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MALACOFAUNAL INVENTORY IN CHINTAMONI KAR BIRD SANCTUARY, WEST BENGAL, INDIA

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Malacofaunal inventory in Chintamoni Kar Bird Sanctuary, West Bengal, India

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Abstract: The knowledge on the floral and faunal composition of protected areas (PAs) is crucial for formulating suitable conservation plan. In this paper, inventory and species richness of non-marine molluscs of Chintamoni Kar Bird Sanctuary has been made and is for the first time from any PA of West Bengal. A total of 276 specimens belonging to 22 species (10 species of land snails and 12 species of freshwater) of non-marine molluscs (land and freshwater) were collected and examined from this sanctuary. The malacofaunal inventory comprises of nine genera under seven families among land snails and 12 genera & seven families from both gastropods & bivalves under the freshwater forms. As far as species richness is concerned, the family Ariophantidae was found to be dominant among land forms whereas species of the families Thiaridae and Unionidae were dominant among freshwater forms.

Keywords: CKBS, freshwater, Mollusca, snails.

Bengali: সংরক্ষিত এলাকার (Protected Areas) প্রাণিজগৎ এবং উত্তীর্ণজগতের সমষ্টি ধারনা থাকা অত্যন্ত গুরুত্বপূর্ণ সেই এলাকার একটি উপযুক্ত সংরক্ষণ পরিকল্পনা গঠনের জন্য। কিছু পরিচিত মেরুদণ্ডী (Vertebrate) স্নায়ুপুরী প্রাণী এবং পাখী ব্যতিত, কুম পরিচিত অমেরুদণ্ডী (Invertebrate) প্রাণীদের নিয়ে তথ্য খুর কর্ম পাওয়া যায় সংরক্ষিত এলাকা থেকে। আমাদের বর্তমান গবেষণা দ্বারা, চিন্তামনিক পাখী অভয়ারণ্যের আ-সামুদ্রিক কুমজ (Mollusca) প্রাণীদের নামের তালিকা এবং প্রজাতির (Species) প্রাচুর্য নিয়ে বিজ্ঞানিক আলোচনা করা হয়েছে। এই প্রথমবারের পশ্চিমবঙ্গের কোন সংরক্ষিত এলাকা থেকে এরম কাজ করা হয়েছে। এই অভয়ারণ্যে থেকে মোট বাইশটি (১২) প্রজাতির ঘার মধ্যে দশটি (১০) প্রজাতির স্থলভাগের কুমজ এবং বারো (১২) প্রজাতির মিষ্টি জলের কুমজ পাওয়া গেছে। মোট দুশো ছিয়াস্তর (২৭ শ) টি নমুনা সংগ্রহ করা হয়েছিল এই অভয়ারণ্য থেকে এবং পরীক্ষা করা হয়েছিল। এই কুমজ প্রাণীদের তালিকাতে, স্থলভাগের কুমজ প্রাণীদের সাতটি (৭) গোত্রের (Families) অধীনে নটি (৯) গণ (Genera) এবং মিষ্টি জলের কুমজ প্রাণীদের সাতটি (৭) গোত্রের অধীনে বারটি (১২) গণ পাওয়া গেছে। আরিওফ্যান্টিডি (Ariophantidae) গোত্রের কুমজ প্রজাতির প্রাচুর্য বেশী পাওয়া গেছে। এই অভয়ারণ্য থেকে। অন্যদিকে মিষ্টি জলের কুমজদের মধ্যে থিয়ারিডি (Thiaridae) এবং ইউনিওনিডি (Unionidae) গোত্রের প্রজাতিগুলোর প্রাধান্য দেখা গেছে।

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Author contribution: SS & BT designed the survey, SS, SD & TB conducted field survey and specimens collection, SS & TB examined and identified the specimens, SS compiled the information, illustration, and prepared the first draft of the manuscript, SD wrote Bengali abstract, BT logistic support, manuscript editing, and all authors contributed to drafting the manuscript.

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INTRODUCTION

The phylum Mollusca is the most diverse and ubiquitous component of ecosystem; and the second largest group of invertebrate in terms of species diversity (Lydeard et al. 2004). Molluscs are considered environmental indicators in terms of spatio-temporal changes in a particular ecosystem or landscape (Elder & Collins 1991; Lewis & Magnuson 2000; Chlyeh et al. 2006; Thom et al. 2017). They play a crucial role in the food chain and serve as a source of calcium for various vertebrates and invertebrates, embryonic development, eggshell formation, and osmoregulation process (Graveland et al. 1994; Graveland & van der Wal 1996; Hotopp 2002). Being a highly diverse group in all possible habitats (marine, freshwater and terrestrial) and their ecological importance through the ecological services which they provide, study on the diversity and distribution need better understanding for ecosystem functioning.

India has 5,227 species of molluscs (6.15% of the global faunal diversity), of which 3,870 species are marine, 1,140 species are land-living, and 217 freshwater species, have been recorded from the Indian territory (Ramakrishnan et al. 2010; Reid et al. 2013; Mukhopadhyay et al. 2017; Aravind & Pál-Gergely 2018; Sajan et al. 2019a,b, 2020; Annon 2020; Pál-Gergely et al. 2020a,b; Sajan & Tripathy 2020). The animal diversity of West Bengal State, however, has been published in 1992 by the Zoological Survey of India (ZSI) which also covered malacofauna. Most of the records in this study were of aquatic snails and terrestrial species from outside protected areas (PAs) (Mitra & Dey 1992; Thakur et al. 1992). There is no documentation of malacofaunal diversity from any of the PAs of West Bengal State till date. Thus, the present study is first of its kind in providing some baseline information on malacofaunal diversity of Chintamoni Kar Bird Sanctuary, a PA situated in the suburban area of Kolkata City in West Bengal.

MATERIALS AND METHODS

Study area

The Chintamoni Kar Bird Sanctuary (CKBS) is situated in South 24 Parganas District of West Bengal (22.700N & 88.666E) in the proximity of the urbanised city of Kolkata. It is also known as Narendrapur Wildlife Sanctuary and locally known by the name 'Kayaler Bagan'. The sanctuary is spread over in an area of 0.7km² and managed by the West Bengal Forest Department and

under the jurisdiction of Sunderban Biosphere Reserve Range. Being surrounded by temporary and permanent small waterbodies as well as terrestrial vegetation, this sanctuary harbours diverse invertebrates, insects, mollusca, reptiles, birds, and small mammals (Chowdhury & Chowdhury 2006; Banerjee & Talapatra 2015; Mitra et al. 2018). In 1982, the area was proposed as a bird sanctuary by the Government of West Bengal, which later was renamed as Chintamoni Kar Bird Sanctuary (CKBS) in 2005.

Sampling methods and Sorting

Field collections of molluscan fauna were carried out from July to November 2017 during monsoon, post monsoon, and winter. Direct search method was used to collect live specimens and dead shells of both land and freshwater molluscs from their natural habitats, viz.: vegetation, near water bodies, pool, inside rotten/decaying logs, on mosses, old walls, leaf litter, bushes, under the rock surface, and bamboo thickets. Dead shells and live specimens encountered were photographed in the field (Nikon D7000 DSLR camera with 105mm macro lens) and were hand-picked for collection. The collected materials were thoroughly cleaned in the field itself with freshwater including the live ones, preserved in 70% ethanol, labelled, and brought to ZSI laboratory for identification. After completion of preservation and identification with labelling, the same were deposited in the National Zoological Collection of Malacology Division of ZSI.

Identification and nomenclature

All the specimens were examined and identified to species level based on the morphological shell characters and standard keys as provided by Blanford & Godwin-Austen (1908); Gude (1914, 1921); Preston (1915), and Mitra et al. 2004 (2005). The nomenclature follows as suggested by Bouchet et al. (2017) for subfamily, family, and higher level systematics.

Acronyms and abbreviations

Art(s).—Article(s) (of the Code) | Code—International Code of Zoological Nomenclature (ICZN 1999) | fig.—figure (in cited publications) | figs—figures (in cited publication) | Fig.—Figure (in this publication) | Figs—Figures (in this publication) | leg.—legit (i.e., the collector) | NZSI—National Zoological Collection of the Zoological Survey of India | p(p).—page(s) | pl(s).—plate(s) | Reg. No.—Registration Number | sic!—sic erat scriptum (thus as it was erroneously written) | spm.—specimen | spms—specimens | ZSI—Zoological Survey of India.

RESULTS AND DISCUSSION

A total of 22 species of land and freshwater molluscs were recorded from CKBS. Of these, 10 species were of land snails belonging to nine genera and seven families; whereas 10 species of gastropods and two bivalves belonging to 12 genera and seven families have been identified as freshwater forms. The family Ariophantidae (n=3) was found to be the maximum, in terms of species composition among land snails, whereas in freshwater forms, Thiaridae (n=3) and Unionidae (n=2) were the dominant family inside the sanctuary. *Macrochlamys indica* Godwin-Austen, 1883, *Ariophanta interrupta* (Benson, 1834), *Indosuccinea semiserica* (Gould, 1846), and *Cryptaustenia bensoni* (Pfeiffer, 1848) were abundantly encountered during the field surveys. Noteworthy to mention here that, the worst invasive alien species *Lissachatina fulica* (Bowdich, 1822) was also recorded from the sanctuary, the source for which could be from the urban Kolkata City. Among freshwater mollusc species, *Indoplanorbis exustus* (Deshayes, 1833), *Filopaludina bengalensis* (Lamarck, 1822), *Idiopoma dissimilis* (Müller, 1774), and *Radix rufescens* (J.E. Gray in G.B. Sowerby I, 1822) were most common species. The riverine species *Brotia costula* (Rafinesque, 1833) and *Tarebia granifera* (Lamarck, 1816) were also recorded, although there is no connectivity to rivers or estuaries to this PA, but the source of their dispersal could be during monsoon, when the area gets flooded and remains temporary swampy wetland for few months.

Systematics accounts of land and freshwater molluscs

Class Gastropoda Cuvier, 1795

Order Stylommatophora A. Schmidt, 1855

Superfamily Helicarionoidea Bourguignat, 1877

Family Ariophantidae Godwin-Austen, 1883

Subfamily Ariophantinae Godwin-Austen, 1883

Genus *Ariophanta* Des Moulins, 1829

Ariophanta Des Moulins, 1829: p. 235, pl. 1, figs 1–5. (Subgenus).

Type species. *Helix laevipes* Müller, 1774 [accepted as *Ariophanta laevipes* (Müller, 1774)]; subsequent designation.

Distribution. Southern and southeastern Asia.

***Ariophanta interrupta* (Benson, 1834)**

(Image 1A, 3C)

Helix interrupta Benson, 1834 (1832–1834): p. 461; Benson, 1834: p. 90; Pfeiffer, 1847: p. 63; Reeve, 1853 [1854]: p. 329, pl. 171, fig. 1159; Pfeiffer, 1859: p. 62;

Hanley & Theobald, 1876 (1870–1876): p. 13, pl. 27, fig.

3.

Helix himalana — Lea, 1834: p. 55, pl. 19, fig. 66.

Helix himalayana (sic!) — Benson, 1834: p. 91; Benson, 1834 (1832–1834): p. 461; Pfeiffer, 1847: p. 63; Reeve, 1852 [1854]: p. 126, pl. 75, fig. 389; Brown, 1866: p. 19.

Nanina interrupta — Gray, 1855: p. 84; Pfeiffer, 1855: p. 84.

Ariophanta himalayana (sic!) — Pfeiffer, 1855: pp. 144–145.

Nanina (Ariophanta) himalayana (sic!) — Beck, 1838: p. 5; Blanford, 1863: p. 85.

Nanina (Ariophanta) himalajana (sic!) — Albers, 1850: p. 62.

Nanina (Ariophanta) interrupta — Beck, 1838: p. 5; Blanford, 1863: p. 85; Nevill, 1878: p. 19.

Ariophanta (Ariophanta) interrupta — Ray, 1948: pp. 109–110.

Ariophanta interrupta race. *sacra* — Annandale, 1912: pp. 33–34, figs 1, 2. (unavailable name Code, 1999: Art. 1.3.4, Art 10.2, Art. 45.5; and treats race. *sacra* as a synonym of *interrupta*)

Ariophanta interrupta — Godwin-Austen, 1880: p. 154, pl. 10, figs 1, 1a; Godwin-Austen, 1898: p. 130, pl. 34, fig. 2; Blanford, 1899: p. 283; Blanford, 1901: p. 244; Blanford & Godwin-Austen, 1908: p. 31; Annandale, 1912: pp. 33–34, figs 1, 2; Subba Rao, Thakur & Mitra, 1989: p. 254, 266–267, fig. 5A; Mitra & Dey, 1992: p. 45; Mitra, Dey & Ramakrishna, 2004: p. 228, figs C49–50; Mitra, Dey & Ramakrishna, 2005: p. 240; Ramakrishna, Mitra & Dey, 2010: p. 238; Raheem et al., 2014: p. 92, figs 56F, 57A–C; Biswas et al., 2015: p. 23, text fig.; Tripathy, Sajan & Mukhopadhyay, 2018: p. 786, fig. C; Sajan et al., 2018b: p. 145, pl. 2, fig. J; Mukhopadhyay et al., 2020: pp. 356, 360, pl. 15, fig. A.

Type locality. “near Sicrigali and the river Jellinghy (tributary of the Ganges; Godwin-Austen, 1880: p. 154), one of the mouths of the Ganges (small village in Sahibganj District, Jharkhand; 25.249028 & 87.708635)”.

Material examined. Reg. No. NZSI M.30172/7, 22.vii.2017, 40 spms., India, West Bengal, South 24 Parganas District, CKBS, leg. T. Biswas & S. Das; Reg. No. NZSI M.33307/9, 01 spm., 2.ix.2017, CKBS; Reg. No. NZSI M.33314/9, 8 spms., 24.ix.2017, CKBS, leg. S.K. Sajan.

Distribution. India (Western Ghats, Andhra Pradesh, Jharkhand, Odisha, West Bengal, and Uttarakhand) and Bangladesh.

Remarks. Most common snail found in CKBS, however, Blanford (1863: p. 85) indicated the error in type locality as “I have but little doubt that *N. Himalayana*, Lea, is *N.*

interrupta, Bens., the Himalayan locality being probably an error".

Subfamily **Macrochlamydinae** Godwin-Austen, 1883

Genus **Macrochlamys** Gray, 1847

Macrochlamys Gray 1847: p. 169 — Benson, 1832: p. 76 (unavailable).

Type species. *Helix vitrinoides* Deshayes, 1831 [accepted as *Macrochlamys vitrinoides* (Deshayes, 1831)], type by monotype.

Distribution. Southern and southeastern Asia.

***Macrochlamys petrosa* (Hutton, 1834)**

(Image 1B, 3A)

Helix petrosa Hutton, 1834: p. 83; Pfeiffer, 1847: p. 56; Benson, 1848: p. 163.

Macrochlamys petrosa — Godwin-Austen, 1883: p. 96; Rensch, 1955: p. 170; Mitra & Dey, 1992: p. 47; Subba Rao et al., 1995: p. 76; pl. 19, figs 1–2; Ramakrishna & Mitra, 2002: p. 43; Patil & Talmale, 2005: p. 1913; Ramakrishna, Mitra & Dey, 2010: p. 280; Patil & Talmale, 2012: pp. 254, 285; Sajan et al., 2019b: p. 809.

Type locality. "dead, in dry ravines, and on the banks of the Ganges; living specimens at Tara, in the range of rocky hills near Mirzapur (Mirzapur, Uttar Pradesh)".

Material examined. Reg. No. NZSI M.34454/10, 2.ix.2017, 7 spms., CKBS; Reg. No. NZSI M.34455/10, 24.ix.2017, 5 spms., CKBS, leg. S.K. Sajan.

Distribution. India (Jharkhand, Meghalaya, Maharashtra, Uttar Pradesh, and West Bengal).

Remarks. Similar to *M. indica*, though not so commonly occurring. Distinguished by more depressed shell and also being excavated around the umbilicus.

***Macrochlamys indica* Godwin-Austen, 1883**

(Image 1C, 3D)

Macrochlamys indica Godwin-Austen, 1883: p. 97, pl. 18, figs 1–8; pl. 21, fig. 7; pl. 25, figs 9, 16; Blanford & Godwin-Austen, 1908: p. 95, fig. 43; Subba Rao & Mitra, 1979: p. 15; Subba Rao, Thakur & Mitra, 1989: p. 272, fig. 6E; Subba Rao & Mitra, 1991: p. 55, pl. 8, fig. 1; Mitra & Dey, 1992: p. 46; Surya Rao & Mitra, 1997: p. 26; Mookherjee et al., 2000: p. 348; Surya Rao et al., 2004: p. 97, pl. 10, fig. 1; Mitra, Dey & Ramakrishna, 2005: p. 255, figs 218–220; Patil & Talmale, 2005: p. 1913; Mitra, Dey & Ramakrishna, 2005: p. 237; Patil, Ramakrishna & Mitra, 2006: p. 174; Ramakrishna, Mitra & Dey, 2010: p. 271; Patil & Talmale, 2011: p. 27; Patil & Talmale, 2012: p. 285; Raheem et al., 2014: p. 104, fig. 66 C–D; Biswas et al., 2015: p. 22, fig.; Budha et al., 2015: p. 21; Phung et al.,

2017: p. 74, fig. 11C; Tripathy, Sajan & Mukhopadhyay, 2018: p. 792; Sajan et al., 2018b: p. 145; Sajan et al., 2019b: p. 809; Tripathy, Sajan & Sidhu, 2019: p. 110; Mukhopadhyay et al., 2020: pp. 356, 360–361, pl. 15, fig. B.

Type locality. "Calcutta (Kolkata, India)".

Material examined. Reg. No. NZSI M.30053/7, 22.vii.2017, 1 spm., CKBS, leg. T. Biswas & S. Das; Reg. No. NZSI M.33311/9, 22.vii.2017, 7 spms., CKBS, leg. S.K. Sajan; Reg. No. NZSI M.33312/9, 2.ix.2017, 2 spms., CKBS, leg. S.K. Sajan.

Distribution. India (except the drier part of the northwestern region), North America, Europe, Africa, and southern Asia.

Remarks. Commonest species of the genus widely and abundantly occurring throughout the country including the Andaman Islands, except the dry part of the north-west. Also, considered a pest on horticultural and agricultural crops.

Superfamily **Pupilloidea** W.Turton, 1831

Family **Cerastidae** Wenz, 1923

Genus **Rhachistia** Connolly, 1925

Rhachistia Connolly, 1925: p. 163.

Type species. *Buliminus (Rhachis) rhodotaenia* E. von Martens, 1869 [accepted as *Rhachistia rhodotaenia* (E. von Martens, 1869)], type by original designation.

Distribution. Eastern Africa, southern and southeastern Asia, and east of Australia.

***Rhachistia bengalensis* (Lamarck, 1822)**

(Image 1D, 3B)

Bulimus bengalensis Lamarck, 1822: p. 124; Hanley & Theobald 1874: pl. 80, fig. 7.

Rachisellus bengalensis — Gude 1914: p. 274.

Rhachis bengalensis — Mitra & Dey 1992: p. 39; Mookherjee et al., 2000: p. 243; Ramakrishna & Mitra, 2002: p. 47; Mitra, Dey & Ramakrishna, 2004: p. 139, fig. C30; Patil & Talmale, 2005: p. 1913; Patil & Talmale, 2011: p. 24; Patil & Talmale, 2012: pp. 277–278.

Rachis bengalensis — Mavinkurve et al., 2004: p. 1685.

Rhachistia bengalensis — Raheem et al., 2014: pp. 69–70, fig. 39B.

Type locality. "Bengal".

Material examined. Reg. No. NZSI M.30054/7, 22.vii.2017, 4 spms., CKBS, leg. T. Biswas & S. Das; Reg. No. NZSI M.30056/10, 2.ix.2017, 1 spm., CKBS; Reg. No. NZSI M.30057/10, 24.ix.2017, 2 spms., CKBS, leg. S.K. Sajan.



Image 1. Terrestrial gastropods: A—*Ariophanta interrupta* (Benson, 1834) | B—*Macrochlamys petrosa* (Hutton, 1834) | C—*Macrochlamys indica* Godwin-Austen, 1883 | D—*Rhachistia bengalensis* (Lamarck, 1822) | E—*Kaliella barrakporensis* (Pfeiffer, 1852) | F—*Lissachatina fulica* (Bowdich, 1822) | G—*Allopeas gracile* (Hutton, 1834) | H—*Laevicaulis alte* (Férussac, 1822) [No Scale] | I—*Indosuccinea semiserica* (Gould, 1846) | J—*Cryptaustenia bensonii* (Pfeiffer, 1848) (Scale: 10mm; Images E,G, 2mm). © S.K. Sajan.

Distribution. India (Maharashtra, Tamil Nadu, Tripura, and West Bengal) and Bangladesh.

Remarks. Only three individuals recorded during survey.

Superfamily **Trochomorphoidea** Möllendorff, 1890

Family **Chronidae** Thiele, 1931

Genus **Kaliella** W.T.Blanford, 1863

Nanina (*Kaliella*) W.T. Blanford, 1863: p. 83.

Type species. *Helix barrakporensis* Pfeiffer, 1853 [accepted as *Kaliella barrakporensis* (Pfeiffer, 1852 [1853])], type by subsequent designation.

Distribution. Europe, Africa, southern and southeastern Asia, and Australia.

***Kaliella barrakporensis* (L.Pfeiffer, 1852 [1853])**

(Image 1E, 3G)

Helix barrakporensis Pfeiffer, 1852: p. 156; Pfeiffer, 1883: p.59.

Nanina (*Kaliella*) *barrakporensis* — Blanford, 1863: p. 83.

Kaliella barrakporensis — Godwin-Austen, 1852: p. 2, 19, pl. 1, figs 1–4; pl. 2, fig. 1; pl. 5, fig 2; Blanford & Godwin-Austen, 1908: p. 258; Dey, Barua & Mitra, 1985: p. 267; Mitra & Dey, 1992: p. 47; Surya Rao et al., 2004: p. 95, pl. 9, fig. 5; Dey, Barua & Mitra, 2003: p. 139; Mavinkurve et al., 2004: p. 1685; Mitra, Dey & Ramakrishna, 2004 (2005): p. 211, fig. 174, text-fig. 49; Patil & Talmale, 2005: p. 1913; Mitra, Dey & Ramakrishna, 2005: p. 236; Surya Rao, Mitra & Dey, 2007: p. 118; Patil & Talmale, 2011: pp. 26–27; Patil & Talmale, 2012: p. 283; Raheem et al., 2014: p. 77, figs 45B–C; Budha et al., 2015: p. 19; Phung et al., 2017: p. 86, fig. 18F; Sajan et al., 2018b: p. 145, pl. 1, fig. F; Tripathy, Sajan & Mukhopadhyay, 2018: p. 791.

Type locality. “ad Barrakpore, Indiæ (Bacon) (Barrackpore, West Bengal)”.

Material examined. Reg. No. NZSI M.30173/7, 22.vii.2017, 7 spms., CKBS, leg. T. Biswas & S.K Sajan; Reg. No. NZSI M.33315/9, 2.ix.2017, 1 spm., CKBS; Reg. No. NZSI M34468/10, 24.ix.2017, 1 spm., CKBS, leg. S.K. Sajan.

Distribution. India (wide distribution range), Bangladesh, Myanmar, Pakistan, Sri Lanka, Nepal, Borneo; Europe, and Africa.

Remarks. One of the most widely occurring land snails in Asia and Africa.

Superfamily **Achatinoidea** Swainson, 1840

Family **Achatinidae** Swainson, 1840

Subfamily **Achatininae** Swainson, 1840

Tribe **Achatinini** Swainson, 1840

Genus **Lissachatina** Bequaert, 1950

Achatina (*Lissachatina*) Bequaert, 1950: p. 49.

Type species. *Achatina fulica* Bowdich, 1822 (accepted as *Lissachatina fulica* (Bowdich, 1822)), type by original designation.

Distribution. Worldwide distribution.

***Lissachatina fulica* (Bowdich, 1822)**

(Image 1F, 3H)

Achatina fulica Bowdich, 1822: pl.13, fig. 3.

Helix (Cochlitoma) fulica — Féruccac, 1821: pp. 1–24.

(nomen nudum)

Achatina fulica — Nevill, 1878: p. 145; Gude 1914: p. 340; Phung et al., 2017: p. 71, fig. 10.

Achatina (Lissaehatina) fulica fulica —Subba Rao, Thakur & Mitra, 1989: p. 26, figs 3A–B; Mavinkurve et al., 2004: p. 1685; Patil & Talmale, 2011: p. 26; Patil & Talmale, 2012: pp. 280–281.

Achatina fulica fulica — Subba Rao et al., 1995: p. 65, pl. 13, figs 7–8; Dey, Barua & Mitra, 2003: p. 136.

Achatina (Lissachatina) fulica fulica —Mookherjee et al., 2000: p. 346.

Lisachatina fulica — Raheem et al., 2014: p. 115, figs 72C; Budha et al., 2015: p. 15; Sajan et al., 2018a: pp. 100–102; Inkhatilay et al., 2019: p. 49, fig. 20A.

Type locality. Unknown ('Mauritius', see Raheem et al., 2014: 115).

Material examined. Reg. No. NZSI M.30048/7, 22.vii.2017, 1 spm., CKBS, leg. T. Biswas & Party; Reg. No. NZSI M.34469/10, 2.ix.2017, 2 spms., CKBS, leg. S.K. Sajan.

Distribution. India (Common throughout including the Andaman & Nicobar Islands) wide distribution range in Asia, Africa, North and South America, and Europe.

Remarks. One of the 100 worst invasive alien species of the world. Recently reported from Sagar Island (Sajan et al. 2018a). Pest on horticultural and agricultural crops.

Subfamily **Subulininae** P.Fischer & Crosse, 1877

Genus **Allopeas** H.B.Baker, 1935

Lamellaxis (*Allopeas*) Baker, 1935: p. 84.

Type species. *Bulimus gracilis* Hutton, 1834 [accepted as *Allopeas gracile* (Hutton, 1834)], type by original designation.

Distribution. Worldwide in distribution, except the Antarctica.

***Allopeas gracile* (Hutton, 1834)**

(Image 1G, 3I)

Bulimus (mithi) gracilis Hutton, 1834: p. 84, 93.

Opeas gracile — Gude, 1914: p. 355; Subba Rao & Mitra, 1979: p. 12; Patil & Talmale, 2005: p. 1913; Ramakrishna et al., Alfred, 2006: p. 44.

Lamellaxis gracile — Subba Rao, Thakur & Mitra 1989: p. 260, pl. 2C; Mitra & Dey, 1992: p. 43; Subba Rao et al., 1995: p. 65, pl. 13, figs 3–4; Patil & Ramakrishna, 2004: p. 156; Patil, 2008a: p. 69.

Lamellaxis (Allopeas) gracile — Ramakrishna, Mitra & Dey, 2010: p. 180; Patil & Talmale, 2011: p. 25.

Opeas gracilis (sic!) — Mavinkurve et al., 2004: p. 1685.

Allopeas gracile — Khanna & Sati, 2003: p. 6; Rowson et al., 2010: pp. 24–25; Budha et al., 2015: p. 15; Phung et al., 2017: pp. 91, 93, fig. 20B; Mukhopadhyay et al., 2020: pp. 356, 361.

Material examined. Reg. No. NZSI M.34460/10, 02.ix.2017, 2 spms., CKBS; Reg. No. NZSI M.34461/10, 15.x.2017, 13 spms., CKBS, leg. S.K. Sajan.

Distribution. India (Common throughout), widely distributed throughout southeastern Asia

Remarks. This invasive alien species occurs very close to human habitations, on damp walls, potted plants, and gardens. The empty shell were collected from the soil. Pest on horticultural crops.

Superfamily **Veronicelloidea** Gray, 1840

Family **Veronicellidae** Gray, 1840

Genus **Laevicaulis** Simroth, 1913

Vaginula (Laevicaulis) Simroth, 1913: p. 147.

Type species. *Vaginula comorensis* P. Fischer, 1883 (accepted as *Laevicaulis alte* (Férussac, 1822)), type by subsequent designation.

Distribution. Widely distributed in eastern & central Africa, southern & southeastern Asia, Australasia & Oceania, and North & South America.

***Laevicaulis alte* (Férussac, 1822)**

(Image 1H, 3J)

Vaginulus alte Férussac, 1821: p. 14; Gude, 1914: p. 482, fig. 153; Ray, 1961: p. 275.

Laevicaulis alte — Subba Rao & Mitra, 1979: p. 10; Patil & Talmale, 2005: p. 1913; Ramakrishna, Dey & Mitra, 2010: p. 114; Patil & Talmale, 2011: p. 22; Raheem et al., 2014: p. 55, fig. 31D; Budha et al., 2015: p. 9.

Type locality. “Pondichéry (Puducherry. India)”

Material examined. Reg. No. NZSI M.30173/7, 02.ix.2017, 3 spms., CKBS, leg. T. Biswas & S.K. Sajan.

Distribution. India (Andhra Pradesh, Bihar, Delhi, Gujarat, Maharashtra, Meghalaya, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Karnataka, and Kerala) and throughout the tropical parts

of the World.

Remarks. Most common invasive species of slug on the Indian plains; voracious feeder on live and decaying vegetation. Pest on horticultural and agricultural crops.

Superfamily **Succineoidea** Beck, 1837

Family **Succineidae** Beck, 1837

Subfamily **Catinellinae** Odhner, 1950

Genus **Indosuccinea** Rao, 1924

Indosuccinea Rao, 1924: p. 375.

Type species. *Succinea semiserica* Gould, 1846 (accepted as *Indosuccinea semiserica* (Gould, 1846)), type by original designation.

Distribution. India, Myanmar, probably in Indo-China, and the Malay Peninsula (Rao 1924).

***Indosuccinea semiserica* (Gould, 1846)**

(Image 1I, 3F)

Succinea semiserica Gould, 1846: p. 100; Hanley & Theobald, 1876: p. 29, pl. 67, figs 2, 3; Gude, 1914: p. 452; Amin-ud-din, 1921: pp. 592–600, figs 21 (3a, 3b), 26, 27.

Succinea baconi — Nevill, 1878: p. 214.

Indosuccinea semiserica — Rao, 1924: p. 374; Ramakrishna, Mitra & Dey, 2010: p. 217; Patil & Talmale, 2012: p. 282.

Type locality. “Tavoy, in hortis”.

Material examined. Reg. No. NZSI M.30174/7, 02.ix.2017, 7 spms., CKBS; Reg. No. NZSI M.34451/10, 15.x.2017, 3 spms., CKBS, leg. S.K. Sajan.

Distribution. India (Maharashtra, Manipur and West Bengal), Bangladesh, and Myanmar.

Remarks. This species is commonly found in forest floors.

Superfamily **Gudeoconchidae** Iredale, 1944

Family **Helicaronidae** Bourguignat, 1877

Subfamily **Durgellinae** Godwin-Austen, 1888

Tribe **Durgellini** Godwin-Austen, 1888

Genus **Cryptaustenia** Cockerell, 1891

Cryptaustenia Cockerell, 1891: p. 99.

Type species. *Vitrina planospira* Benson, 1859 (accepted as *Cryptaustenia succina* (Reeve, 1862)), type by monotypy.

Distribution. Southern and southeastern Asia.

***Cryptaustenia bennoni* (Pfeiffer, 1848)**

(Image 1J, 3E)

Vitrina bennoni Pfeiffer, 1848: p. 107.

Austenia bennoni — Godwin-Austen, 1883: p. 150, pl. 36, figs 6–7.

Succinea bensoni — Patil & Talmale, 2005: p. 1913.
Cryptaustenia bensoni — Blanford & Godwin-Austen, 1908: p. 187; Ramakrishna, Mitra & Dey, 2010: p. 257.

Type locality. “In the Botanical Garden of Calcutta”.

Material examined. Reg. No. NZSI M.30236/8, 2.ix.2017, 09 spms., CKBS, leg. S.K. Sajan.

Distribution. India (Andhra Pradesh, Odisha (Eastern Ghats), and West Bengal) and Myanmar.

Remarks. This species is found on trunk, bark and on leaves; few shells collected from the forest floor.

Superfamily **Ampullarioidea** Gray, 1824

Family **Ampullariidae** Gray, 1824

Subfamily **Ampullariinae** Gray, 1824

Genus **Pila** Röding, 1798

Pila Röding, 1798: p. 145.

Type species. *Helix ampullacea* Linnaeus, 1758 (accepted as *Pila ampullacea* (Linnaeus, 1758)), type by subsequent designation.

Distribution. Asia and Africa.

***Pila globosa* (Swainson, 1822)**

(Image 2A)

Ampullaria globosa Swainson, 1822: pl. 119.

Ampullaria globosa var. *minor* — Nevill, 1877: p. 4.

Ampullaria globosa var. *incrassatula* — Nevill, 1877: p. 4.

Pila globosa — Preston, 1915: p. 97; Prashad, 1917: pp. 231–232, text fig. 1; Sewell, 1934: p. 56; Subba Rao, 1989: p. 58, figs 80–82; Patil & Ramakrishna, 2004: p. 146; Patil & Talmale, 2005: p. 1913; Patil, 2005: p. 440; Patil, Ramakrishna & Mitra, 2006: pp. 165–166; Ramakrishna et. Alfred, 2006: p. 43; Patil, 2006: p. 12; Ramakrishna & Dey, 2007: p. 98; Nasemann et al., 2007: p. 75, pl. 19, fig. 6, pl. 20, fig. 4; Patil, 2008b: p. 358; Raghunathan & Punithavelu, 2009: p. 149; Patil & Talmale, 2011: p. 6; Patil & Talmale, 2012: p. 257; Punithavelu & Raghunathan, 2013: p. 23; Cowie, 2015: p. 37; Basu et al., 2018: p. 12049; Tripathy, Sajan & Chandra, 2019: p. 14; Mukhopadhyay et al., 2020: pp. 355, 357, pl. 15, fig. H.

Type locality. “Rivers of India”.

Material examined. Reg. No. NZSI M.20234/8, 22.vii.2017, 8 spms., CKBS; Reg. No. NZSI M.30180/7, 22.vii.2017, 8 spms., CKBS, leg. T. Biswas & Party; Reg. No. NZSI M.34452/10, 15.ix.2017, 1 spm., CKBS, leg. S.K. Sajan.

Distribution. India (Assam, Bihar, Odisha, Himachal Pradesh, Jharkhand, Maharashtra, Madhya Pradesh, Meghalaya, Rajasthan, Uttar Pradesh, and West Bengal).

Remarks. One of the most common freshwater snail of India. Tripathy et al. (2020: p. 11, figs 8, 14) treated

Ampullaria globosa var. *minor* as a junior synonym of *P. globosa*.

Superfamily **Cerithioidea** J. Fleming, 1822

Family **Thiaridae** Gill, 1871 (1823)

Subfamily **Thiarinae** Gill, 1871 (1823)

Genus **Melanoides** Olivier, 1804

Melanoides Olivier, 1804: p. 40.

Type species. *Melanoides fasciolata* Olivier, 1804 [accepted as *Nerita tuberculata* O.F. Müller, 1774]

Distribution. Africa, Central Asia, South and Southeast Asia, Malay-Archipelago, Philippines and various Pacific Islands.

***Melanoides tuberculata* (Müller, 1774)**

(Image 2B)

Nerita tuberculata Müller, 1774: pp. 191–192.

Melania pyramis — Benson, 1836: p. 354.

Tiara (Striatella) tuberculata — Preston, 1915: pp. 15–16.

Melanoides (Melanoides) peddamunigalensis — Ray & Ray Chowdhuri, 1969: p. 48, figs 12–17.

Melanoides (Melanoides) tuberculata — Starmuehlner, 1976: p. 591; Subba Rao, 1989: pp. 103–104, figs 183–184.

Thiara (Melanoides) tuberculate (sic!) — Agrawal, 1995: p. 34.

Thiara (Melanoides) tuberculatus (sic!) — Patil & Talmale, 2005: p. 1913; Ramakrishna et. Alfred, 2006: p. 44.

Thiara (Melanoides) tuberculata — Surya Rao, Mitra & Manna, 2004: pp. 41–42; Patil & Ramakrishna, 2004: pp. 147–148; Patil, 2005: pp. 441–442; Patil, Ramakrishna & Mitra, 2006: pp. 167–168; Patil, 2006: p. 14; Punithavelu & Raghunathan, 2007: p. 87; Patil, 2008a: p. 65; Raghunathan & Punithavelu, 2009: p. 149; Punithavelu & Raghunathan, 2013: p. 26.

Thiara tuberculata — Ramakrishna, Siddiqui & Sahu, 2006: p. 28.

Melanoides tuberculata — Ramakrishna & Dey, 2007: p. 161; Nasemann et al., 2007: pp. 70–71, pl. 18, figs 4, 5, pl. 20, fig. 5; Patil, 2008b: p. 358; Patil, 2008c: p. 118; Patil, 2009: p. 279; Patil & Talmale, 2011: pp. 8–9; Patil & Talmale, 2012: p. 261; Surya Rao, Venkitesan & Rao, 2013: p. 86; Biswas et al., 2015: p. 20; Tripathy, Sajan & Mukhopadhyay, 2018: p. 794; Basu et al., 2018: p. 12049; Tripathy, Sajan & Chandra, 2019: p. 14; Mukhopadhyay et al., 2020: pp. 355, 357.

Type locality. “In littore Curomandel (On the shore Curomandel) [Coromandel Coast, Tamil Nadu, India]”.

Material examined. Reg. No. NZSI M.30045/7, 22.vii.2017, 3 spms., India, West Bengal, South 24



Image 2. Shell of freshwater gastropods and bivalves: A—*Pila globosa* (Swainson, 1822) | B—*Melanoides tuberculata* (O. F. Müller, 1774) | C—*Mieniplotia scabra* (Müller, 1774) | D—*Tarebia granifera* (Lamarck, 1816) | E—*Brotia costula* (Rafinesque, 1833) | F—*Filopaludina bengalensis* (Lamarck, 1822) | G—*Idiopoma dissimilis* (Müller, 1774) | H—*Indoplanorbis exustus* (Deshayes, 1834) | I—*Gyraulus convexiusculus* (Hutton, 1849) | J—*Radix rufescens* (Gray, 1822) | K—*Lamellidens marginalis* (Lamarck, 1819) | L—*Parreysia favidens* (Benson, 1862) (Scale: 10mm; Fig. I, 1mm). © S.K. Sajan.

Parganas District, Chintamoni Kar Bird Sanctuary, leg. T. Biswas and Party; Reg. No. NZSI M.34462/10, 2.ix.2017, 5 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary, leg. S.K. Sajan.

Distribution. India: Widely distributed throughout India except Kashmir; Elsewhere: North and South Africa, eastern Mediterranean, southern China, Malay Archipelago, North Australia, Pacific Island.

Remarks. This species has a global distribution.

Genus *Mieniplotia* Low & Tan, 2014

Mieniplotia Low & Tan, 2014: pp. 15–17.

Type species. *Buccinum scabrum* Müller, 1774 [accepted as *Mieniplotia scabra* (Müller, 1774)], type by original designation.

Distribution. South and Southeast Asia, east coast of South Africa to Fiji.

Mieniplotia scabra (Müller, 1774)

(Image 2C)

Buccinum scabrum Müller 1774: p. 136.

Tiara (Plotia) scabra — Preston, 1915: p. 35–36.

Thiara (Thiara) scabra — Pace, 1973: p. 52; Subba Rao, 1989: p. 96; Patil & Ramakrishna, 2004: pp. 146–147; Patil & Talmale, 2005: p. 1913; Patil, 2005: p. 441; Patil, Ramakrishna & Mitra, 2006: p. 167; Patil, 2006: p. 13; Ramakrishna & Dey, 2007: p. 153; Nasemann et al., 2007: pp. 69–70, pl. 17, fig. 8; Punithavelu & Raghunathan, 2007: p. 87, pl. 4, fig. 3; Patil, 2008a: p. 65; Raghunathan & Punithavelu, 2009: p. 149; Patil & Talmale, 2011: p. 8; Patil & Talmale, 2012: p. 260; Punithavelu & Raghunathan, 2013: p. 25.

Thiara scabra — Brandt, 1974: p. 163; Neubert, 1998: pp. 350–351.; Surya Rao, Venkitesan & Rao, 2013: p. 85.

Mieniplotia scabra — Low & Tan, 2014: pp. 15–17.

Type locality. “In paludofis littoris Coromandel Tranquebari Danorum maxime vulgare”.

Material examined. Reg. No. NZSI M.30051/7, 22.vii.2017, 3 spms. (1 spm., Juvenile), India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary, leg. T. Biswas and S. Das.

Distribution. India: West Bengal, Bihar, Jharkand, Kerala, Madhya Pradesh, Maharashtra, Pondicherry, Sikkim, Tamil Nadu, Uttaranchal, Uttar Pradesh; Elsewhere: South East Asia

Remarks. This species is inhabited to coastal rivers, brackish water and stagnant water.

Genus *Tarebia* H. Adams & A. Adams, 1854

Tarebia H. Adams & A. Adams, 1854: p. 304.

Type species. *Melania granifera* Lamarck, 1816

[accepted as *Tarebia granifera* (Lamarck, 1816)], type by subsequent designation.

Distribution. South and Southeast Asia, South China and part of the Asia Pacific Islands.

Tarebia granifera (Lamarck, 1816)

(Image 2D)

Melania granifera Lamarck, 1816: pl. 458, figs 4a–b; Lamarck, 1822: p. 167.

Melania celebensis — Quoy & Gaimard, 1834: p. 152, pl. 56, figs 26–29.

Thiara (Tarebia) granifera — Pace, 1973: p. 62, pl. 12, fig. 3, pl. 13, fig. 4.

Tarebia granifera — Starmuehlner, 1976: p. 569, figs 72–75, pl. 16, figs 175–179; Ramakrishna & Dey, 2007: p. 168, figs. 113A–B; Patil & Talmale, 2011: p. 9; Patil & Talmale, 2011: pp. 8–9; Patil & Talmale, 2012: p. 261; Surya Rao, Venkitesan & Rao, 2013: pp. 86–87; Tripathy, Sajan & Chandra, 2019: p. 14; Tripathy, Sajan & Sidhu, 2019: p. 108.

Thiara (Tarebia) granifera — Subba Rao, 1989: p. 110, figs 212–213; Raghunathan & Punithavelu, 2009: p. 149.

Type locality. “Unknown”.

Material examined. Reg. No. NZSI M.30046/7, 22.vii.2017, 7 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary, leg. T. Biswas & S. Das.

Distribution. India: West Bengal, Madhya Pradesh, Bihar; Elsewhere: South Africa, Madagascar, Malaysia, Philippines, Formosa and Pacific Islands.

Remarks. This species has been introduced into U.S.

Family *Pachychilidae* Fischer & Crosse, 1892

Genus *Brotia* H. Adams, 1866

Brotia H. Adams 1866: p. 150.

Type species. *Melania pagodula* Gould, 1847 [accepted as *Brotia pagodula* (Gould, 1847)], by Monotype.

Distribution. Indian subcontinent, Indo-China, Malaysia, Malay-Archipelago and Philippines.

Brotia costula (Rafinesque, 1833)

(Image 2E)

Melania costula Rafinesque, 1833: p. 166.

Brotia costula costula — Brandt, 1974: p. 181, pl. 13 figs 37–38; Nesemann et al., 2007: pp. 72, pl. 18 fig. 1.

Brotia (Antimelania) costula — Subba Rao, 1989: p. 108; Hatter et al., 2004: p. 4; Punithavelu & Raghunathan, 2007: p. 87; Punithavelu & Raghunathan, 2013: p. 26.

Brotia costula —Bentheim Jutting, 1956: p. 374, fig.

76; Köhler & Glaubrecht, 2001: p. 284, fig. D, p. 295, 297, fig. 10A–H; Köhler & Glaubrecht, 2006: pp. 159–251; Budha, 2016: p. 41, fig.; Basu et al., 2018: p. 12049.

Type locality. “Gomti River [Gomti river, Jabalpur, Madhya Pradesh, India].”

Material examined. Reg. No. NZSI M.30047/7, 22.vii.2017, 5 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary, leg. T. Biswas & S. Das.

Distribution. India: West Bengal, Assam, Arunachal Pradesh, Bihar, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Uttar Pradesh. Elsewhere: Bangladesh, Nepal, Thailand, Myanmar, Lao, Cambodia, Vietnam and Malaysia.

Remarks. Mainly found in fast flowing water in streams and river, also recorded from ponds. In CKBS, the dead shell have been collected from small pond.

Superfamily **Viviparoidea** Gray, 1847

Family **Viviparidae** Gray, 1847

Subfamily **Bellamyinae** Rohrbach, 1937

Genus **Filopaludina** Habe, 1964

Filopaludina Habe, 1964: p. 48.

Type species. *Paludina bengalensis* Lamarck, 1822 [accepted as *Filopaludina bengalensis* (Lamarck, 1822)], type by original designation.

Distribution. South and Southeast Asia.

***Filopaludina bengalensis* (Lamarck, 1822)**

(Image 2F)

Paludina bengalensis Lamarck 1822: p 174.

Vivipara bengalensis — Preston, 1915: p. 83; Annandale, 1920: p. 113; Annandale, 1921: p. 267; Ramakrishna et. Alfred, 2006: p. 44.

Vivipara bengalensis race *bengaiensis* — Annandale & Sewell, 1921: p. 270, pl. 1, figs 1–3.

Bellamya (Filopaludina) bengalensis — Brandt, 1974: p. 20; Nasemann et al., 2007: pp. 73–74, pl. 19, figs 2–3, pl. 20, fig. 1.

Bellamya bengalensis form. *typica* — Subba Rao, 1898: p. 45; Patil & Ramakrishna, 2004: pp. 143–144; Patil, 2005: pp. 439–440; Patil, Ramakrishna & Mitra, 2006: p. 164; Patil, 2006: p. 11; Patil, 2008a: p. 64; Patil, 2008c: p. 116; Patil, 2009: p. 277; Patil & Talmale, 2011: p. 1, 5; Patil & Talmale, 2012: pp. 249, 255; Surya Rao, Venkitesan & Rao, 2013: p. 79.

Bellamya bengalensis form *bengalensis* — Patil & Talmale, 2005: p. 1913.

Bellamya bengalensis — Punithavelu & Raghunathan, 2007: p. 86, pl. 4, fig. 1; Patil, 2008b: p. 357; Raghunathan & Punithavelu, 2009: p. 149; Punithavelu & Raghunathan,

2013: pp. 22–23; Basu et al., 2018: p. 12049.

Filopaludina bengalensis — Mukhopadhyay, Tripathy & Ghosh, 2017: p. 503; Tripathy, Sajan & Chandra 2019: p. 14; Tripathy, Sajan & Sidhu, 2019: p. 108, fig. I; Mukhopadhyay et al., 2020: pp. 355–356, pl. 15, fig. F.

Type locality. “dans les rivières du Bengale”.

Material examined. Reg. No. NZSI M.30049/7, 22.vii.2017, 5 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary, leg. T. Biswas and S. Das; Reg. No. NZSI M.34459/10, 2.ix.2017, 24 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary; Reg. No. NZSI M.34453/10, 9.x.2017, 10 spms., Chintamoni Kar Bird Sanctuary, leg. S.K. Sajan.

Distribution. India: distributed throughout the India.

Remarks. One of the commonest species of South East and South Asia.

Genus **Idiopoma** Pilsbry, 1901

Idiopoma Pilsbry, 1901: p. 189.

Type species. *Vivipara hendazensis* Pilsbry, 1901 [accepted as *Idiopoma dissimilis* (O. F. Müller, 1774)], type by original designation.

Distribution. South and Southeast Asia, North America.

***Idiopoma dissimilis* (Müller, 1774)**

(Image 2G)

Nerita dissimilis Müller, 1774: p. 184.

Bellamya dissimilis — Subba Rao, 1989: p. 48. figs 64–67; Surya Rao, Mitra & Manna, 2004: p. 40; Patil & Ramakrishna, 2004: p. 145; Patil & Talmale, 2005: p. 1913; Patil, Ramakrishna & Mitra, 2006: p. 165; Ramakrishna, Siddiqui & Sahu, 2006: p. 28; Ramakrishna, Mitra & Aravind, 2006: pp. 9–10; Ramakrishna & Dey, 2007: pp. 90–91, taxt-figs 50A-B; Punithavelu & Raghunathan, 2007: p. 86, pl. 4, fig. 2; Patil, 2008a: p. 64; Patil, 2008b: p. 357; Patil, 2008c: pp. 116–117; Patil, 2009: p. 278; Raghunathan & Punithavelu, 2009: p. 149; Patil & Talmale, 2011: p. 6; Punithavelu & Raghunathan, 2013: p. 23; Surya Rao, Venkitesan & Rao, 2013: p. 82; Basu et al., 2018: p. 12049.

Idiopoma dissimilis — Brandt, 1974: pp. 36–37; Nasemann et al., 2007: p. 74, pl. 19, figs 4, 5, pl. 20, fig. 3; Tripathy, Sajan & Chandra, 2019: p. 14; Mukhopadhyay et al., 2020: pp. 355, 357.

Type locality. “In Museo Spengleriano”.

Material examined. Reg. No. NZSI M.30050/7, 22.vii.2017, 11 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary, leg. T. Biswas and S. Das; Reg. No. NZSI M.34465/10,

2.ix.2017, 8 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary; Reg. No. NZSI M.34464/10, 9.ix.2017, 5 spms., Chintamoni Kar Bird Sanctuary, leg. S.K. Sajan.

Distribution. India: Common throughout India; Elsewhere: Bangladesh, Malaysia, Myanmar, Pakistan, Sri Lanka.

Remarks. It is also known as *Bellamya dissimilis*; species has a wide distribution in India.

Superfamily **Lymnaeoidea** Rafinesque, 1815

Family **Bulinidae** P. Fischer & Crosse, 1880

Subfamily **Bulininae** P. Fischer & Crosse, 1880

Genus **Indoplanorbis** Annandale & Prashad, 1921

Indoplanorbis Annandale & Prashad, 1920: p. 578.

Type species. *Planorbis exustus* Deshayes, 1834
[accepted as *Indoplanorbis exustus* (Deshayes, 1833)]

Distribution. Africa, Central Asia, South and Southeast Asia

***Indoplanorbis exustus* (Deshayes, 1833)**

(Image 2H)

Planorbis exustus Deshayes (in Belanger), 1833: pp. 417–418, pl. 1, figs 11–13; Preston, 1915: pp. 115–116.

Planorbis (*Planorbis*) *exustus* — Germain, 1921: pp. 26–41, figs 1–16, pl. 1, figs 4–9, pl. 4, figs 11, 17, 18.

Indoplanorbis exustus — Annandale, 1922: p. 160; Bentham Jutting, 1956: p. 471; Brandt, 1974: pp. 234–235, pl. 16, fig. 99; Subba Rao, 1989: p. 142, figs 326–327; Agrawal, 1995: p. 36; Neubert, 1998: p. 359; Surya Rao, Mitra & Manna, 2004: p. 42; Hatter et al., 2004: p. 5; Patil & Ramakrishna, 2004: p. 150; Patil & Talmale, 2005: p. 1913; Patil, 2005: p. 444; Patil, Ramakrishna & Mitra, 2006: pp. 169–170; Ramakrishna et. Alfred, 2006: p. 44; Ramakrishna, Siddiqui & Sahu, 2006: p. 29; Ramakrishna, Mitra & Aravind, 2006: pp. 10–11; Punithavelu & Raghunathan, 2007: p. 88; Nasemann et al., 2007 : p. 90, pl. 23, figs 1a–c; Ramakrishna & Dey, 2007 : p. 253–254, text figs 109A & 109B; Patil, 2008a: p. 66; Patil, 2008b: p. 359; Patil, 2008c: p. 119; Patil, 2009: p. 280; Raghunathan & Punithavelu, 2009: p. 150; Patil & Talmale, 2011: pp. 15–17; Patil & Talmale, 2012: p. 267; Punithavelu & Raghunathan, 2013: p. 30; Surya Rao, Venkitesan & Rao, 2013: p. 90; Basu et al., 2018: p. 12049; Tripathy, Sajan & Chandra, 2019: p. 14; Mukhopadhyay et al., 2020: pp. 356, 359, pl. 15, fig. D.

Type locality. “côte du Malabar [Malabar Coast, India]”.

Material examined. Reg. No. NZSI M.34449/10, 2.ix.2017, 6 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary; Reg. No. NZSI M.34467/10, 9.ix.2017, 4 spms., Chintamoni Kar Bird Sanctuary, leg. S.K. Sajan.

M.34450/10, 2.ix.2017, 5 spms., Chintamoni Kar Bird Sanctuary, leg. S.K. Sajan.

Distribution. India: Widely distributed throughout country; Elsewhere: South and South East Asia.

Remarks. Monotypic genus, found in southern Asia, south east Arabia and Socotra Island. Common in ponds, ditches and canals with or without vegetations.

Family **Planorbidae** Rafinesque, 1815

Subfamily **Planorbinae** Rafinesque, 1815

Genus **Gyraulus** Charpentier, 1837

Gyraulus Charpentier, 1837: p. 21.

Type species. *Planorbis hispidus* Draparnaud, 1805 (= *Planorbis albus* O.F. Müller, 1774). [accepted as *Gyraulus albus* (O. F. Müller, 1774)], type by subsequent designation.

Distribution. Cosmopolitan distribution in all possible range countries.

***Gyraulus convexiusculus* (Hutton, 1849)**

(Image 2I)

Planorbis convexiusculus Hutton, 1849: p. 657.

Planorbis saigonensis — Crosse & Fischer 1863: p. 362, pl. 13, fig. 7.

Planorbis (*Gyraulus*) *convexiusculus* — Preston, 1915: pp. 118–119; Germain, 1921: pp. 118–119.

Planorbis (*Gyraulus*) *nanus* — Germain, 1921: pp. 131–132, pl. 2, figs 10–12.

Gyraulus convexiusculus — Annandale & Prashad, 1919: pp. 52–54; Bentham Jutting, 1956: p. 463; Brandt, 1974: pp. 239–240, pl. 17, fig. 3; Subba Rao, 1989 : pp. 154–155, figs 362–364; Neubert, 1998: p. 357; Patil & Ramakrishna, 2004: p. 151; Patil & Talmale, 2005: p. 1913; Patil, 2005: p. 444; Patil, Ramakrishna & Mitra, 2006: p. 170; Patil, 2006: p. 15; Ramakrishna & Dey, 2007: p. 234, figs 172A & 172A; Nasemann et al., 2007: p. 91, pl. 23, figs 2a–c; Patil, 2008a: p. 67; Patil, 2008c: p. 119; Patil, 2009: p. 280; Raghunathan & Punithavelu, 2009: p. 150; Patil & Talmale, 2011: p. 14; Patil & Talmale, 2012: p. 266; Glöer & Pešić, 2012: p. 50, fig. 20a; Punithavelu & Raghunathan, 2013: p. 31; Surya Rao, Venkitesan & Rao, 2013: p. 89; Basu et al., 2018: p. 12049; Tripathy, Sajan & Chandra, 2019: p. 14; Mukhopadhyay et al., 2020: pp. 356, 359, pl. 15, fig. I.

Type locality. “Afghanistan”.

Material examined. Reg. No. NZSI M.34466/10, 2.ix.2017, 2 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary; Reg. No. NZSI M.34467/10, 9.ix.2017, 4 spms., Chintamoni Kar Bird Sanctuary, leg. S.K. Sajan.

Distribution. India: Common throughout India;



Image 3. Living snails: A—*Macrochlamys petrosa* (Hutton, 1834) | B—*Rhachistia bengalensis* (Lamarck, 1822) | C—*Ariophanta interrupta* (Benson, 1834) | D—*Macrochlamys indica* Godwin-Austen, 1883 | E—*Cryptaustenia bensonii* (Pfeiffer, 1848) | F—*Indosuccinea semiserica* (Gould, 1846) | G—*Kaliella barrakporensis* (Pfeiffer, 1852) | H—*Lissachatina fulica* (Bowdich, 1822) | I—*Allopeas gracile* (Hutton, 1834) | J—*Laevicaulis alte* (Férussac, 1822). © S.K. Sajan.

Elsewhere: South East Asia, South Asia, Philippines and Japan.

Remarks. Species has wide distribution in India.

Family **Lymnaeidae** Rafinesque, 1815

Subfamily **Amphipeleinae** Pini, 1877

Genus **Radix** Montfort, 1810

Radix Montfort, 1810: p. 266.

Type species. *Radix auriculatus* Montfort, 1810 [accepted as *Radix auricularia* (Linnaeus, 1758)], type by original designation.

Distribution. Asia, Europe, Africa, North America.

***Radix rufescens* (J. E. Gray in G. B. Sowerby I, 1822)**

(Image 2J)

Limnea rufescens Gray in G. B. Sowerby I, 1822: p. 44, pl. 178, fig. 1.

Limnaea acuminata Lamarck 1882: p. 160; Annandale & Rao, 1925: p. 199; Ramakrishna et. Alfred, 2006: p. 44.

Limnaea (Pseudosuccinea) acuminata form. *typica* — Patil & Ramakrishna, 2004: p. 148; Patil & Talmale, 2005: p. 1913; Patil, Ramakrishna & Mitra, 2006: p. 168; Patil, 2006: p. 14; Patil, 2008a: p. 66; Patil, 2008b: p. 358–359.

Limnaea (Pseudosuccinea) acuminata form. *typical* (sic!) — Patil & Talmale, 2012: pp. 262–263.

Limnaea (Pseudosuccinea) acuminata — Agrawal, 1995: p. 35; Punithavelu & Raghunathan, 2007: pp. 87–88; Raghunathan & Punithavelu, 2009: p. 150; Punithavelu & Raghunathan, 2013: p. 27.

Pseudosuccinea acuminata (sic!) — Basu et al., 2018: p. 12049.

Radix rufescens — Aksenova et al., 2018: p. 4; Tripathy, Sajan & Chandra, 2019: p. 14; Mukhopadhyay et al., 2020: pp. 355, 357–358, pl. 15, fig. E.

Type locality. "East Indies". (from title).

Material examined. Reg. No. NZSI M.30052/7, 22.vii.2017, 3 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary, leg. T. Biswas and S. Das; Reg. No. NZSI M.34458/10, 9.ix.2017, 9 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary; Reg. No. NZSI M.34463/10, 2.x.2017, 15 spms., Chintamoni Kar Bird Sanctuary leg. S.K. Sajan.

Distribution. India: Common throughout India; Elsewhere: South East Asia, South Asia, Philippines and Japan.

Remarks. The synonymy of *Limnaea acuminata*.

Class **Bivalvia** Linnaeus, 1758

Order **Unionoida** Stoliczka, 1871

Superfamily **Unionoidea** Rafinesque, 1820

Family **Unionidae** Rafinesque, 1820

Subfamily **Parreysiinae** Henderson, 1935

Genus **Lamellidens** Simpson, 1900

Lamellidens Simpson, 1900: p. 854.

Type species. *Unio marginalis* Lamarck, 1819 [accepted as *Lamellidens marginalis* (Lamarck, 1819)]

Distribution. South and Southeast Asia.

***Lamellidens marginalis* (Lamarck, 1819)**

(Image 2K)

Unio marginalis Lamarck, 1819: p. 79, [Encyclop. pl. 247, figs 1a–c].

Lamellidens marginalis — Simpson, 1900: p. 854; Subba Rao, 1989: p. 168, figs 404–405; Agrawal, 1995: p. 37; Patil & Ramakrishna, 2004: p. 152; Patil & Talmale, 2005: p. 1913; Patil, 2005: p. 445; Patil, Ramakrishna & Mitra, 2006: p. 171; Ramakrishna et. Alfred, 2006: p. 45; Ramakrishna & Dey, 2007: pp. 288–289, figs 211A–B; Graf & Cummings, 2007: p. 310; Nasemann et al., 2007: p. 29, pl. 8, figs 3–4; Patil, 2008a: pp. 67–68; Patil & Talmale, 2011: pp. 18–19; Patil & Talmale, 2012: pp. 268–269; Surya Rao, Venkitesan & Rao, 2013: pp. 91–92; Basu et al., 2018: p. 12049; Tripathy, Sajan & Chandra, 2019: p. 14; Mukhopadhyay et al., 2020: pp. 356, 360, pl. 15, fig. L.

Type locality. "au Bengale".

Material examined. Reg. No. NZSI M.34447/10, 2.ix.2017, 1 spm., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary, leg. S.K. Sajan.

Distribution. India: Common throughout India; Elsewhere: South and Southeast Asia.

Remarks. One of the common mussels of India.

Genus **Parreysia** Conrad, 1853

Parreysia Conrad, 1853: p. 267.

Type species. *Unio multidentatus* Philippi, 1847 [accepted as *Parreysia corrugata* (O. F. Müller, 1774)], type by monotypy.

Distribution. South and Southeast Asia.

***Parreysia favidens* (Benson, 1862)**

(Image 2L)

Unio favidens Benson, 1862: p. 188.

Unio pinax — Benson, 1862: p. 192.

Unio tripartitus — Lea, 1863: p. 190.

Unio flavidens (sic!) — Reeve, 1865(1868): pl. 26, sp. 131; errata [– read *favidens*].

Parreysia favidens (sic!) — Prashad, 1919: p. 292.

Parreysia (Parreysia) favidens — Patil, Ramakrishna & Mitra, 2006: p. 172; Ramakrishna & Dey, 2007: p. 299, figs 220A–B; Patil, 2008a: p. 68; Patil, 2008c: p. 120; Patil, 2009: p. 281; Patil & Talmale, 2012: p. 270.

Parreysia favidens favidens — Nasemann et al., 2007: pp. 31–32, pl. 9, figs 1–2.

Parreysia favidens — Simpson, 1900: p. 842; Preston, 1912: p. 299; Subba Rao, 1989: p. 180, figs 466–467, 484–485; Patil & Ramakrishna, 2004: pp. 152–153; Patil & Talmale, 2005: p. 1913; Patil, 2005: p. 446; Ramakrishna et. Alfred, 2006: p. 45; Ramakrishna & Dey, 2007: p. 299, figs 220A–B; Graf & Cummings, 2007: p. 310; Patil & Talmale, 2011: p. 20; Tripathy, Sajan & Chandra, 2019: p. 14; Mukhopadhyay et al., 2020: pp. 356, 360, pl. 15, fig. K.

Type locality. “Ganges at Bhitoura, between Cawnpore and Allahabad”.

Material examined. Reg. No. NZSI M.34448/10, 2.ix.2017, 2 spms., India, West Bengal, South 24 Parganas District, Chintamoni Kar Bird Sanctuary, leg. S.K. Sajan.

Distribution. India: Common throughout India; Elsewhere: Bangladesh, Nepal, Sri Lanka, Myanmar.

Remarks. One of the common mussels of India.

CONCLUSION

A detailed malacological sampling was carried out for the first time from any protected Area of West Bengal and molluscan diversity have been reported for the first time from the CKBS. A total of 276 specimens were collected and examined from the Chintamoni Kar Bird Sanctuary, West Bengal which reveals presence of 22 species of land and freshwater molluscs. The malacofauna apparently remains most diverse in relation to such a small PA. But invasive alien species viz. *Lissachatina fulica*, *Allopeas gracile* and *L. alte* which was recorded from this sanctuary is a matter of concern, as it may impact the local biodiversity including succession in the molluscan fauna. This investigation will provided baseline information for the further future study on molluscan diversity. Nevertheless, documentation of other such least studied invertebrate from the PA will support better biodiversity conservation for the area.

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