Acta Phytopathologica et Entomologica Hungarica 57 (2022) 2, 94–105
DOI: 10.1556/038.2022.00165

AKADÉMIAI KIADÓ

Two new species of *Dicharax* Kobelt & Möllendorff, 1900 from Myanmar and one from Thailand (Gastropoda: Caenogastropoda: Alycaeidae)

Barna Páll-Gergely[1]* and András Hunyadi[2]

[1] Plant Protection Institute, Centre for Agricultural Research, Eötvös Loránd Research Network, Herman Ottó út 15, H-1022, Budapest, Hungary

[2] Adria sétány 10G 2/5., H-1148, Budapest, Hungary

RESEARCH ARTICLE

Received: October 20, 2022 • Revised manuscript received: November 3, 2022 • Accepted: November 10, 2022
Published online: November 24, 2022

ABSTRACT

In this paper, three new species of the alycaeid genus *Dicharax* Kobelt & Möllendorff, 1900 are described, namely *Dicharax floridus* n. sp., *Dicharax spatiosus* n. sp. (Both from Shan State, Myanmar) and *Dicharax kosztarabi* n. sp. (from Thailand). All three new species are known from their holotypes.
http://zoobank.org/28168F06-CFBF-405F-90F7-A3399060D88C

KEYWORDS

taxonomy, systematics, Southeast Asia, singletons, rare species

INTRODUCTION

The Alycaeidae is a terrestrial Caenogastropod family of the superfamily Cyclophoroidea. Its geographic range spans between India (western Himalaya, see Sajan et al., 2020 and Western Ghats, see Aravind and Páll-Gergely, 2018) in the west, the Japanese Honshu Island in the east,

* Corresponding author. E-mail: pallgergely2@gmail.com, pall-gergely.barna@atk.hu

and southern Indonesia in the south (Godwin-Austen, 1882–1920; Gude, 1921; van Benthem Jutting, 1948, 1959; Minato, 1988; Gittenberger et al., 2017; Páll-Gergely and Auffenberg, 2019). The family currently has 344 extant species (Páll-Gergely and Auffenberg, 2019; Páll-Gergely et al., 2020; Páll-Gergely et al., 2021; Jirapatrasilp et al., 2021; MolluscaBase eds., 2022). The most specious genus is *Dicharax* Kobelt and Möllendorff, 1900, which currently contains 158 species (MolluscaBase eds., 2022). *Dicharax* is characterised by the lack of spiral striation on both the protoconch and the teleoconch, although very few species with spiral striation is also included in this genus (see Páll-Gergely et al., 2017, 2021). One of the hotspots of *Dicharax* is found in the southeastern Himalaya, and this remarkable diversity continues in Myanmar and northern Thailand (Páll-Gergely et al., 2021). Namely, 23 *Dicharax* species are known in Myanmar, and 14 from Thailand (Páll-Gergely and Auffenberg, 2019; Jirapatrasilp et al., 2021). In the following, we describe two new *Dicharax* species from Myanmar's Shan State, and one from the Erawan National Park in Thailand.

All three species described herein are represented by single shells (singletons). Although singletons may be the result of applying inadequate collecting methods (Wells et al., 2019), most of them indeed represent species that are rare in the nature, and description of them is necessary for a more complete understanding of global species diversity (Lim et al., 2012; Wells et al., 2019).

MATERIAL AND METHODS

Ten to thirty photographs were taken of each shell using a Keyence LHX5000 digital microscope, and merged into a single image with Photoshop. The map (Fig. 2) is made using Google Earth Pro.

We distinguish three regions of the teleoconch following Páll-Gergely et al. (2017: Fig. 1A, B): Region 1 (R1) – ranges from the beginning of the teleoconch to the beginning of the differently ribbed region where the sutural tube lies; Region 2 (R2) – extends from the differently ribbed area to the constriction; and Region 3 (R3) – ranges from the constriction to the peristome.

RESULTS

Superfamily Cyclophoroidea J.E. Gray, 1847
Family Alycaeidae W.T. Blanford, 1864

Genus *Dicharax* Kobelt and Möllendorff, 1900

Charax Benson, 1859: 177.

Dicharax Kobelt and Möllendorff, 1900: 186. (replacement name for *Charax* Benson, 1859, non *Charax* Scopoli, 1777 [Pisces]).

***Dicharax floridus* Páll-Gergely & Hunyadi, n. sp. (Fig. 1)**

http://zoobank.org/E57C31B7-43F4-4362-B3E0-97B1456AEA5C

Type material: Holotype, coll. HA (to be deposited in the HNHM), Myanmar, Shan State, Hopong centre 7.4 km towards Namsang, rd. #4 N 5 km, near Parpant Cave, 20°50.963′N,

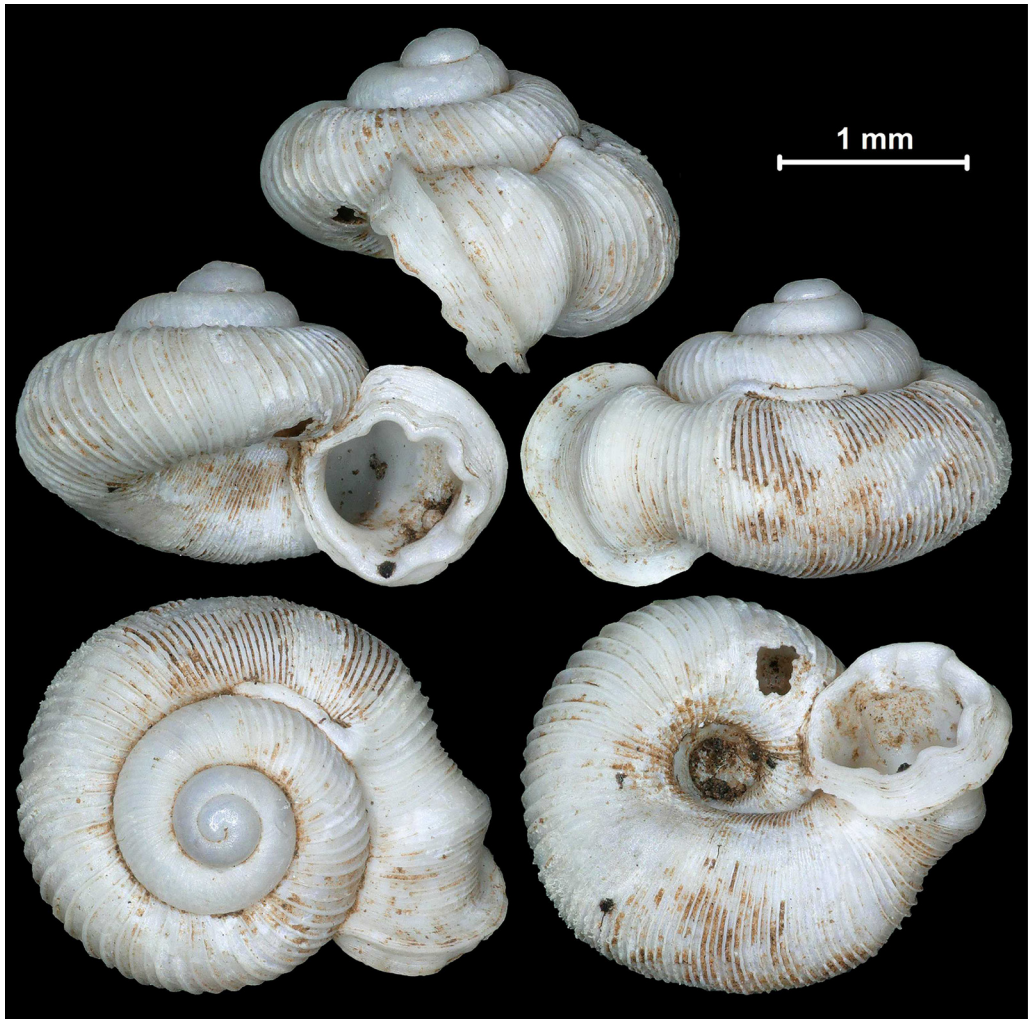

Fig. 1. Holotype of *Dicharax floridus* Páll-Gergely & Hunyadi, n. sp. Photos: B. Páll-Gergely

97°14.267′E, 1170 m a.s.l., (locality code: 2018/36), leg. A. Hunyadi, K. Okubo & J.U. Otani, 6 October 2018.

Diagnosis: A small *Dicharax* species with a depressed shell (shell shape low conical), regularly, sparsely spaced R1, a nearly half whorl long R2+R3, a prominent R2 swelling, a fringed aperture and a strongly expanded outer peristome.

Description: Single shell corroded, off-white, original colour unknown; shell outline slightly ovate in dorsal view; spire only slightly elevated, dorsal side low conical; body whorl rounded; protoconch moderately elevated, rather glossy, ca. 1.5 whorls (although teleoconch-protoconch boundary not clearly visible); R1 of ca. 1.75 whorls; first 0.75 whorls with weak wrinkles, this abruptly changes to a strongly, sparsely ribbed surface; last half R1 whorl with ca. 30 ribs, spaces

between ribs much wider than a rib; ribs strong, elevated, slightly turned backwards (towards protoconch), while at the end of R1 ribs slightly turn towards aperture; boundary between R1 and R2 distinct due to denser R2 ribs, and because the rib morphology changes (i.e. R2 ribs bent towards aperture); R2 with ca. 32 elevated ribs that turn towards aperture, space between ribs narrower than a rib; R2+R3 less than a half whorl (ca. 160°); R2 slightly quadrangular in cross section, i.e. bears a slight keel on its middle and on its ventral side; R2 slightly shorter than R3; boundary between R2 and R3 conspicuous due to strong, elevated ribs at the beginning of R3 and a deep constriction; R3 with a prominent, elevated, but blunt swelling that is situated closer to the peristome, both sides equally steep; aperture oval, oblique to the shell axis; boundary between inner and outer peristomes conspicuous; inner peristome fringed, 6 notches result in 5 incisions, basal one most conspicuous (widest); outer peristome strongly expanded (most strongly towards dorsal and upper palatal side) and even reflected towards umbilicus; umbilicus elongate, showing all whorls, moderately wide, less than one third of shell width.

Operculum: unknown.

Measurements: SW = 2.59 mm, SH = 1.74 mm.

Differential diagnosis: The combination of the fringed inner peristome, the strongly expanded outer peristome, and the sparsely ribbed R1 distinguishes this new species from all congeners. Several *Dicharax* species from Myanmar possesses a fringed inner peristome. Among them, *Dicharax blanfordi* (Godwin-Austen, 1914) (material examined: Chwegalé, Arakan Hills, NHMUK 1906.4.4.177 holotype, see Fig. 2) is the most similar to *D. floridus* n. sp. due to the similar ratios of shell regions and similar density of ribs. However, *D. blanfordi* is much larger, the inner peristome is less fringed, and the outer peristome is less expanded. *Dicharax cucullatus* (Theobald, 1870) is larger, it has a more depressed spire, a shorter R3 with a narrower swelling, a much less prominent outer peristome, and denser R1 and R2 ribs, and the same is true for *D. davisi* (Godwin-Austen, 1914) (see Jirapatrasilp et al., 2021) and *D. ochraceus* (Godwin-Austen, 1893) (material examined: Ruby mine Disr., Up. Burma, leg. Doherty, NHMUK 1903.7.1.2684, 2 syntypes, Fig. 3). *Dicharax ataranensis* (Godwin-Austen, 1914) has a nearly smooth R1 (widely-spaced ribs are only visible near the suture), a shorter R2 with denser ribs, and the outer peristome is not reflected as much as in this new species.

Etymology: The specific epithet *floridus* (blooming in Latin) refers to the flower-like aperture.

Distribution: This new species is known from the type locality only (see Fig. 4).

***Dicharax spatiosus* Páll-Gergely & Hunyadi, n. sp.** (Fig. 5)

http://zoobank.org/26035B88-61B8-4162-AB71-CB9BFB20FF16

Type material: Holotype, coll. HA (to be deposited in the HNHM), Myanmar, Shan State, Pinlaung centre N 7.5 km, Tar Kge, near „Big Bang Cave", 20°10.273′N, 96°47.442′E, 1540 m a.s.l. (locality code: 2018/32), leg. A. Hunyadi, K. Okubo & J.U. Otani, 14 October 2018.

Diagnosis: A *Dicharax* species with a depressed shell, rounded body whorl and aperture, very long R2 having bent ribs, and two prominent swellings on R3.

Description: Single shell corroded, off-white, original colour may be light brownish or pinkish; shell outline slightly ovate in dorsal view; spire only slightly elevated; body whorl rounded; protoconch low, rather glossy, ca. 1.25 whorls (although teleoconch-protoconch boundary not clearly visible); R1 of ca. 1.75 whorls; first whorl of R1 with dense, very fine ribs, which gradually become stronger, but remains dense until the very end of R1, which abruptly

Fig. 2. Dicharax blanfordi (Godwin-Austen, 1914), NHMUK 1906.4.4.177 (holotype).
Photo: Kevin Webb, NHM

turns to more widely-spaced until end of R1; last half R1 whorl (counting until beginning of sutural tube) with ca. 60 ribs; spaces between R1 ribs approximately as wide as a rib except for the end of R1, where spaces are wider than a rib; ribs low, wrinkle-like; boundary between R1 and R2 distinct due to denser R2 ribs, and higher R2 ribs; R2 with ca. 58 elevated ribs that turn towards aperture; R2+R3 more than a half whorl (ca. 190°); R2 inflated (i.e. its diameter is wider than that of the neighbouring R1), slightly shorter than R3; boundary between R2 and R3 conspicuous due to strong, elevated ribs at the beginning of R3 beginning and a deep constriction; R3 with a prominent, elevated and sharp central swelling bearing some ribs, and an additional swelling between the main swelling and the peristome; second swelling starts from the

Fig. 3. Dicharax ochraceus (Godwin-Austen, 1893), NHMUK 1903.7.1.2684, syntype, Photo: Kevin Webb, NHM

suture, but disappears before umbilicus (most visible in lateral view); aperture oblique to shell axis, rounded, not fringed; boundary between inner and outer peristomes conspicuous; inner peristome prominent, expanded and even reflected towards umbilicus; outer peristome wider, strongly expanded in one plane, reflected only towards umbilicus; umbilicus shows all whorls, moderately wide, less than one third of shell width.

Operculum: The operculum of the holotype was in its aperture. Operculum concave, outer side with remains of a very slightly elevated lamina; nucleus missing, there was probably an elevated central nipple on the inner side.

Measurements: SW = 5.01 mm, SH = 3.06 mm.

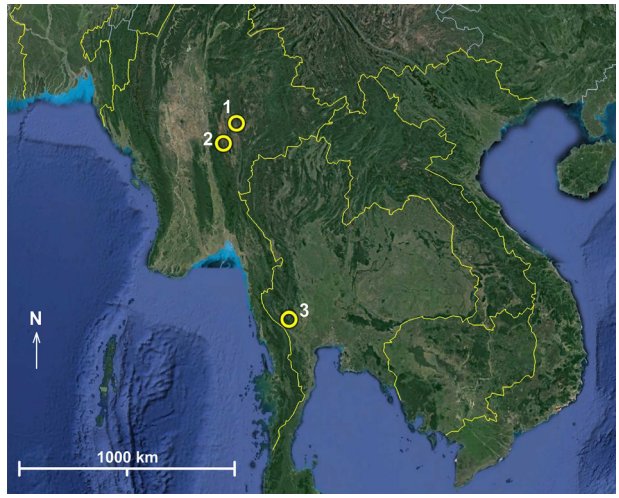

Fig. 4. Map showing the type localities of three new *Dicharax* species. 1: *Dicharax floridus* n. sp., 2: *Dicharax spatiosus* n. sp., 3: *Dicharax kosztarabi* n. sp.

Differential diagnosis: *Dicharax notus* (Godwin-Austen, 1914) is smaller, has a blunter R3 swelling, lacks a second R3 swelling, and has a shorter R2 (see Páll-Gergely et al., 2021). *D. cucullatus* is similar to this new species in size and the long R2, but its R3 swelling is situated closer to the peristome, lacks a second R2 swelling, and has a fringed aperture (see Jirapatrasilp et al., 2021). *Dicharax woodthorpei* (Godwin-Austen, 1914) (see Páll-Gergely et al., 2021) is also somewhat similar to the new species in terms of general shell and aperture shape, but it lacks a conspicuous second R3 swelling, and its R2 bears no elevated ribs, but has light and dark alternating colour stripes (or some of the R2 ribs may be separated individually at the beginning of R2).

Etymology: The specific epithet *spatiosus* (spacious, wide in Latin) refers to the wide aperture and spacious R3 of this new species.

Distribution: This new species is known from the type locality only (see Fig. 4).

Remarks: The holotype has a scraped hole on its R2, suggesting that it was probably eaten by an *Atopos* slug (Fig. 5).

***Dicharax kosztarabi* Páll-Gergely & Hunyadi, n. sp.** (Fig. 6)

http://zoobank.org/D4D89AB1-1D8D-4E55-B833-CA3BDD9EB0EC

Type material: Holotype, coll. HA (to be deposited in the HNHM), Thailand, Kanchanaburi Province, Erawan National Park, Erawan falls Trail, 90 m a.s.l., 14°22.310′N, 99°8.699′E (locality code: 2015/28), leg. A. Hunyadi, 17 February 2015.

Additional material: 6 juvenile/broken shells (not paratypes), coll. HA, same data as for the holotype.

Diagnosis: A *Dicharax* species with a depressed shell, pinkish colouration, regular, rather widely-spaced ribs on the last whorl of R1, a short R2 with dense, bent ribs, and a rounded aperture.

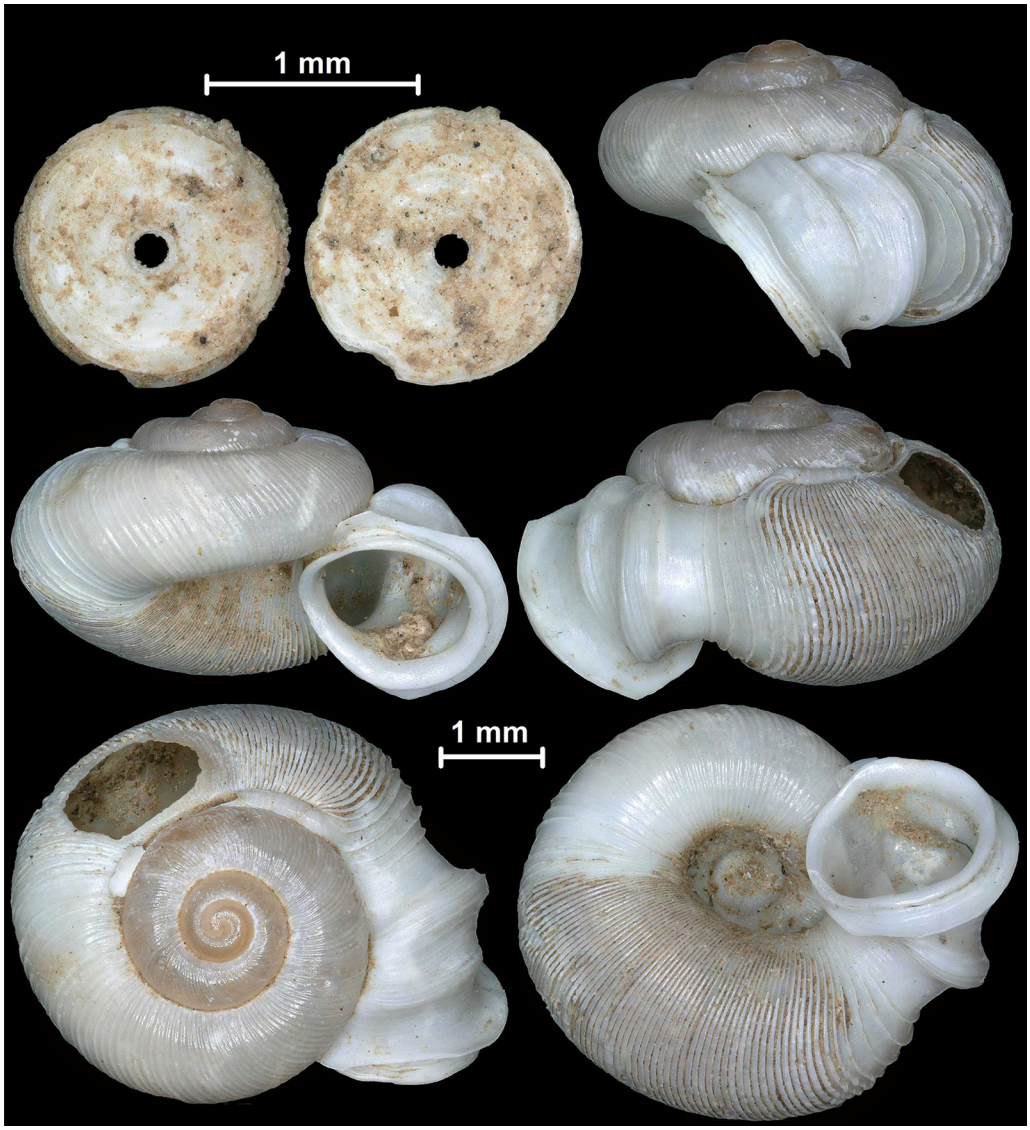

Fig. 5. Holotype of *Dicharax spatiosus* Páll-Gergely & Hunyadi, n. sp. Photos: B. Páll-Gergely

Description: Shell off-white to pinkish/light brownish; shell outline slightly ovate in dorsal view; spire only slightly elevated; body whorl rounded; protoconch low, rather glossy, ca. 1.25 whorls; R1 of 1.75 whorls; first whorl of R1 with dense, fine ribs (spaces between ribs only slightly wider than a rib), which gradually become more widely-spaced (spaces between ribs at the end of R1 are much wider than a rib); last half R1 whorl with ca. 32 ribs; ribs straight, strong, narrow, but relatively low; boundary between R1 and R2 distinct due to much denser R2 ribs; R2

Fig. 6. Holotype of *Dicharax kosztarabi* Páll-Gergely & Hunyadi, n. sp. Photos: B. Páll-Gergely

with ca. 30 low and rather narrow ribs, spaces between ribs is approximately as wide as a rib; R2+R3 more than a quarter whorl (ca. 110°); R2 shorter than R3; boundary between R2 and R3 conspicuous due to smooth R3 beginning and a deep constriction; R3 nearly smooth, glossy, only with weak growth lines, and blunt but prominent, elongated central swelling; aperture oblique to shell axis, rounded; boundary between inner and outer peristomes distinct; inner peristome prominent, slightly protruding; outer peristome as strong as inner peristome, strongly

expanded, slightly reflected in direction of umbilicus; umbilicus shows all whorls, wide, approximately a third of shell width.

Operculum: unknown.

Measurements: SW = 2.7 mm, SH = 1.7 mm.

Differential diagnosis: *Dicharax subroseus* Páll-Gergely, 2021, which is the most similar species, has more widely-spaced, stronger R1 ribs, deeper constriction between R1 and R2, more sparsely spaced ribs on R2, and a more expanded inner peristome (Páll-Gergely et al., 2021). *Dicharax panhai* Jirapatrasilp & Páll-Gergely, 2021 has a more conical dorsal side, an oval umbilicus, a shorter combined R2+R3, less (18) ribs on R2, its R3 more prominent ribs, and the swelling is situated closer to the peristome.

Etymology: This new species is dedicated to and named after the late Mihály Kosztarab (1927–2022), Hungarian entomologist, a world specialist of scale insect (Markó and Kontschán, 2022).

Distribution: This new species is known from the type locality only (see Fig. 4).

Remarks: The type locality of *D. kosztarabi* n. sp. is situated only 7–8 km from the type locality of *D. panhai*. This also highlights the local endemism and high species diversity of this group in the Thai-Myanmar border region.

ACKNOWLEDGEMENTS

We are grateful to Jonathan Ablett for allowing access to the collection of the NHM, and to Vukašin Gojšina and Parin Jirapatrasilp for their comments on the manuscript. This study was supported by the Hungarian Research Fund (TKA FK 135262), the Bolyai Research Scholarship of the Hungarian Academy of Sciences, and grants from the SYNTHESYS Project (GB-TAF-2523) to BPG.

ABBREVIATIONS

HA	Collection András Hunyadi (Budapest, Hungary)
HNHM	Hungarian Natural History Museum (Budapest, Hungary)
NHM	The Natural History Museum (London, UK)
NHMUK	When citing lots deposited in the NHM
SH	shell height
SW	shell width (diameter)

REFERENCES

Aravind, N.A., and Páll-Gergely, B. (2018). *Dicharax* (?) *bawai* n. sp from southern India (Gastropoda: Cyclophoroidea: Alycaeidae). *Archiv für Molluskenkunde*, 147(1): 55–62.

Benson, W.H. (1859). A sectional distribution of the genus *Alycæus*, Gray, with characters of six new species and of other Cyclostomidæ collected at Darjiling by W. T. Blanford, Esq. *The Annals and Magazine of Natural History*, 3(3): 176–184.

van Benthem Jutting, W.S.S. (1948). Systematic studies on the non-marine Mollusca of the Indo-Australian archipelago. 1. Critical revision of the Javanese operculate landshells of the families Hydrocenidae, Helicinidae, Cyclophoridae, Pupinidae and Cochlostomatidae. *Treubia*, 19: 539–604.

van Benthem Jutting, W.S.S. (1959). Catalogue of the non-marine Mollusca of Sumatra and of its satellite islands. *Beaufortia*, 7(83): 41–191.

Blanford, W.T. (1864). On the classification of the Cyclostomacea of eastern Asia. The *Annals and Magazine of Natural History*, 3(13): 441–465.

Gittenberger, E., Leda, P., Gyeltshen, C., Sherub, S., and Dema, S. (2017). *A field Guide to the common molluscs of Bhutan*. National Biodiversity Centre (NBC), Ministry of Africulture and Forests, Serbithang, Thimphu, Bhutan, pp. 1–111.

Godwin-Austen, H.H. (1882–1920). *Land and freshwater Mollusca of India, including South Arabia, Baluchistan, Afghanistan, Kashmir, Nepal, Burma, Pegu, Tenasserim, Malaya Peninsula, Ceylon and other islands of the Indian Ocean; Supplementary to Mssers Theobald and Hanley's Conchologica Indica*. Taylor and Francis, London, pp. 257–442.

Gray, J.E. (1847). A list of the genera of recent Mollusca, their synonyma and types. *Proceedings of the Zoological Society of London*, 15(1847): 129–219.

Gude, G.K. (1921). *The Fauna of British India including Ceylon and Burma. Mollusca. III. Land operculates (Cyclophoridae, Truncatellidae, Assimineidae, Helicinidae)*. Taylor and Francis, London, pp. 1–386.

Jirapatrasilp, P., Páll-Gergely, B., Sutcharit, C., and Tongkerd, P. (2021). The operculate micro land snail genus *Dicharax* Kobelt & Möllendorff, 1900 (Caenogastropoda, Alycaeidae) in Thailand, with description of new species. *Zoosystematics and Evolution*, 97(1): 1–20.

Kobelt, W. and von Möllendorff, O.F. (1900). Zur Systematik der Pneumonopomen. *Nachrichtsblatt der Deutschen Malakozoologischen Gesellschaft*, 32: 186.

Lim, G.S., Balke, M., and Meier, R. (2012). Determining species boundaries in a world full of rarity: singletons, species delimitation methods. *Systematic Biology*, 61(1): 165–169.

Markó, V. and Kontschán, J. (2022). In memoriam Mihály Kosztarab (1927–2022). *Acta Phytopathologica et Entomologica Hungarica*, 57(2): 93.

Minato, H. (1988) *A systematic and bibliographic list of the Japanese land snails*. H. Minato, Shirahama, pp. 1–294. [pls 1–7].

MolluscaBase eds. (2022). MolluscaBase. Available at: https://doi.org/10.14284/448, https://www.molluscabase.org on 2022-10-20 (Accessed: 3 November 2022).

Páll-Gergely, B. and Auffenberg, K. (2019). A review of the Alycaeidae of the Philippines with descriptions of new species and subspecies (Gastropoda: Caenogastropoda: Cyclophoroidea), *Molluscan Research*, 39(4): 377–389.

Páll-Gergely, B., Hunyadi, A., ĐỖ, Đ.S., Naggs, F., and Asami, T. (2017). Revision of the Alycaeidae of China, Laos and Vietnam (Gastropoda: Cyclophoroidea) I: the genera Dicharax and Metalycaeus. *Zootaxa*, 4331(1): 1–124. https://doi.org/10.11646/zootaxa.4331.1.1.

Páll-Gergely, B., Hunyadi, A., Grego, J., Reischütz, A., and Auffenberg, K. (2021). Nineteen new species of Alycaeidae from Myanmar and Thailand (Gastropoda: Caenogastropoda: Cyclophoroidea). *Zootaxa*, 4973(1): 1–61.

Páll-Gergely, B., Sajan, S., Tripathy, B., Meng, K., Asami, T., and Ablett, J.D. (2020). Genus-level revision of the Alycaeidae (Gastropoda: Cyclophoroidea), with an annotated species catalogue. *ZooKeys*, 981: 1–220.

Sajan, S., Páll-Gergely, B., Tripathy, B., Chatterjee, P., Chandra, K., and Sivakumar, K. (2020). Redescription and ecological niche of a land snail *Dicharax strangulatus* (L. Pfeiffer, 1846) in the Himalaya (Gastropoda: Cyclophoroidea: Alycaeidae). *Journal of Conchology*, 43(5): 521–530.

Scopoli, J.A. (1777). *Introductio ad historiam naturalem, sistens genera lapidum, plantarum et animalium hactenus detecta, caracteribus essentialibus donata, in tribus divisa, subinde ad leges naturae. Introductio ad historiam naturalem*. Apud Wolfgangum Gerle, Prague, pp. 1–506. https://doi.org/10.5962/bhl.title.10827.

Theobald, W. (1870). Descriptions of new species of land shells from the Shan States and Pegu. *Journal of the Asiatic Society of Bengal*, 39: 395–402.

Wells, A., Johanson, A.K., and Dostine, P. (2019). Why are so many species based on a single specimen? *Zoosymposia*, 14: 32–38.