

RAHULA REVISITED (PULMONATA: EUCONULIDAE), WITH DATA FOR BHUTAN, INDIA (ASSAM), LAOS, VIETNAM AND INDONESIA, INCLUDING TWO NEW SPECIES

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Abstract New data for *Rahula* species in Bhutan are given, including a new species and an extended description of *R. trongsaensis* based on a newly found fully grown shell. The genus is known from only the eastern half of the country. Two hitherto overlooked nominal taxa of *Kaliella* from Assam are regarded as *Rahula* species resembling *R. trongsaensis*; photographs of syntypes of these taxa are presented. Additions to the species list for *Rahula* that was published earlier are added, including a new species for Indonesia, Sulawesi. An updated distribution map for the genus is provided.

Key words Euconulidae, *Rahula*, taxonomy, new species, Bhutan, Asia, distribution

INTRODUCTION

The genus *Rahula* Godwin-Austen, 1907 was classified with the family Helicarionidae Bourguignat, 1877, superfamily Helicarionoidea Bourguignat, 1877 by Zilch (1959: 306) and Gittenberger *et al.* (2017a, c), whereas Vermeulen, Liew & Schilthuizen (2015), Gittenberger *et al.* (2017b) and Foon & Marzuki (2020) adopted Euconulidae H.B. Baker, 1928, superfamily Trochomorpoidea Mörch, 1864. Since neither anatomical nor molecular data are available for *Rahula* we here follow the latest published classification.

Pilsbry (1934: 20, 21, pl. 4 fig. 9) described *Sinaenigma* as a subgenus of *Rahula*. Its shell is more depressed than usual in *Rahula* and resembles Punctidae Morse, 1864, as for example species of *Paralaoma* Iredale, 1913 (see Gittenberger, Budha & Bank, 2020). In conformity with Foon & Marzuki (2020), pending additional data, we do not use subgenera in *Rahula*.

New records for *Rahula* species in Bhutan are presented, including the description of *Rahula namgayae* sp. nov., and a new distribution map for the species in Bhutan is provided. The description of *R. trongsaensis*, which was based on only a juvenile shell, is improved now that a fully grown specimen was found. Two nominal taxa that were described as species of *Kaliella* Blanford, 1863 from the state of Assam, India, are dealt with because of a striking similarity to *R. trongsaensis*.

Supplementary data to the checklist of *Rahula* species in Gittenberger, Leda & Sherub (2017b) are presented, including the description of *Rahula maasseni* sp. nov. from Indonesia. The known range of the genus has expanded in southeastern direction in Indonesia, where *R. maasseni* sp. nov. now marks the distributional borderline in Sulawesi. Two recently described species from peninsular Malaysia fill the large gap that existed between India and northern Vietnam in the north and Indonesia in the south. In Bhutan all records for the genus are in the eastern half of the country at 335–2300m a.s.l. This is most probably not caused by the distribution of the sampling sites but a biogeographical pattern.

Abbreviations used: H=shell height, NBCB=National Biodiversity Centre, Serbithang, Thimphu, Bhutan; NHMUK=Natural History Museum, London, United Kingdom; RMNH=National Biodiversity Center Naturalis, Leiden, The Netherlands, W=shell width.

SYSTEMATICS

Superfamily Trochomorpoidea Mörch, 1864
(after Bouchet *et al.*, 2017: 365)

Family Euconulidae H.B. Baker, 1928

Genus *Rahula* Godwin-Austen, 1907.

Type species, by original designation: *Helix macroleuris* Benson, 1859.

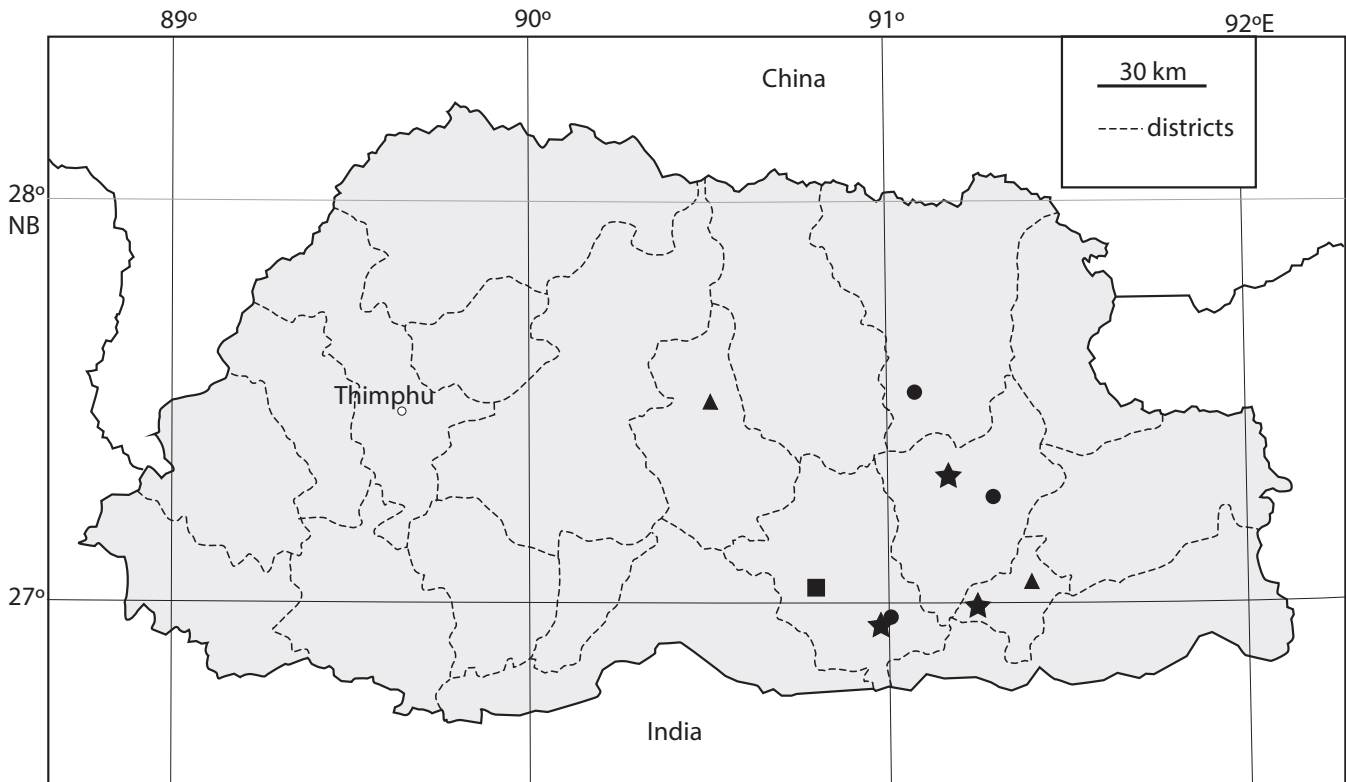


Figure 1 Records for *Rahula* spec. in Bhutan. *Rahula bascauda*, square and 3 stars; *R. kleini*, 3 dots; *R. trongsaensis*, 2 triangles; *R. namgayae*, 1 square.

Rahula bascauda (Benson, 1859)
Fig. 1

Material examined District Mongar, 8km WNW of Mongar, 1110m a.s.l., 27°18'05"N 91°09'07"E, E. Gittenberger, Choki Gyeltshen & Kezang Tobgay leg. 01-10-2019 (NBCB1085/2). District Pemagatshel, 28km SW of Pemagatshel, 1420m a.s.l., 26°59'13"N 91°15'33"E, E. Gittenberger, Choki Gyeltshen & Kezang Tobgay leg. 27-09-2019 (NBCB1071/1). District Zhemgang, between Duenmang Tsachu and Gonphu Zero Point, 24km SE of Zhemgang, 335m a.s.l., 27°02'N 90°48'E, scree in warm broadleaf forest, Sherub & Ugyen Tenzin leg. 08-01-2017 (NBCB1114/2). District Zhemgang, near Kagtong, c. 10km NNE of Panbang; 1047m a.s.l., 26°56'17"N 90°59'49"E, Choki Gyeltshen & Nima Gyeltshen leg. 10-02-2018 (NBCB1115/1).

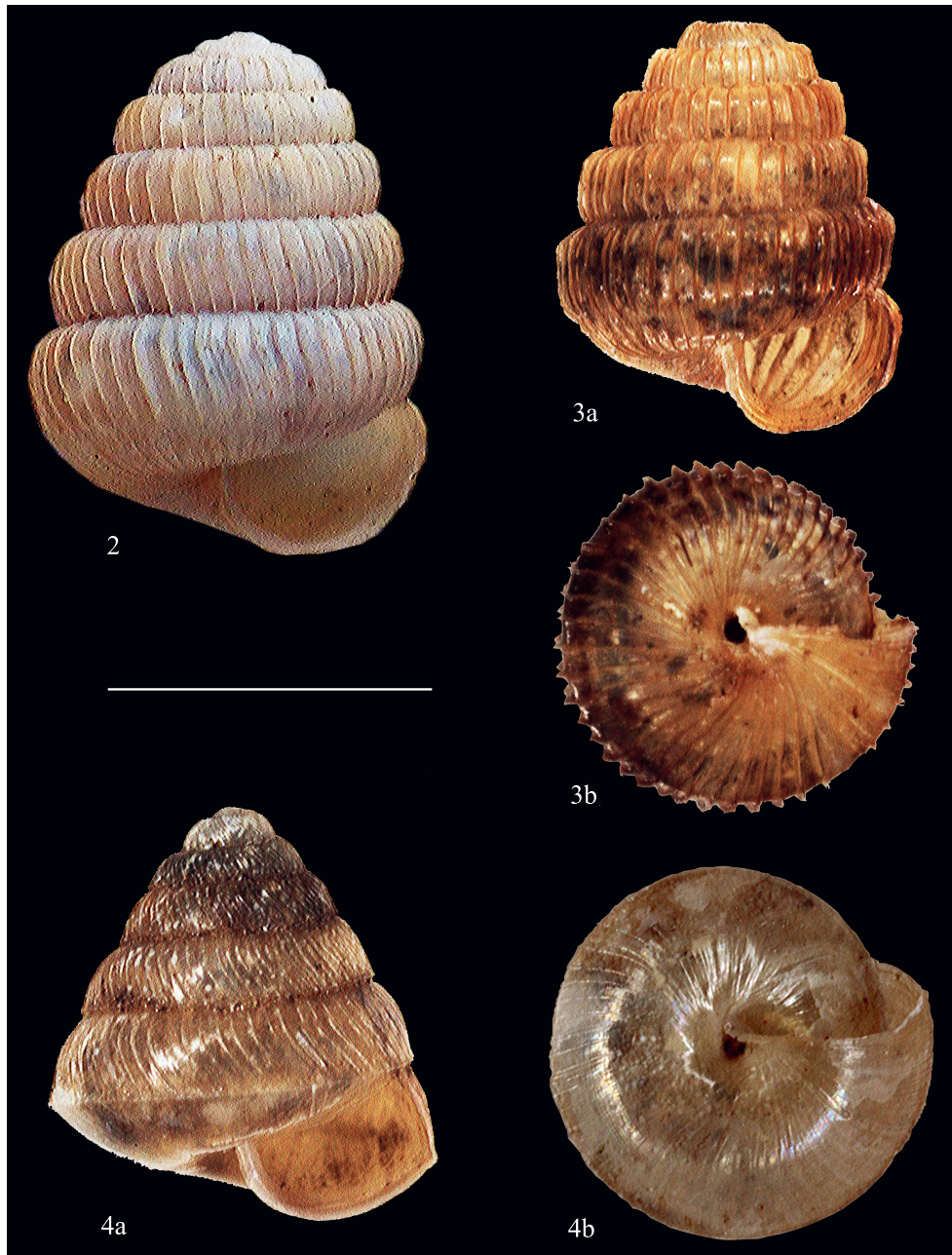
Notes See Gittenberger, Tenzin & Sherub (2017c: 120) for more data. The species is known from 4 localities now (Fig. 1). The shell from the district Pemagatshel has 6 whorls; with W 4.9mm and H 4.3mm it is the largest specimen known from Bhutan.

Rahula kleini Gittenberger, Leda & Sherub, 2017
Figs 1, 2

Material examined District Mongar, 8km ESE of Mongar, 2300m a.s.l., 27°16'00"N 91°18'18"E, type locality, E. Gittenberger & Pema Leda leg. 16-04-2015 (NBCB1011). District Lhuentse, Garbrag (Phag Sang), 11km W of Gorgon, 1800m a.s.l., 27°30'N 91°04'E, Ugyen Tenzin, Dawa Yoezer & Sherub leg. 22-02-2017 (NBCB1116/1). District Zhemgang, near Kagtong, c. 10km NNE of Panbang; 1047m a.s.l.; 26°56'17"N 90°59'49"E; Choki Gyeltshen & Nima Gyeltshen leg. 10-02-2018 (NBCB1117/1).

Notes This species is known by three records, with a single shell each. The measurements, H/W ratio and number of whorls of these shells are: 3.08×2.76mm, H/W 1.12, 6¼ whorls (holotype), 3.15×2.50mm, H/W1.26, 7 whorls (Lhuentse), and 2.9×2.4mm, H/W 1.21, 6¾ whorls (Zhemgang).

Rahula namgayae Gittenberger & Choki Gyeltshen, sp. nov.
Figs 1, 3



Figures 2–4 *Rahula* species. 2 *R. kleini* Gittenberger, Leda & Sherub, 2017 3 *R. namgayae* sp. nov. 4 *R. trongsaensis* Gittenberger, Leda & Sherub, 2017. Scale bar 2mm.

Holotype Bhutan, district Zhemgang, 19.5km SE of Tingtibi; 780m a.s.l.; 27°01'21"N 90°49'43"E; NBCB1026 E. Gittenberger, Choki Gyeltshen & Kezang Tobgay leg. 26-09-2019.

Derivation of name The specific epithet *namgayae* refers to Ms Namgay, in acknowledgement of friendship and hospitality in Bhutan.

Diagnosis Shell with obliquely shouldered, flattened whorls with very prominent vertical ribs; umbilicus very narrow.

Description The brown shell is turreted conical with $5\frac{3}{4}$ obliquely shouldered whorls that are flattened in the middle and a deeply incised suture; the spire tapers increasingly clear towards the obtuse apex. The protoconch has some widely spaced radial riblets. The teleoconch is covered with very prominent, straight ribs, 8 per mm above the aperture, running parallel to the columella. The ribs are slightly heightened by fine periostracal lamellae; they are shortly interrupted at the level of the parieto-palatal transition. The

umbilicus is narrow, measuring 1/17 of the shell width.

Measurements H 2.5mm, B 2.3mm, H/W 1.09.

Differentiation *Rahula namgayae* is most similar to *R. kleini*. It differs from that species by the shape of the whorls resulting in a more turreted shell, and straight, vertical ribs.

Notes Since the palatal border of the aperture is sharp, the shell is not yet fully grown.

Rahula trongsaensis Gittenberger, Leda & Sherub, 2017
Figs 1, 4

Rahula trongsaensis Gittenberger, Leda & Sherub, 2017b: 414 (“district Trongsa, Trongsa”), fig. 2.

Material examined District Trongsa, Trongsa, 2210m a.s.l., 27°29'53"N 90°30'35"E, E. Gittenberger & Pema Leda leg. 20-04-2015 (NBCB1012/holotype). District Pemagatshel, W-side Pemagatshel, Nangkhor, 1050m a.s.l., 27°02'24"N 91°23'52"E, E. Gittenberger, Choki Gyeltshen & Kezang Tobgay leg. 28-09-2019 (NBCB1027).

Description The light yellowish brown adult shell that is available now enables an improved description of this species that was hitherto known from only a juvenile specimen with 4½ whorls. It is conical with moderately convex sides in profile and has 5¾ flattened whorls separated by a little incised suture running immediately below the sharp edge of the keel. The protoconch is covered with dense radial riblets and finer spiral lines that can be followed on the initial teleoconch whorls. The teleoconch has prominent, prosocline ribs. On the last whorl, above the peripheral, sharp keel, there are very oblique, curved ribs, ca. 9 per mm. Below the keel there is a very fine, inconspicuous sculpture of spiral lirae; the radial sculpture is largely obsolete there. The narrow, round umbilicus measures 1/17 W.

Dimensions H 2.5mm; B 2.4mm.

Notes When *R. trongsaensis* was described by Gittenberger, Leda & Sherub (2017b) the authors apparently overlooked descriptions and figures

of two so-called *Kaliella* species from areas near Bhutan that are strikingly similar in the drawings, viz. *K. costulata* Godwin-Austen, 1882 and *K. subcostulata* Godwin-Austen, 1882. By courtesy of Jonathan Ablett, Life Sciences Natural History Museum, London, photos of type specimens of both nominal taxa, made by Kevin Webb, were made available for study (Figs 5, 6). It turned out that the radially ribbed, keeled shells of these species, are very similar to *R. trongsaensis* indeed. *Rahula trongsaensis* differs from the costate *Kaliella* species most clearly by the nature of its radial ribs, that are more oblique and more strongly curved. Additional slight differences, like a little more strongly tapering apical part and the more clearly sloping profile of the whorls, might be individual and not species specific. The syntype of *K. subcostulata* differs most conspicuously from the *Rahula* species by the number of ribs on the last whorl, increasing from 9 per mm above the aperture to >20 sharp ribs per mm on the final half of the last whorl (Fig. 6a, b). The poorly preserved syntype of *K. costulata* (Fig. 5) shows a more moderate increase in rib numbers on the last whorl, i.e. from 11 per mm to >15 per mm. According to Godwin-Austen (1882: 8) the shells of *K. costulata* and *K. subcostulata* are 3.3mm and 2.8mm broad, respectively. The syntypes of both taxa are smaller however, measuring 2.6 and 2.4mm, respectively. Despite the possibility of convergence, we transfer both costate nominal *Kaliella* taxa to the quite diverse, conchologically based genus *Rahula* (see below). Additional material is needed to judge the status of these two taxa, that are closely related if not synonyms.

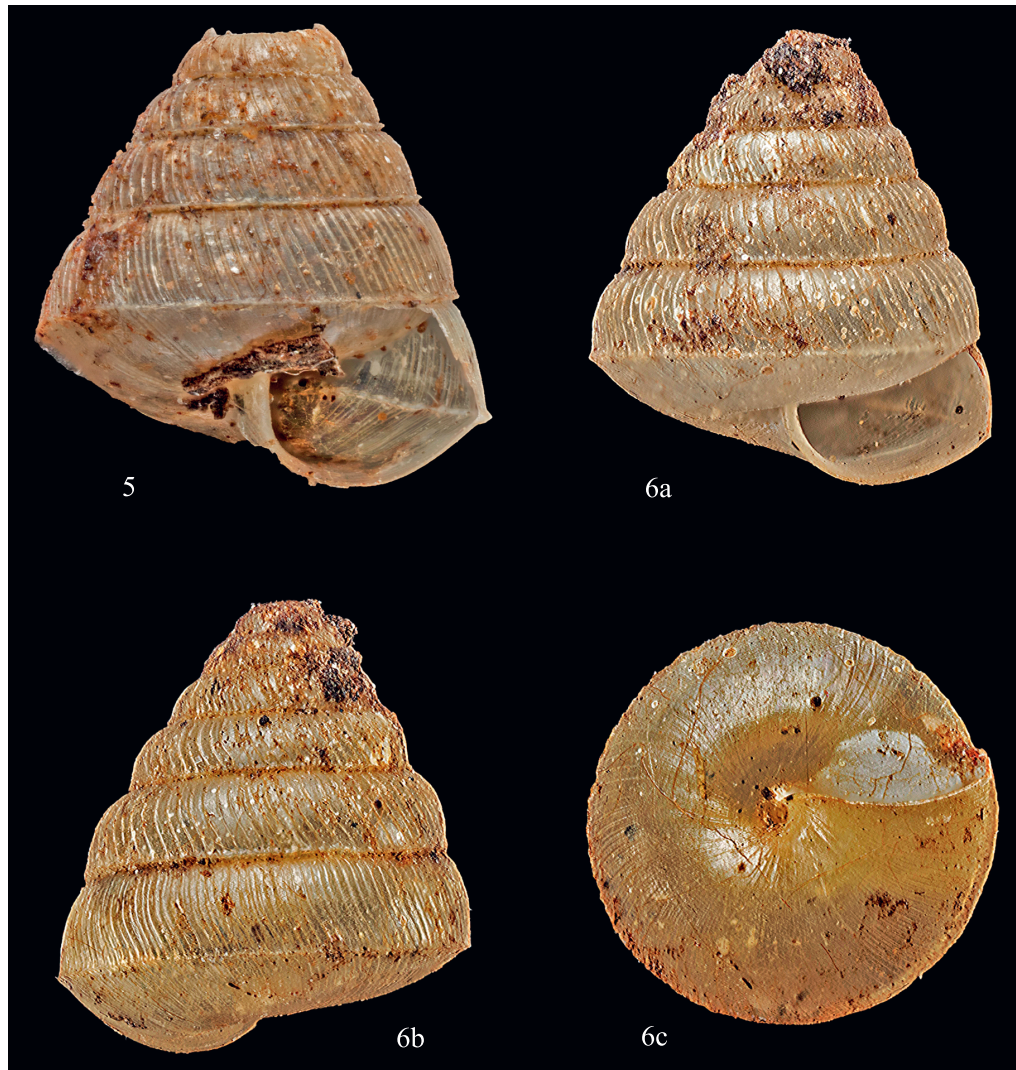
ADDITIONAL DATA FOR *RAHULA* SPECIES

Since the first records of *Rahula* species in Bhutan, published with an overview of additional species classified in that genus by Gittenberger, Pema & Sherub (2017b), the following new data came to our knowledge.

NE India

Notes Three species are added. For a description, see the notes under *Rahula trongsaensis*.

Rahula costulata (Godwin-Austen, 1882)
Fig. 5



Figures 5–6 *Rahula* species. 5 *R. costulata* (Godwin-Austen, 1882), syntype (NHMUK 1903.7.1.13), India, Assam, “Tanir Ridge, Dafla Hills”. 6 *R. subcostulata* (Godwin-Austen, 1882), syntype (NHMUK 1903.1.7.14), India, Assam, “North Khasi Hills”, 1340m a.s.l. Photographs by Kevin Webb © the Natural History Museum, London

Kaliella costulata Godwin-Austen, 1882: 7 (India, “Tanir Ridge, Dafla Hills, Assam, 4400 feet”, ca. 1340m a.s.l.), pl. 2 fig. 5.

Notes India, Assam, “Hengdan Peak, North Cachar Hills, about 8000 feet” (ca. 2440m a.s.l.) is mentioned as a second locality (Godwin-Austen, 1882: 8).

See the notes with *Rahula trongsaensis*.

Rahula subcostulata (Godwin-Austen, 1882)
Fig. 6

Kaliella subcostulata Godwin-Austen, 1882: 8 (India, Assam, “North Khasi Hills”), pl. 2 fig. 6.

Notes See the notes with *Rahula trongsaensis*.

Rahula teriai Ray & Rajagopaleingear, 1954

Rahula bascauda Godwin-Austen, 1907 (part.): 218, pl. 117 fig. 1a. Not Benson, 1859.

Rahula munipurensis var. *teriai* Ray & Rajagopaleingear, 1954: 58 (India, Assam, Khasi Hills, “Teria Ghat”), pl. 10 [not pl. 6] fig. 2.

Notes *Rahula teriai* was based on a figure published by Godwin-Austen (1907), that was drawn again by Ray & Rajagopaleingear (1954). Ray & Rajagopaleingear (1954: 57) mentioned that the shell on which Godwin-Austen’s (1907) figure 1a was based was not found in the British Museum. According to Subba Rao *et al.* (1995: 80), who incorrectly report this taxon from the Jaintia

Hills, the original material could not be traced in the National Zoological Collections of Zoological Survey of India, Calcutta.

Subba Rao *et al.* (1995) have mixed up the descriptions, in particular the measurements, of *Rahula bascauda* (Benson, 1859) and *R. munipurensis* Godwin-Austen, 1907.

Peninsular Malaysia

Notes Recently, two *Rahula* species were described from peninsular Malaysia. These species slightly reduce the biogeographical gap between the northern and the southern records for the genus (Fig. 11).

Rahula limbooliati Foon & Marzuki, 2020: 138 ("Gunung Senyum, Pahang, Peninsular Malaysia", 3°42'N 102°26'E) fig. 1A–G.

Rahula tonywhitteni Foon & Marzuki, 2020: 141 ("Gunung Tempurung, Perak, Peninsular Malaysia", 4°25'N 101°11'E) fig. 3A–F.

Indonesia, Sabah and Sarawak

Notes A single shell of a *Rahula* species was found by Mr W.J.M. Maassen in Sulawesi.

Rahula maasseni Gittenberger, sp. nov.
Fig. 7

Holotype Indonesia, Sulawesi, 3km NW Saroako in direction Lake Matanna; 02°28'96"S 121°17'12"E; RMNH.MOL.346844. W.J.M. Maassen leg. 18-07-2002.

Derivation of name The specific epithet *maasseni* refers to Mr. W.J.M. Maassen, who discovered this species, in acknowledgement of lasting good-fellowship

Diagnosis Shell convex-conical, little higher than broad, with very convex whorls; without peripheral keel.

Description The shell is convex-conical with 5½ very convex whorls, separated by a deep suture. The 1¼ whorls of the protoconch have dense radial riblets; the 4¼ whorls of the teleoconch have prominent, straight, prosocline, more widely spaced ribs, 7 per mm above the aperture on the last whorl. Below the periphery, at the level of the parieto-palatal connection, the ribs are interrupted, to continue more or less towards the very narrow (1/30 B) umbilicus. There is neither a peripheral keel nor a spiral ridge.

Measurements H 2.30, W 2.15mm.

Differentiation The three already known *Rahula* species from the archipelago, viz. *R. delopleura* Vermeulen, Liew & Schilthuizen, 2015, *R. moolenbeeki* Maassen, 2000 and *R. raricostulata* (Smith, 1893), have shells with a sharp peripheral ridge. In *R. eurhabdota* the shells are more depressed conical and the whorls more clearly shouldered. A close relationship with *R. maasseni* seems unlikely however, because of a 3300km wide land and sea distributional gap.

Notes With the record of *R. maasseni* sp. nov. the distributional borderline of the genus *Rahula*

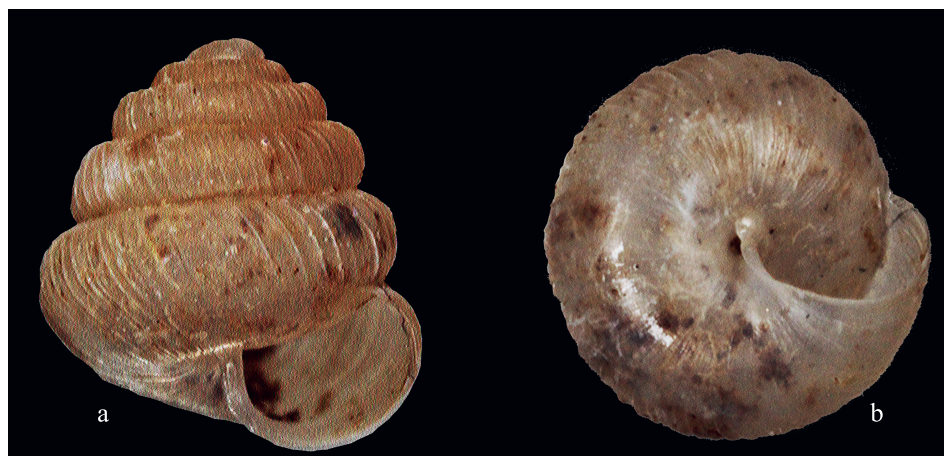
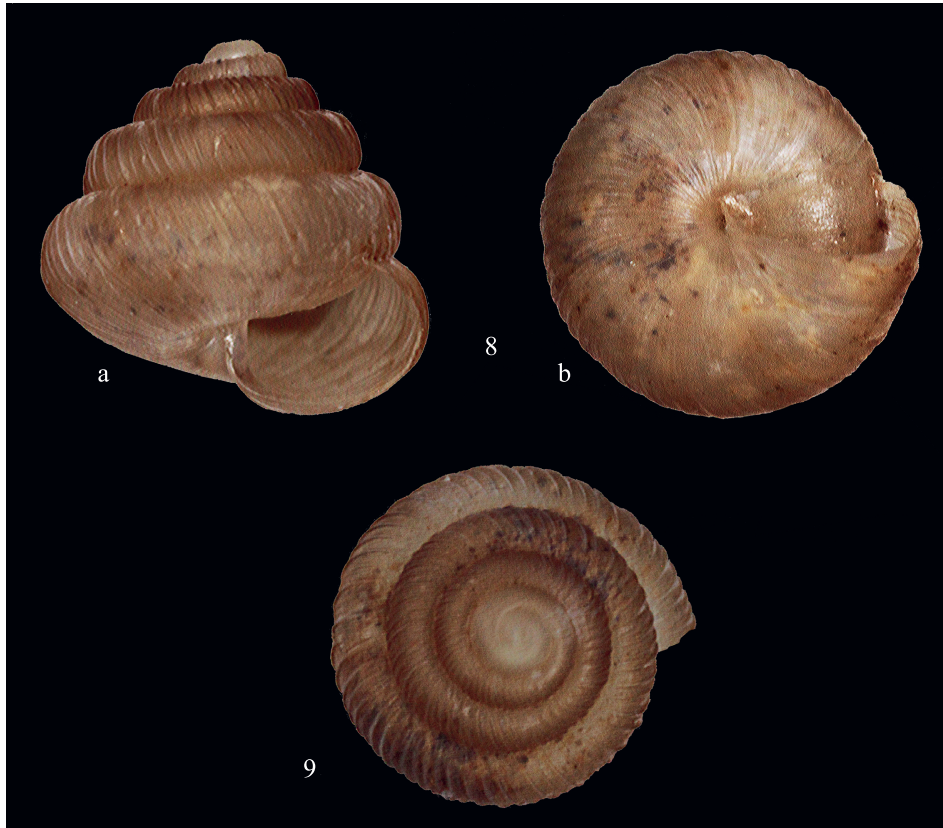


Figure 7 *Rahula maasseni* Gittenberger, sp. nov., holotype (RMNH.MOL. 346844), Indonesia, Sulawesi, 3km NW Saroako in direction Lake Matanna; 02°28'96"S 121°17'12"E.



Figures 8–9 *Rahula eurhabdota* (Saurin, 1953), Vietnam, province of Ha Giang, Dong Van, rockface at the border of the city; 1450m a.s.l

shifts 900km in SE direction to south of the equator.

Laos and Vietnam

Notes At two localities in northern Vietnam, a *Rahula* species was found that clearly differs by the absence of a peripheral keel from the two congeneric species that are already known from that country (Gittenberger, Leda & Sherub, 2017b: 416), i.e. *R. jucunda* (Bavay & Dautzenberg, 1912) and *R. ornatissima* (Bavay & Dautzenberg, 1912). It cannot be distinguished from *R. eurhabdota*, described from an area 550km more to the southwest, in Laos.

Rahula ornatissima was reported as *Kaliella ornatissima* from the province of Luang Namtha as new for Laos by Inkhavilay *et al.* (2019: 70).

Rahula eurhabdota (Saurin, 1953)

Figs 8–10

Kaliella eurhabdota Saurin, 1953: 113 (“Pah Hia” [see Páll-Gergely *et al.*, 2016: 13]), 118, pl. 4 fig. 9. Inkhavilay *et al.*, 2019: 69, 117 fig. 30F.

Material examined Vietnam, province of Ha Giang, Dong Van, rockface at the border of the city, 1450m a.s.l., 23°21'N 105°23'E, E. Gittenberger leg. 25-05-2018; province of Cao Bang, Trung Khanh district, Gun (Dam Thuy), Nguom Ngao cave entrance, 450m a.s.l., 22°40'N 106°16'E, E. Gittenberger leg. 26-05-2018.

Description The light brown, conical shell is about as high as broad. It has up to 5¼ whorls that are separated by a very deep suture. The initial whorls are broadly shouldered; the last whorl has a slightly straightened peripheral part and a broad, flattened, slanting base. The protoconch of 1¼ whorls has a dense sculpture of radial riblets. The teleoconch has much more widely spaced radial ribs, 7–9 per mm on the last whorl above the aperture; in between there is a very fine silky structure. Several ribs on the final two whorls are accentuated by a white callus. Shortly below the periphery, at the level of the parieto-palatal connection, the ribs become abruptly less prominent or end. The umbilicus is very narrow, measuring 1/20 W or less.

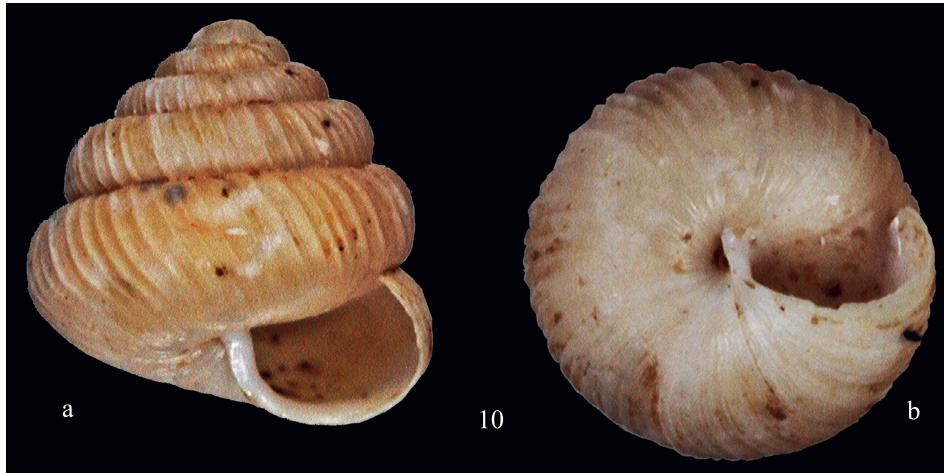


Figure 10 *Rahula eurhabdota* (Saurin, 1953), Vietnam, province of Cao Bang, Trung Khanh district, Gun (Dam Thuy), Nguom Ngao cave entrance; 450m a.s.l.

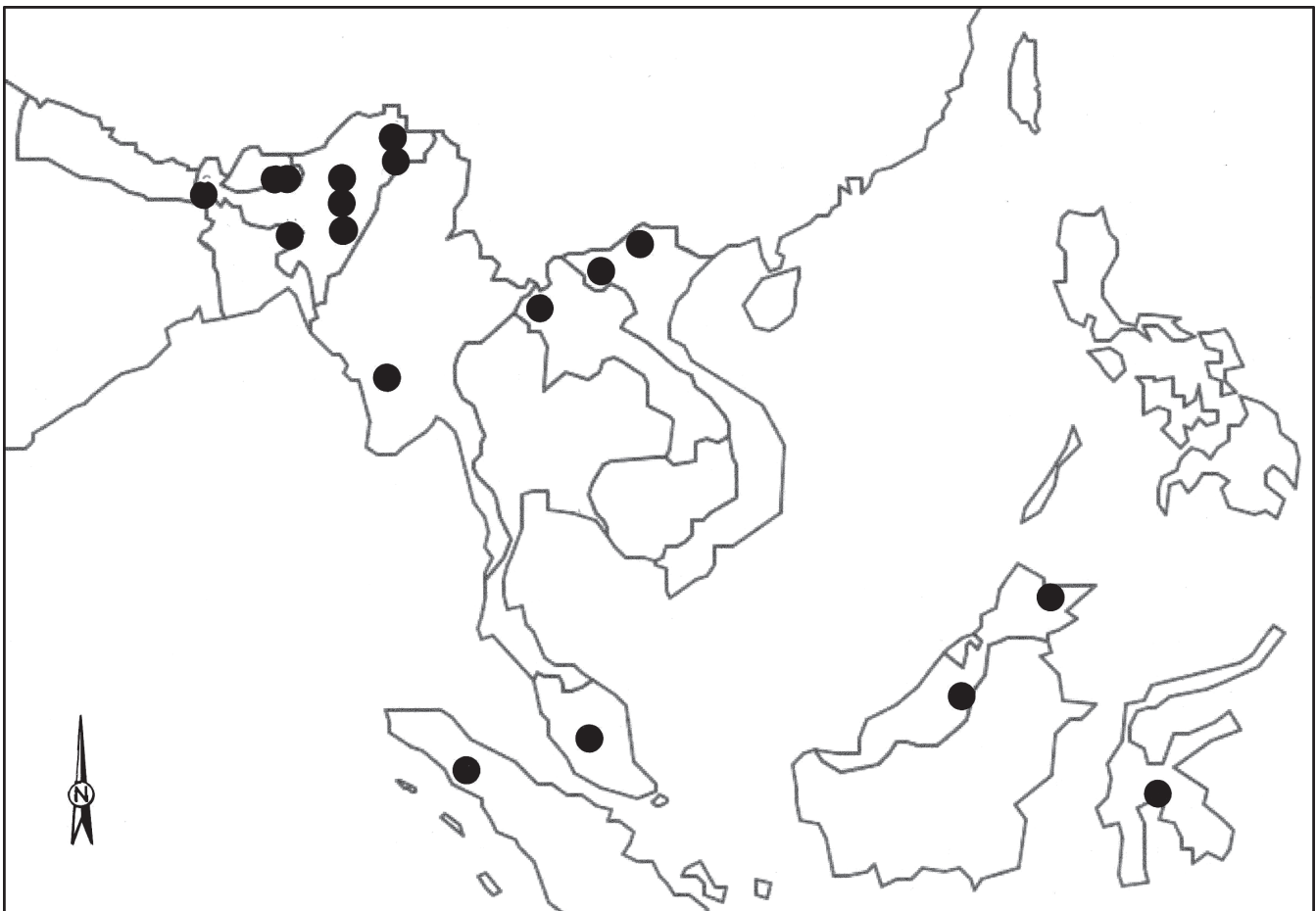


Figure 11 Map of southeastern Asia showing scattered distribution of the areas with one or more *Rahula* species.

Measurements of the two largest shells: H 2.56 W 2.58mm (Dong Van) and H 2.01 W 2.00mm (Nguom Ngao cave entrance).

Notes There is a surprisingly large distributional gap in the range of this species.

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REFERENCES

- BOUCHET P, ROCROI J-P, HAUSDORF B, KAIM A, KANO Y, NÜTZEL A, PARKHAEV P, SCHRÖDL M & STRONG EE 2017 Classification and nomenclator of gastropod families. *Malacologia. International Journal of Malacology* **61** (1-2): 1-526. <https://doi.org/10.4002/040.061.0201>
- FOON JK & MARZUKI ME 2020 Two new species of land snails of the genus *Rahula* from Peninsular Malaysia (Gastropoda: Euconulidae) *Raffles Bulletin of Zoology Supplement* **35**: 137-142. <http://zoobank.org/urn:lsid:zoobank.org:pub:22882CC5-194E-4A2C-840E-ADBA8050E59C>
- GITTENBERGER E, BUDHA PB & BANK RA 2020 Amazing *Paralaoma servilis* (Gastropoda, Pulmonata, Punctidae) *Basteria* **84** (1-3): 76-82.
- GITTENBERGER E, LEDA P, GYELTSHEN C, SHERUB S & DEMA S 2017a A field guide to the common molluscs of Bhutan: i-v, 1-111. National Biodiversity Centre, Thimphu, Bhutan.
- GITTENBERGER E, LEDA P & SHERUB S 2017b Gastropods in Bhutan, the genus *Rahula* (Pulmonata: Helicarionidae) *Journal of Conchology* **42** (6): 413-418.
- GITTENBERGER E, TENZIN U & SHERUB S 2017c Additional records of *Rahula* species (Pulmonata, Helicarionidae) in Bhutan *Basteria* **81**: 119-122.
- GODWIN-AUSTEN HH 1882 Land and freshwater Mollusca of India, including South Arabia, Baluchistan, Afghanistan, Kashmir, Nepal, Burmah, Pegu, Tenasserim, Malay Peninsula, Ceylon, and other islands of the Indian Ocean 1 [part.]: i-vi, 1-66, pls 1-12. <https://www.biodiversitylibrary.org/item/47128#page/5/mode/1up>
- INKHAVILAY K, SUTCHARIT C, BANTAOWONG U, CHANABUN R, SIRIWUT W, SRISONCHAI R, POLYOTHA A, JIRAPATRASILP P & PANHA S 2019 Annotated checklist of the terrestrial molluscs from Laos (Gastropoda: Neritimorpha, Caenogastropoda and Heterobranchia) *ZooKeys* **834**: 1-166. <https://doi.org/10.3897/zookeys.834.28800>
- PÁLL-GERGELY B, MURATOV IV & ASAMI T 2016 The family Plectopylidae (Gastropoda, Pulmonata) in Laos with the description of two new genera and a new species *ZooKeys* **592**: 1-26. <https://doi.org/10.3897/zookeys.592.8118>
- PILSBRY HA 1934 Zoological results of the Dolan West China Expedition of 1931, - Part II, mollusks *Proceedings of the Academy of Natural Sciences of Philadelphia* **86**: 5-28. <https://www.jstor.org/stable/4064145>
- SAURIN E 1953 Coquilles nouvelles de l'Indochine *Journal de Conchyliologie* **93**: 113-120.
- VERMEULEN Jj, LIEW T-S & SCHILTHUIZEN M 2015 Additions to the knowledge of the land snails of Sabah (Malaysia, Borneo), including 48 new species *ZooKeys* **531**: 1-139.
- ZILCH A 1959 Gastropoda. *Euthyneura* [part.]. *Handbuch der Paläozoologie* **6** (2, 1-2): 1-400.

