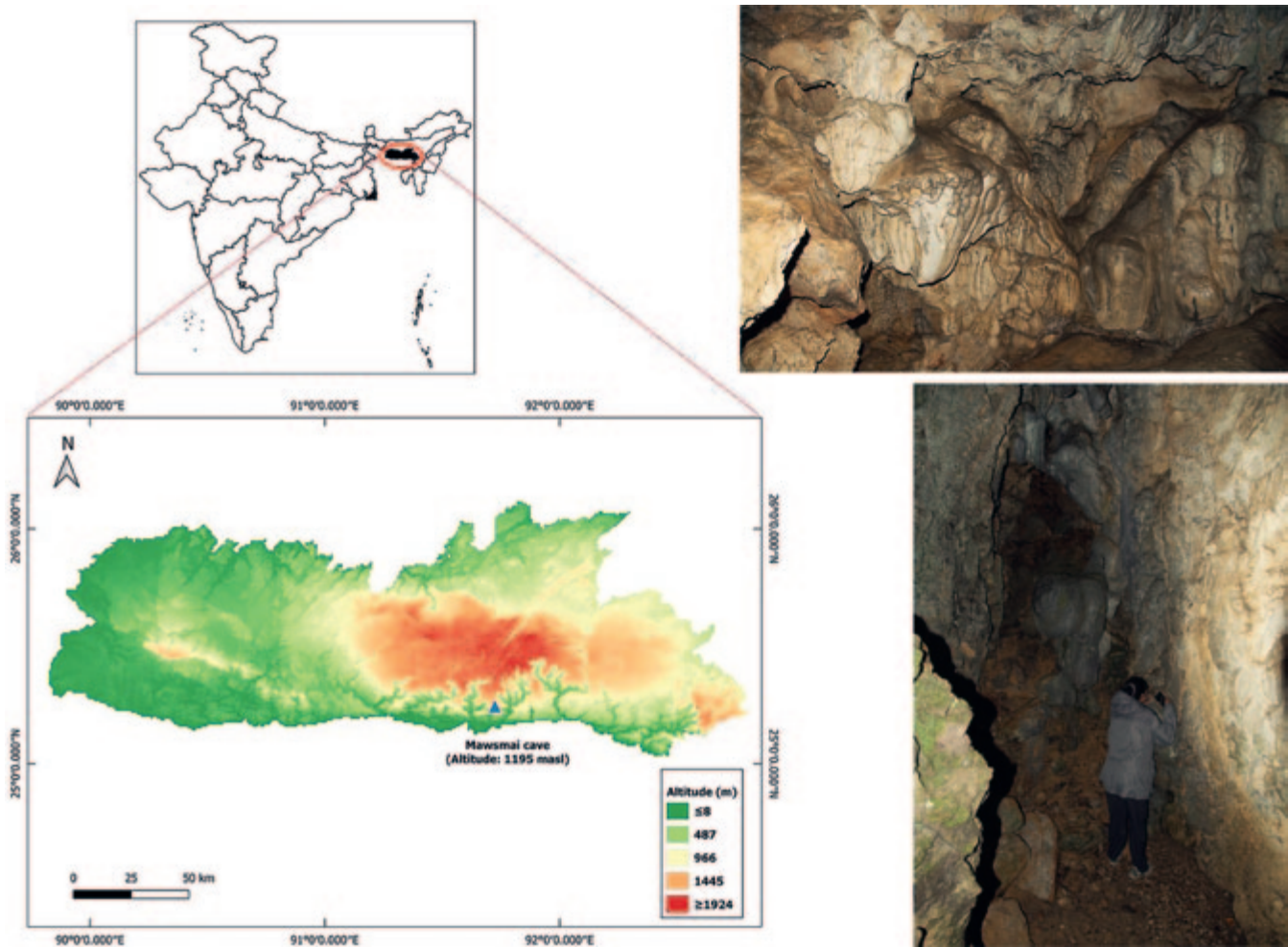


Figure 1 Map shows the type locality with elevation profile of *G. maswmaiensis* sp. nov. Inset images shows interior of the cave where the samples were collected.

goes down to sub-zero degrees, while it rarely reaches beyond 28°C in the summer season. The temperature differs between <25°C inside the cave and <39°C outside during the summer months (Jha & Bairagya, 2011).

Samples of *Georissa* were collected during our field survey of Mawsmal cave, Meghalaya during the first week of August 2018 (Fig. 1). In the laboratory, the collected specimens were washed carefully with water to remove soil from the shell and observed under a Nikon Stereo-microscope (SMZ1270). The images were taken using a Keyence Digital microscope (VHX-6000 series). ImageJ (1.8.0_112) software was used in measuring the various shell parameters. Specimens were described based on shell characters only. We compared our specimen with photos of the type of *G. saritta* Benson, 1851 which was kindly shared with us by Dr. Tom White from NHM, London.

ABBREVIATIONS

Institutional

- ATREE: Ashoka Trust for Research in Ecology and the Environment, Bangalore
 ZSIWGRC: Zoological Survey of India Western Ghats Regional Centre, Calicut
 NHM: Natural History Museum, London

Measurements

- SH=Shell height
 SW=Shell width
 AH=Aperture height
 AW=Aperture width
 AA=Angle of aperture
 ApA=Aperture area
 SpH=Spire height
 SpW=Spire width
 LWH=Last whorl height
 PWH=Penultimate whorl height

PWD=Penultimate whorl diameter without aperture
 PWDA=Penultimate whorl diameter with aperture
 WSABW=Width of the suture above the body whorl
 WSAPW=Width of the suture above the penultimate whorl
 SI=Suture Inclination
 PrW=Protoconch width
 SE=Standard error
 OH=Operculum height
 OW=Operculum width
 mm=millimeter

SYSTEMATICS

Class Gastropoda Cuvier, 1797

Family Hydrocenidae Troschel, 1856

Genus *Georissa* Blanford, 1864

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Type species Georissa pyxis, Benson 1856 (Thyet-Myo, Myanmar).

Diagnosis Shell minute, dextral, conical, perforate or imperforate, with spiral or radial striae. Operculum calcareous, rounded to ovate, concentric, paucispiral, and has a characteristic calcareous peg arising from the inner surface. Animal body small, foot short; hemispherical lobes in tentacles.

Georissa mawsmiensis sp. nov.

Figs 2 A–F

Derivation of name The specific epithet '*mawsmiensis*' refers to the type locality 'Mawsmi cave' from which the specimens were collected.

Holotype ZSI/WGRC/I.R-INV 14957, Mawsmi Cave, Meghalaya, India. 25.245° N, 91.72405° E, altitude 1195 masl, 4th August 2018. Leg. Nipu Kumar Das, N.A. Aravind, and Anushree Jadhav.

Paratype Five paratypes, ZSI/WGRC/I.R-INV 14958, AT/Type/LS501–LS504. Same as holotype.

Measurements (in mm) ($n=6$) Holotype SH=1.822, SW=1.418, SH/SW 1.285. All other shell measurements are given in Table 1.

Description of the Holotype Shell amber in colour, small, turbinata, about 1.2 times higher than wide (Table 1), narrowly umbilicated, spiral multilirate; whorls 3.62, rounded with strong liration; 9–10 ribs on the last whorl, 5–6 well marked and the other basal ribs are fuzzy, distance between 2nd and 3rd spiral ribs is 0.14mm (SE 0.004); protoconch globular comprising 1.13 whorls with smooth surface, clearly distinguishing protoconch/teleoconch transition zone, teleoconch consist of 2.495 whorls, with 3 ribs; suture impressed; spire conical; apex blunt, somewhat rounded; aperture ovate, oblique, peristome simple, slightly thickened; prominent columellar callus.

Operculum Thick, calcareous, white, oval, multispiral or concentric, externally concave, characteristic calcareous slender peg on the inner surface of operculum present (Fig. 2F). The measurement of the operculum is: OH 0.064 (SE=1.91E–0.4), OW 0.05 (SE= 4.46E–04).

Differential Diagnosis The detailed comparison of shell morphology for the new species with its congeners is given in Table 2. The adult shell dimension (in mm) of *G. mawsmiensis* sp. nov. (1.82×1.42) is slightly larger than *G. pyxis* (1.5×1.25), *G. fraterna* (1.4×0.95); almost equal to *G. blanfordiana* (1.8×1.2), smaller than *G. sarrita* (2×1.25; Fig. 2G–J) and *G. liratula* (2.2×1.8). The shell size variation among these species is also found to be distinct (Fig. 3), while the new species shows greater intraspecific shell size variation. Besides, *G. mawsmiensis* sp. nov. is imperforate similar to the other congeners, while *G. pyxis* and *G. illex* are perforate. The shell colour of *G. mawsmiensis* sp. nov. is amber, white in *G. sarrita*, yellow in *G. liratula* and *G. blanfordiana*, and pale yellow-green in *G. fraterna*. All these species including the new species shows multiliration, however, *G. mawsmiensis* sp. nov. is distinct in the presence of four very prominent spiral striations on body whorls (counting from the suture to aperture, in apertural view), compared to five each in *G. liratula*, and *G. pyxis*, six each in *G. illex*, and *G. frustillum*, seven in *G. sarrita*, seven to eight in *G. rawesiana*, and eight in *G. fraterna*.

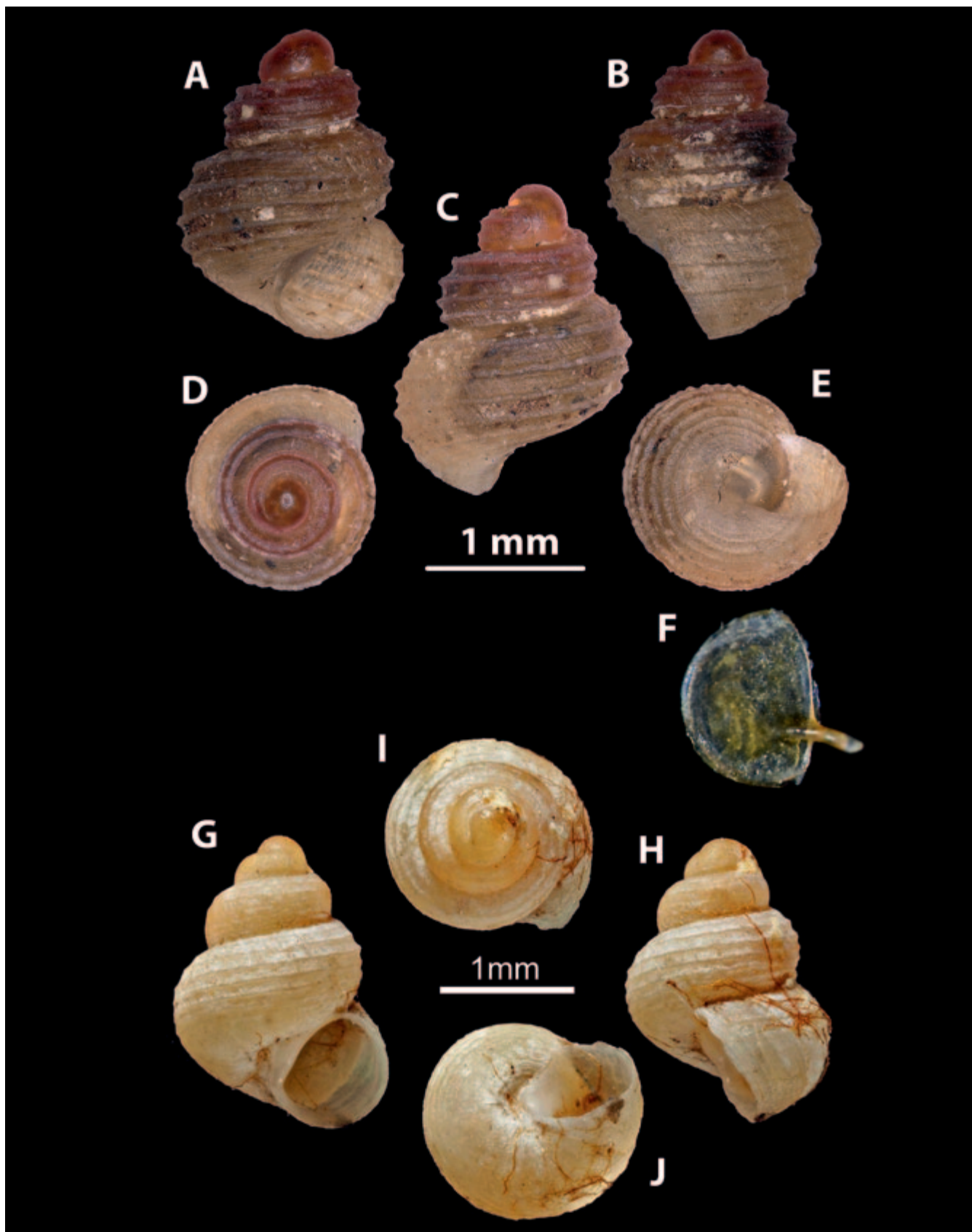


Figure 2 A–F) Holotype of *G. mawsmienseis* sp. nov. with different views, G–J) Syntype of *G. sarrita* from Meghalaya (Image of *G. sarrita* is from Cambridge University Museum of Zoology, registration number UMZC I.103725.A)

Table 1 Shell measurements for all the type specimens (in mm) of *G. mausmaierensis* sp. nov.

Shell Features	Holotype ZSI/ WGRC/I.R-INV	Paratype ZSI/ WGRC/I.R-INV	Paratype (AT/Type/ LS501)	Paratype (AT/ Type/LS502)	Paratype (AT/ Type/LS503)	Paratype (AT/ Type/LS504)
	14957	14958	LS501)	Type/LS502)	Type/LS503)	Type/LS504)
Shell						
Shell Height (SH)	1.822	1.566	1.637	1.386	1.340	1.359
Shell Width (SW)	1.418	1.29	1.308	1.230	1.123	1.113
SH/SW	1.285	1.214	1.251	1.127	1.193	1.221
Aperture						
Aperture height with peristome (AH)	0.841	0.746	0.719	0.705	0.593	0.635
Aperture width with peristome (AW)	0.859	0.767	0.771	0.766	0.663	0.684
Aperture area (ApA) AH/AW	0.277	0.231	0.205	0.212	0.183	0.184
Aperture inclination or Angle of aperture (AA, in degree)	0.979	0.973	0.932	0.920	0.894	0.928
Spire						
Spire Height (SpH)	61.441	60.246	62.82	62.074	51.575	54.88
Spire Width (SpW)	1.015	0.818	0.922	0.666	0.728	0.680
Height (LWH)	1.254	1.127	1.144	1.014	0.949	0.930
Body/Last Whorl						
Height (PWH)	1.345	1.196	1.241	1.112	1.048	1.043
Width (PWD)	1.649	1.423	1.494	1.291	1.256	1.254
Width with Aperture (PWDA)	0.788	0.656	0.682	0.574	0.574	0.580
Width of the suture above the body whorl (WSABW)	1.204	1.025	1.062	1.009	0.939	0.933
Width of the suture above the penultimate whorl (WSAPW)	0.740	0.635	0.645	0.581	0.544	0.544
Suture						
Width of the suture above the penultimate whorl (WSAPW)	0.427	0.346	0.341	0.333	0.323	0.307
Protoconch						
Suture inclination (SI)	12.074	8.568	10.405	11.858	16.174	12.442
Operculum						
Width (PrW)	0.434	0.341	0.397	0.420	0.407	0.386
Height (OH)						
Width (OW)						
						0.064
						0.050

Table 2 Comparison of conchological characters of all *Georissa* species from India and Myanmar

	<i>G. mawsmiensis</i> sp. nov.	<i>G. sarritta</i> (Benson 1851)	<i>G. liracula</i> (Stoliczka 1871)	<i>G. illex</i> (Benson 1856)	<i>G. pyxis</i> (Benson 1856)	<i>G. fraternna</i> (Theobald & Stoliczka 1872)	<i>G. frustillum</i> (Benson 1860)	<i>G. ravesiana</i> (Benson 1860)	<i>G. blanfordiana</i> (Stoliczka 1871)
Size (H×W) (in mm)	1.82×1.42	2×1.25	2.2×1.8 (Maj), 2.2×1.5 (Min)	2.65×1.65	1.5×1.25	1.4×0.95	2.5×1.75	2×1.5	1.8×1.2 (Maj), 1.8×1 (min)
Shell shape	Ovate- conical	Ovate- conical	Globose- conical, solid	Ovate-sharp	Ovate- conical	Cylindrical, conoid, solid	Ovate- elongated, solid	Almost globose- conical, more slender than <i>G.</i> <i>liracula</i>	Globose- conoid, moderate solid
Color	Amber	White	Yellow			Pale, yellow- green			Yellow
Umbilicus	Imperforate	Sub imperforate, covered by thickened callus	Imperforate	Perforate	Perforate	Imperforate	Imperforate	Imperforate	Imperforate
Whorls	3.6	4	3-3.5	4	4	3.5	5	4	3.5
Liration	Multilirate	Multilirate	Multilirate, a little more numerously spirally ribbed than <i>G. sarrita</i>	Multilirate	Multilirate	Multilirate	Multilirate	Multilirate	-
Spiral striae/ ribs from suture to aperture	4	7	5	6	5	8	6	7-8 finer spiral striation	No spiral ribs; longitudinal ribs present
Spire	Conical	Conical	Conical	Bright, Elongate- conical	Conical	Conical	Sub pyramidal	Conical	Sub acute
Apex	Roundish	Obtuse	Subobtuse, mammillato, smooth, yellow actually reddening	Obtuse	Obtuse	Strongly mammillato	Obtuse	Obtuse	Reddening, <i>mammillato</i> <i>laevissimo</i>

	<i>G. macosmatensis</i> sp. nov.	<i>G. saritta</i> (Benson 1851)	<i>G. liratula</i> (Stoliczka 1871)	<i>G. illex</i> (Benson 1856)	<i>G. pyxis</i> (Benson 1856)	<i>G. fraterna</i> (Theobald & Stoliczka 1872)	<i>G. frustillium</i> (Benson 1860)	<i>G. ravesiana</i> (Benson 1860)	<i>G. blanfordiana</i> (Stoliczka 1871)
Shell features									
Aperture	Sub-circular	Hardly oblique, ovate	Semilunar	Ovate	Semi circular	Almost semi circular	Oblique, truncate oval, above <i>nechon</i> to consider angular left side	Barely oblique, semi circular	Late semilunar
Peristome	Simple and slightly thickened	Simple, sharp, expansiuculo, edges distant	Simple, curve, within grooved, thick, whitish	Thin, non-continuous	Thin, sharp, non-continuous	Simple, ?	Thin, non-continuous	Thin	Uniform curve like, back (even above) angular, lip thick, slightly curved, above very little dilated, below constricted
Operculum	Paucispiral, has calcareous peg emerged from inner surface	Unknown	Testaceum, thin, almost transparent, somewhat wide semilunar	Thin, horny, transparent, paucispira, nucleio basali	Unknown	Testaceo, thin, almost transparent, paucispiral,	Unknown	Unknown	Unknown
Distribution	Mawsmai cave, Meghalaya, India	Cherra Poonjee [present Cherrapunjee], Khasi hills, Meghalaya, India	Damotha, near Moulmein, Myanmar	Phie Than, Tenasserim, Myanmar	Thyet-Mio, Myanmar	Ataran River Valley, near Moulmein, Myanmar	Ava, Myanmar	Near Moulmein, Myanmar	Near Moulmein, Moulmein, Myanmar

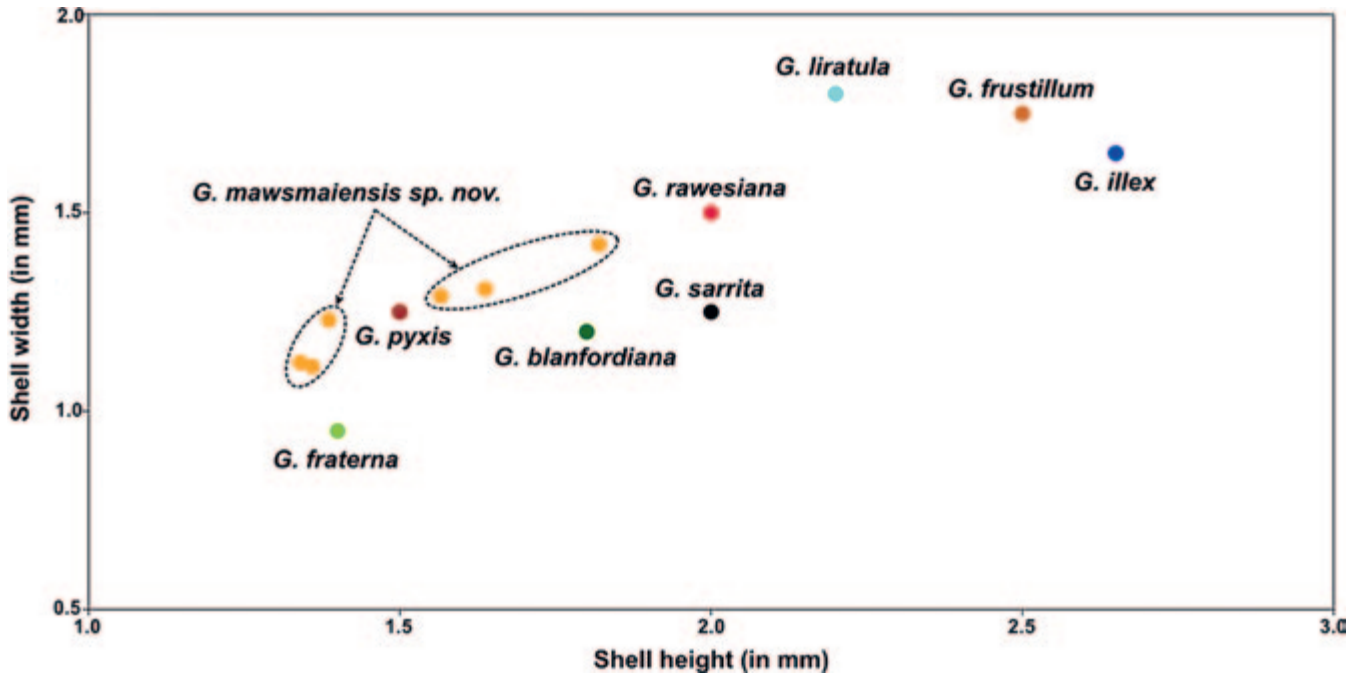


Figure 3 Shell size comparison of *G. mawsmiensis* sp. nov. with its congeners from India and Myanmar.

Distribution The species is known only from its type locality.

Ecology Specimens were collected on the surface of moist limestone rocks approximately 4–5m inside the cave entrance. The cave was dark, with the exception of a few artificial lights. We also sampled the surrounding cave entrance and did not find any individuals of this species. The wall of the cave was wet with dripping water. The cave is a major tourist attraction, and several changes have been made to increase the aesthetics of the cave, such as artificial lights and cemented floor and steps. There is a high tourist influx, which may pose a high threat to this micro snail species.

DISCUSSION

Georissa is found in soil or subterranean habitats in low land tropical forest to high altitude evergreen forests (Schilthuizen *et al.* 2004; Haase and Schilthuizen, 2007) or on rock surfaces rich in calcium (Schilthuizen *et al.* 2004). With the description of *G. mawsmiensis* sp. nov. from the limestone cave, the number of *Georissa* species from the Indian region is now two species and both are exclusively found in Meghalaya state. Despite being rich in biodiversity, this region of India is underexplored. A further extensive survey of the limestone caves in the Meghalaya and

other parts of India might yield interesting snail fauna, including many new species of *Georissa*.

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