

Species inventory of land and freshwater Molluscs from Andhra Pradesh and Telangana states of India

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Abstract

As per the Article 7(a) of the UN Convention on Biological Diversity, Identifying components of biological diversity importance for its conservation and sustainable use is the first step for in-situ conservation of the species. On the other hand, there are more than 50% of the faunal diversity, yet to be explored and documented, particular in country like India. From the biogeographic point of view, India holds major biodiversity with atleast four hotspots, beside biodiversity rich areas. The state of Andhra Pradesh and Telangana are among them, which is least explored, in spite of the rich vegetation covers and deltoic areas and invertebrate fauna in particular have never received adequate attention from this landscape. Thus, the inventory of land and freshwater molluscs was carried out in some parts of the Andhra Pradesh and Telangana state of Deccan Peninsula India as part of the faunal inventory of Eastern Ghats by ZSI, during August to September 2016, primarily to explore the diversity and distribution of malacofauna in the region. This paper deals with a total of 25 species (13 species of land snails belonging to 2 Order 6 families and 12 of freshwater molluscs belonging to 5 order and 8 families) identified and along with the current threats evaluated and conservation measures suggested.

Keywords: Deccan Peninsula, India, Mollusca, Taxonomy, Threats

Introduction

The phylum molluscs constitute the second largest group in animal phyla in terms of animal discovery (Abbott, 1989; Bouchet 1992; Lydeard *et al.*, 2004; Bouchet *et al.*, 2005). They contribute 6% of the total species on the earth (Clark and May, 2002; Lydeard *et al.*, 2004). The state of undivided state of (Including the new state Telangana) falls under the Deccan Peninsular Biogeographical Zone-6 and part of Eastern Highlands and Central Plateau province of India (Rodgers and Panwar, 1988; Rodgers *et al.*, 2002). The Andhra Pradesh is an important area for molluscan distribution due to the tropical moist deciduous forests vegetation and moderate rainfalls. There are several land and freshwater species of mollusca viz. *Diplommatina gracilis* Beddome, 1875, *D. minima* Beddome, 1875, *Opisthostoma distortuln* Beddome, 1875, *Cyathopoma elatum* Beddome,

1875, *Opisthostoma deccanense* Beddome, 1875, *Vivipara bengalensis* f. *Annandalei* Kobelt, 1909, *Vivipara bengalensis* f. *colairensis* Annandale, 1921, *Vivipara bengalensis* f. *Eburnea* Annandale, 1921, *Melanoides virgulata* (Férrusac, 1827), *Melanoides scabra* var. *tigiris* Annandale, 1921, *Melanoides peddamunigalellsis* Ray and Roy Chowdhury, 1969, *Limnaea biacuminata* Annandale and Rao, 1925, *Nanina (Ariophanta) Kadapaensis* Nevill, 1878, *Xestina albata* Blanford, 1880, *Succinea graveleyi* (Rao, 1924), *Glessula jeyporensis* Beddome, 1906 and *G subjerdoni* Beddome, 1906 have been described from this area during late 19th century. Thereafter, other species viz. *Stagnicola tungabhadraensis* (Ray, 1967), and *Scaphula nagarjunai* Janaki Ram and Radhakrishna, 1984 were also been described from the landscape. Nevertheless, species viz. *Gabbia stenothyroides* (Dohrn, 1857), *G. travancorica* (Benson, 1860), *Pila virens* (Lamarck, 1822), *Mysorella costigera* (Küster, 1852),

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Stenolneiallia toruiosa (Bruguière, 1789), *Paludomus tanschauricus* (Gmelin, 1771), *Lamellidens consobrinus* (Lea, 1859) are known to be widely distributed throughout range of Deccan Peninsular India.

The present inventory on land and freshwater molluscs was carried out in selected areas of Andhra Pradesh and Telangana state of India, to fill the gap on biodiversity information from such geographical areas in term of malacofaunal diversity. The present study is based on a time constrained field surveys and therefore, represent only for the selected areas covered during the field work in Andhra Pradesh and Telangana states of India.

Material and Methods

Study Area

The field survey was carried out in some selected landscapes of the Andhra Pradesh and Telangana state of India during August 2016 and October 2016 (Figure 1). The covered area were Surveyed as follows:

Maradumilli Hills (MH): The Maredumilli forests (Lat. 17° 33' 9.4428" N; Long. 81° 40' 24.276" E) is situated in East Godavari district of Andhra Pradesh and the area is rich in biodiversity with having semi-evergreen forests with undulating terrain, which forms part of the Eastern Ghats.

Nallamala Hills (NH): The Nallamala hills is a group of low rugged hills with the precipitous cliffs ranges in the central parts of the Eastern Ghats (Lat. 15° 20' -16° 31' N; Long. 78° 30' -80° 10' E). From the Palnad basin in the north to the Tirupati basin in the south and form the Nallamalais forests form a series of parallel hill ranges oriented north-south towards the eastern portion of the peninsular India in Andhra Pradesh (Venkata *et al.*, 2010). The vegetation is typically of south tropical dry deciduous and Southern tropical moist deciduous forest types intermingled with scrubs (Champion and Seth, 1968).

Nagarjunasagar-Srisailem Tiger Reserve (NSTR): Nagarjunasagar-Srisailem Tiger Reserve (NSTR) is situated on the banks of River Krishna (Lat. 15°53'-16° 43' N; Long. 78°30'-79°28' E). NSTR is a massive stretch of forest located in the southern Indian State of Andhra Pradesh. The Reserve, spanning an area of 4347 km²

(with a core area of 1200 km²) was declared as a Protected Area (Wildlife Sanctuary) in 1978 and became a Project Tiger site in 1983. The NSTR spreads over five districts viz. Nalgonda, Mahaboobnagar, Kurnool, Prakasam and Guntur, in Andhra Pradesh state of India. The geo-topography of the habitat is unique, with plateau, ridges, gorges and deep valleys, supporting tropical dry deciduous forests with an undergrowth of bamboo and grasses.

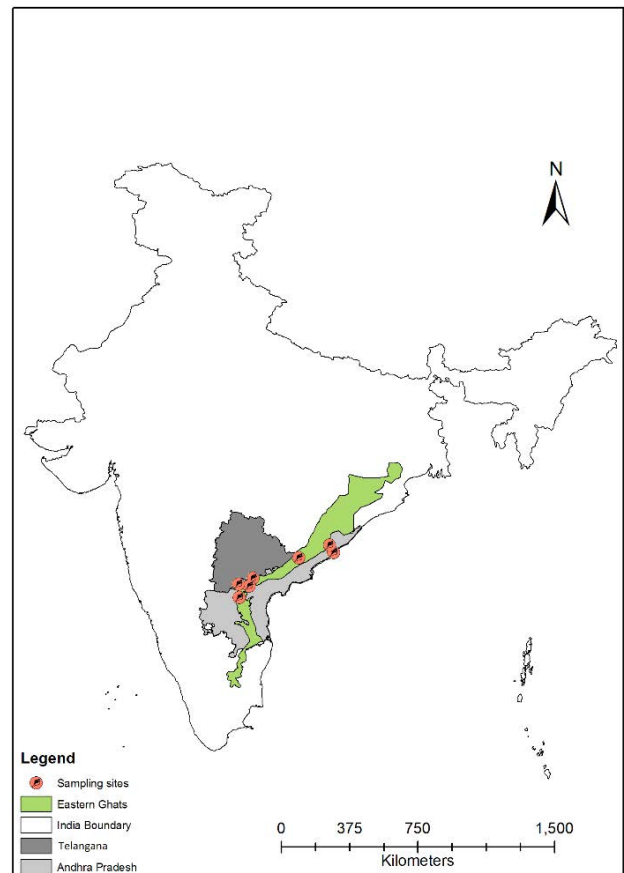


Figure 1. The map of survey sites in Andhra Pradesh and Telangana states of India along with Eastern Ghats mountainous range.

Ethipothala Falls (EF): The Ethipothala is a waterfall formed by the mountain streams which falls from a height of 70 feet (21 m) high river cascade, situated on the Chandravanka River in Andhra Pradesh (Lat. 16° 32' 13.8366" N; Long. 79° 24' 26.5716" E). Three streams namely Nakka Vagu, Tummala Vagu and Chandravanka

Vagu combines to form this waterfall and drained into the Krishna River.

Bavikonda Hills (BH): The Bavikonda, a hill, is overlooking the sea between Bimunipatnam and Visakhapatnam city (Lat. 17° 49' 2" N; Long. 83° 23' 27" E) and is situated in the Andhra Pradesh state and fallen into the middle of the Eastern Ghats range.

Gosthani Sarovar (GS): Gosthani Sarovar Vihar is situated at the Thatipudi Reservoir Project, located near the Thatipudi village in the Gantiyada Mandal of Vizianagaram district of Andhra Pradesh (Lat. 18° 10' 58.1052" N; Long. 83° 11' 48.1416" E). This reservoir was constructed in 1968 across the River Gosthani, originates at Ananthagiri Hills of the Eastern Ghats.

Amrabad Tiger Reserve (ATR): The Amrabad Tiger Reserve (ATR) is notified as a Tiger Reserve in 1983, is situated on the north bank of the river Krishna and the area is shared between the Mahaboobnagar and Nalgoda district of Telangana state (Lat. 16° 14' 40.5126" N; Long. 78° 42' 23.8746" E). The total area is 2611.39 km², of which 2166.37 km² has been declared as important tiger habitat and core zone, whereas 445.02 km² is created for the buffer zone and Important Bird area falling under the criteria of A1, A2 as per the guideline is given by Bird Life International. The main forest type of ATR is southern dry mixed deciduous forests, southern tropical moist deciduous forest types intermingled with scrubs, bamboos and grasses.

Methodology

Field Sampling: Visual search survey method was used for mollusca in the aquatic and terrestrial habitats (Emberton *et al.*, 1996). The land and freshwater mollusca from the field sites were collected from different field gazettes viz. nylon scoop, nets, forceps, rubber gloves, polythene baes and plastic containers were used for proper collection and safe keeping of the specimens. All the possible macro habitats of the land snails viz. rotten woods, leaves, trunks, leaf litter, tree, under rock surface, under forest debris and possible humid areas where the maximum possible availability of land snails, were surveyed physically. For the freshwater mollusca, the bank of the streams, water bodies, pools, under rock surface, stream trails and wetland vegetation were investigated. For land snails,

during their active periods i.e. during and after rainfalls, early morning and night, intensive field visits were made. At least one living individual or dead shell of each species was collected as voucher specimen and was brought to the laboratory either in wet or dry conditions. The living shells were collected and narcotised, thoroughly washed to remove mucous, and then treated with ascending grade of spirit (20%, 40%, 60%) and preserved in 70% ethyl alcohol in the field itself and brought back to the ZSI laboratory for identification. For land mollusca, identification and classification as suggested by Nevill, (1878); Gude, (1914); Vaught, (1989); Mitra *et al.*, (2005); Raheem *et al.*, (2014) were followed, whereas freshwater mollusca identification was done using the keys prescribed by Preston (1915) and Subba Rao (1989). After identification of the specimens, were deposited in the National Zoological Collection (NZC) in the Mollusca Section of Zoological Survey of India, Kolkata.

The Systematic Accounts

Land Mollusca

Class: GASTROPODA

Order: MESOGASTROPODA

Family: CYCLOPHORIDAE

Subfamily: CYCLOPHORINAE

Genus: *Cyclophorus* Montfort, 1810

Cyclophorus polynema (Pfeiffer, 1854) [Plate 1; Figure A]

Material examined: Maradumilli Hills (8 ex.), Date: 09.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29421/7

Shell characters: Shell moderate in size, thick, turbate, umbilicate, whitish with brown markings, sculptured by oblique striae, decussated by spiral lines; a dark band on the periphery and brown circular patches just below, whorls 4 ½; aperture oblique, peristome thickened and expanded, the edge of umbilicus sub-angulate.

Known Distribution Range: Andhra Pradesh, Odisha, West Bengal.

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Subfamily: PTEROCYCLINAE

Genus *Pterocyclus* Benson, 1832

Pterocyclus rupestris Benson, 1832 [Plate 1; Figure B]

Material examined: Maradumilli Hills (11 exs.), Date: 09.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29420/7

Shell characters: Shell whitish with regular angular chocolate markings, both above and below, closely, radially striate; apex scarcely raised, the last whorl moderately descending; aperture circular, differs from the other being marked with chocolate streaks both above and below and also in the form of the wing; the inner peristome forms a loop and the outer extends above it producing a broad flap, which terminates a little in front of the margin of the aperture, touching the last whorl.

Known distribution range: Jharkhand, Odisha, West Bengal. Present report is the range extension to Andhra Pradesh.

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Order STYLOMMATOPHORA

Family CERASTUIDAE

Genus *Rachis* Albers, 1850

Rachis punctatus (Anton, 1839) [Plate 1; Figure C]

Material examined: Nagarjunasagar-Srisailem Tiger Reserve (1 ex.), Date: 31.viii.2016, Coll: Dr Varadaraju and Party, Reg. No: M29426/7

Shell characters: Shell conical ovate, perforate, whitish with transverse fuscous streaks and a single infra peripheral band; whorls seven; scarcely rounded vertically striate; aperture vertical, ovate; peristome slightly thickened and reflected; columella vertical, reflected.

Known distribution range: Andhra Pradesh, Kerala, Laccadive, Maharashtra, Odisha, Tamil Nadu, West Bengal

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Family SUBULINIDAE

Subfamily SUBULINIDAE

Genus ***Glessula*** Von Martens, 1860

Glessula subtornensis Gude, 1914 [Plate 1; Figure D]

Material examined: Maradumilli Hills (8 exs.), Date: 09.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29435/7

Shell characters: Shell oblong-conoid, rather thin, very finely striae; spire conoid; suture impressed. Apex rather prominent; whorls 8, scarcely convex; aperture sub-vertical, broadly truncated, semi-oval; peristome thickened.

Known distribution range: Andhra Pradesh, Kerala, Tamil Nadu

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Subfamily RUMININAE

Genus ***Zootecus*** Westerlund, 1887

Zootecus insularis (Ehrenberg, 1831) [Plate 1; Figure E]

Materials examined: Ethipothala lake falls (5 exs.), Date: 01.ix.2016, Coll: Dr Varadaraju and Party; Date: 01.ix.2016, Reg. No: M 29434/7; Near DFO office, Nalgona (4 exs.), Date: 30.viii.2016, Coll: Dr Varadaraju and Party, Reg. No: M 29433/7; Nagarjuna sagar (4 exs.), Date: 31.viii.16, Coll: Dr Varadaraju and Party, Reg. No: M29436/7

Shell characters: Shell sub-cylindrical, attenuate, small, pale, white, thick, very narrowly perforate, finely marked by vertical striae which are bent at the suture, a few faint spiral striae also present; Whorls 7-8, the last whorl ascending a little in front, fairly convex; aperture sub-vertical, semi-ovate, angled above, columella thickened, slightly reflected, outer lip thickened inside.

Known distribution range: Andhra Pradesh, Bihar, Delhi, Jammu and Kashmir, Maharashtra, Punjab, Rajasthan, Uttar Pradesh.

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Family HELICARIONIDAE

Subfamily SESARINAE

Genus ***Kaliella*** Blanford, 1863

Kaliella barrakporensis (Pfeiffer, 1852) [Plate 1; Figure F]

Material examined: Ethipotale, Temple side shallow river water camp (1 ex.), Nalgonda, Date: 02.ix.2016, Coll: Dr Varadaraju and Party.

Shell characters: Shell small and trochiform, very narrowly perforate; Strong and obliquely ribbed above; Suture deeply impressed, whorl 6; Keeled at periphery; Peristome simple; Columellar margin oblique and reflected.

Known distribution range: Widely distributed throughout India and Indian subcontinent.

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Family: ARIOPHANTIDAE

Subfamily MACROCHLAMYDINAE

Genus ***Macrochlamys*** Benson, 1832

Macrochlamys indica (Blanford & Godwin-Austen, 1908) [Plate 2; Figure K]

Material examined: Nagarjuna Sagar (1 ex.), Date: 01.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29429/7

Shell characters: Shell depressed with a little raised spire, narrowly perforate, with microscopic spiral marking, whorls 5-6; the last whorl rounded at the periphery; aperture lunate, sub vertical columellar margin obliquely descending, reflected above

Known distribution range: Andhra Pradesh, common throughout India

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Macrochlamys perplana Godwin-Austen, 1883 [Plate 2; Figure L]

Material examined: Ethipotale, Temple side shallow river water camp, Nalgonda (1 ex.), Date: 02.ix.2016, Coll: Dr Varadaraju and Party.

Shell characters: Shell perforate, smooth and shining, depressed; spire flat; whorls 6; the last broad and rounded;

aperture broadly lunate, columellar margin oblique and curved, expanded near the perforation.

Known distribution range: In India: Andhra Pradesh, Jharkhand, Odisha, West Bengal

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Subfamily ARIOPHANTINAE

Genus ***Ariophanta*** Desmoulins, 1829

Ariophanta interrupta (Benson, 1834) [Plate 2; Figure J]

Material examined: Maredumilli (2 ex.), Date: 09.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29430/7

Shell characters: Shell depressed convex with a blunt apex, thick, sinistral, coarsely and obliquely plicate, decussated by spiral striae which often become obsolete; body whorl angulate at the periphery, smooth and tumid below; aperture widely crescent shaped; peristome thickened, umbilicus deep narrow.

Known distribution range: Andhra Pradesh, Jharkhand, Odisha, West Bengal

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Genus ***Cryptozonia*** Moerch, 1872

Cryptozonia belangeri (Deshays, 1834) [Plate 2; Figure G]

Material examined: Maradumilli (1 ex.), Date: 9.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M28428/7

Shell characters: Shell openly perforate, depressely globose, obliquely striate; whorls 5-5½, convex; aperture roundly lunate; peristome thin, basal and columellar margins slightly reflected; purplish or whitish in colour.

Known distribution range: Andhra Pradesh, Kerala, Tamil Nadu

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Cryptozona ligulata (Férussac, 1921) [Plate 2; Figure H]

Material examined: Nagarjuna sagar (5 ex.), Date: 31.viii.2016, Coll: Dr Varadaraju and Party, Reg. No: M29422/7; Near DFO office, Nalgondala (1 ex.), Date: 02.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29423/7; Ethipothala, Temple side shallow water canal Nalgonda (1 ex.), Date: 02.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29432/7

Shell characters: Shell perforate, sub-globose, depressed, thick, finely striate; and decussated above; darker above the periphery, usually with a brown band along the suture; whorls 4½ nearly flat; aperture large and oblique.

Known distribution range: Andhra Pradesh, Kerala, Odisha, Tamil Nadu

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Cryptozona semirugata (Beck, 1837) [Plate 2; Figure I]

Material examined: Near DFO office, Nalgondala (2 ex.), Date: 31.viii.2016, Coll: Dr Varadaraju and Party

Shell Characters: Shell large, globes, perforate, thick and narrowly perforate; finely sculptured above and smooth in lower surface; Spire conoid, whorl 5-6, convex; Aperture oblique, roundly lunate; Peristome thin, columella reflected above.

Known distribution range: Peninsular region of India and also recorded from Sri Lanka.

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Family CAMAENIDAE

Subfamily CAMAENINAE

Genus *Trachia* Albers, 1860

Trachia asperella (Pfeiffer, 1846) [Plate 2; Figure M]

Material examined: Near DFO office Nalgonda (1 ex.), Date: 30.viii.2016, Coll: Dr Varadaraju and Party, Reg. No: M29425/7

Shell characters: Shell small, depressed, broadly perforate, thick, pale yellowish to whitish with deep chocolate bands of variable formations, commonly with one broad band

above the periphery and a few narrow ones on both sides often with a very broad one on the base. roughly sculptured with close oblique striae crowded with microscopic granules throughout; spire very low; almost flattened, whorls 4, flattened above, the last whorl bluntly angulate above the periphery, slightly compressed and tapering below, descending in front; aperture oblique, semicircular margins strongly reflected throughout, columella slowly curving.

Known distribution range: Andhra Pradesh, Madhya Pradesh, Maharashtra

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Fresh Water Molluscs

Class GASTROPODA

Order MESOGASTROPODA

Superfamily VIVIPAROIDEA

Family VIVIPARIDAE

Subfamily BELLAMYINAE

Genus *Bellamyia* Jousseaume, 1880

Bellamyia bengalensis f. annandalei (Kobelt, 1909) [Plate 3; Figure N]

Material examined: Gosthani saravor (5 ex.), Date: 15.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29452/7; Ethipothala temple side shallow river water canal Nalgonda (6 ex.), Date: 2.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29454/7; Nagarjuna sagar (16 ex.), Date: 31.viii.2016, Coll: Dr Varadaraju and Party, Reg. No: M29457/7; Ethipotala lake falls (2 ex.), Date: 01.ix.2016, Coll: Dr Varadaraju and Party, Reg No: M29456/7

Shell characters: Shell thin, whorls gradually increasing; sutures shallow; aperture sub-rhomboidal and subangulate anteriorly.

Known distribution range: Andhra Pradesh, Tamil Nadu, West Bengal

IUCN status: Least Concern

Order ARCHITAENIOGLOSSA

Family VIVIPARIDAE

Genus *Idiopoma* Pilsbry, 1901

Idiopoma dissimilis (Müller, 1774) [Plate 3; Figure O]

Material examined: Ethipothala, Temple side shallow river water canal Nalgonda (2 ex.), Date: 02.ix.2016, Coll. Dr Varadaraju and Party, Reg. No: M29455/7; Nagarjuna sagar (1 ex.), Date: 31.viii.2016, Coll. Varadajaju and Party, Reg. No: M29453/7

Shell characters: Shell small, broadly ovate in shape, without dark spiral bands, spire swollen, suture deeply impressed, and body whorl indistinctly angulate, greenish with a blackish peristome.

Known distribution range: Common throughout the India

IUCN status: Least Concern

Family AMPULLARIIDAE

Genus ***Pila*** (Bolten) Roeding, 1798

Pila virens (Lamarck, 1822) [Plate 3; Figure P]

Material examined: Ethipothala Lake falls (2 ex.), Date: 01.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29451/7

Shell characters: Shell large, globose, imperforate or sub perforate, body whorl highly inflated and shoulder above; spire short, sutures deep and distinct canalculated, aperture ovate.

Known distribution range: Andhra Pradesh (Cuddapath, Khamman, Krishna, Prakasam, Srikakulam, Vishapatnam). A common species throughout peninsular India.

IUCN status: Least Concern

Superfamily CERITHIOIDEA

Family THIARIDAE

Subfamily THARINAE

Genus ***Melanoides*** Olivier, 1804

Melanoides tuberculata (Müller, 1774) [Plate 3; Figure Q]

Material examined: Nagarjuna Sagar (2 ex.), Date: 31.viii.2016, Coll: Varadaraju and Party, Reg. No: M29443/7; Ethipothala, temple side shallow river water camp Nalgonda (13 ex.), Date: 02.ix.2016, Coll: Varadaraju and Party, Reg. No: M29450/7; Gosthani Sarovar (2 ex.), Date: 15.ix.2016, Coll: Dr. Varadaraju & Party, Reg. No: M29442/7

Shell characters: Shell with a high spire and moderately large body whorl, whorls evenly rounded, dark red-brown dots and flames, either irregularly distributed or longitudinally arranged on the shell surface, sculptured with vertical ribs and spiral striae, distinct and raised on the upper whorls, but flatter on the lower ones.

Known distribution range: Widely distributed throughout India except Kashmir.

IUCN status: Least Concern

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

Tarebia lineata (Gray, 1828) [Plate 3; Figure S]

Material examined: Nagarjuna sagar (5 ex.), Date: 31.viii.2016, Coll: Dr Varadaraju & Party, Reg. No: M29446/7; Maredumilli (1 ex.), Date: 09.ix.2016, Coll: Dr Varadaraju & Party, Reg. No: M29441/7; Ethipothala, temple side shallow river water camp, Nalgonda (15 ex.), Date: 02.ix.2016, Coll: Dr Varadaraju & Party, Reg. No: M29447/7; Ethipothala lake falls (1 ex.), Date 01.ix.2016, Coll: Dr Varadaraju & Party, Reg. No: M29444/7, Gosthani sarovar (27 ex.), Date: 15.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29449/7

Shell characters: Shell elongate, conical, rows of nodules less distinct, rather obsolete on the lower whorls, dark spiral lines distinct, and apex acute.

Known distribution range: Andhra Pradesh, Assam, Bihar, Jharkhand, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal

IUCN status: Least Concern

Genus ***Thiara*** Roeding, 1798

Thiara (Thiara) scabra (Müller, 1774) [Plate 3; Figure R]

Material examined: Ethipothala, Temple side shallow river water camp, Nalgonda (5 ex.), Date: 02.ix.2016, Coll: Dr, Varadaraju and Party, Reg. No: M29445/7; Ethipothala lake falls (1 ex.), Date: 01.ix.2016, Coll: Dr Varadaraju & Party, Reg. No: M29448/7

Shell characters: Shell rather short and broad, whorls slightly flattened above and rounded below, regularly increasing in size; rows of spines present on the whorls; spiral striae on the shell surface strong near umbilical

region. Prefers slow moving water but occurs in slow or fast moving water as well as stagnant water.

Known distribution range: Andhra Pradesh, Jharkhand, Kerala, Madhya Pradesh, Maharashtra, Pondicherry, Tamil Nadu, West Bengal

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Subclass PULMONATA

Order BASOMMATOPHORA

Superfamily LYMNÆOIDEA

Family LYMNÆIDAE

Genus *Lymnaea* Lamarck, 1799

Lymnaea (Pseudosuccinea) acuminata (Lamarck, 1822) [Plate 4; Figure T]

Material examined: Nalagonda (12 ex.), Date: 03.ix.2016, Coll: Dr Varadaraju & Party, Reg. No: M29437/7

Shell characters: Shell thin, ovate, spire short acuminate, body whorl much inflated, a little angular above, with a large aperture. This species usually occurs in permanent water bodies with abundant vegetations.

Known distribution range: Common throughout India.

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Superfamily PLANORBOIDEA

Family BULLINIDAE

Subfamily BULLININAE

Genus *Indoplanorbis* Annandale & Prasad, 1921

Indoplanorbis exustus (Deshayes, 1834) [Plate 4; Figure U]

Material examined: Ethipothala (1 ex.), Date: 02.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29427/7

Shell characters: Shell large, thick, discoidal, sinister, rounded at periphery aperture ear-shaped, suture, deeply impressed.

Known distribution range: Common throughout India

IUCN Status: Least Concern.

Class BIVALVIA

Order UNIONOIDA

Superfamily UNIONOIDEA

Family UNIONIDAE

Subfamily AMBLEMINEAE

Genus *Lamellidens* Simpson, 1900

Lamellidens marginalis (Lamarck, 1819) [Plate 4; Figure V]

Material examined: Ethipothala (2 valves), Date: 02.ix.2016, Coll: Dr Varadaraju & Party, Reg. No: M29440/7

Shell characters: Shell smooth, oblong-ovate; posterior end broad, roundly angular, produced wing narrow; dorsal margin little curved; ventral margin slightly contracted; periostracum blackish brown; Cardinal teeth two on right valve.

Known distribution range: Widely distributed in India

IUCN status: Least Concern

Genus *Parreysia* Conrad, 1853

Parreysia favidens (Benson, 1862) [Plate 4; Figure W]

Material examined: Ethipothala, Temple side shallow river water camp, Nalgonda (6 valves); Date: 02.ix.2016, Coll: Dr Varadaraju & Party, Reg. No: M29439/7

Shell characters: Shell thick and heavy, inflated, with strong zig-zag ribs on the beak, unequilateral and angulate both on anterior and posterior margins, cardinal teeth strong and broad.

Known distribution range: Andhra Pradesh, Assam, Bihar, Jharkhand, Maharashtra, Meghalaya, Garo hills. Khasi hills. Odisha, Rajasthan, Tamil Nadu, Chennai, Uttar Pradesh, West Bengal.

IUCN status: Least Concern

Parreysia (Parreysia) corrugata (Müller, 1774) [Plate 4; Figure X]

Material examined: Nagarjuna sagar (2 valves), Date: 31.viii.2016, Coll: Dr. Varadaraju & Party, Reg. No: M29438/7

Shell characters: Shell elliptic, smooth, scarcely inequilateral; umbones prominent; lunule well-marked; sculptured radiating; oblique, linear ridges, ventral margin convex, greenish in colour.

Known distribution range: Widely distributed throughout India, except Jammu and Kashmir

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Subclass HETERODONTA

Order VENEROIDA

Superfamily CYRENOIDEA (=CORBICULOIDEA)

Family CYRENIDAE (=CORBICULIDAE)

Genus *Corbicula* Megerle von Mühlfeld, 1811

Corbicula striatella Deshayes, 1854 [Plate 4; Figure Y]

Material examined: Ethipothala, temple side shallow river water camp, Nalgonda (5 valves, 1 ex.), Date: 02.ix.2016, Coll: Dr Varadaraju and Party, Reg. No: M29424/7; Ethipothala, Lake walls falls (6 ex.), Date: 01.ix.2016, Coll: Dr Varadaraju & Party, Reg. No: M29431/7

Shell characters: Shell triangularly ovate, thick, concentrically ribbed, dorsal margin arched, umboes very prominent, vertical margin rounded, ligament external, cardinalteeth, lateral teeth compressed and finely serrated. The pallial line with a trace of sinus, muscle scars fairly deeply developed.

Table 1. The land and freshwater Molluscs species recorded from the different study sites

Species	NSTR	EF	NH	ATR	MH	BH	GS
<i>Cyclophorus polynema</i>	x	x	x	x	√	x	x
<i>Pterocyclus rupestris</i>	x	x	x	x	√	x	x
<i>Rachis punctatus</i>	√	x	x	x	x	x	x
<i>Glessula subtornensis</i>	x	x	x	x	x	x	x
<i>Zootecus insularis</i>	√	√	√	x	x	x	x
<i>Kaliella barrakporensis</i>	x	√	x	x	x	x	x
<i>Macrochlamys indica</i>	√	x	x	x	x	x	x
<i>Macrochlamys perplana</i>	x	√	√	x	x	x	x
<i>Ariophanta interrupta</i>	x	x	x	x	√	x	x
<i>Cryptozona belangeri</i>	x	x	x	x	√	x	x
<i>Cryptozona ligulata</i>	√	x	√	x	x	x	x
<i>Cryptozona semirugata</i>	x	√	x	x	x	x	x
<i>Trachia asperella</i>	√	√	√	√	√	x	x
<i>Bellamya bengalensis</i>	x	x	√	x	x	x	x
<i>Idiopoma dissimilis</i>	x	x	x	x	x	x	x
<i>Pila virens</i>	x	√	x	x	x	x	x
<i>Melanoides tuberculata</i>	√	√	√	x	√	x	√
<i>Trachia scadea</i>	x	√	x	x	x	x	x
<i>Lymnaea acuminata</i>	√	√	√	√	√	√	√
<i>Indoplanorbis exustus</i>	x	√	√	x	x	x	x
<i>Lamellidens marginalis</i>	x	√	√	x	x	x	x
<i>Parreysia(Parreysia) favidens</i>	x	√	√	x	x	x	x
<i>Parreysia corrugata</i>	√	x	x	x	x	x	x
<i>Corbicula stiatella</i>	x	√	√	x	x	x	x

Note: NSTR: Nagarjunasagar-Srisailam Tiger Reserve EF: Ethipothala Falls, NH: Nallamala Hills ATR: Amrabad Tiger Reserve, MH: Maradumilli Hills, BH: Bavikonda Hills, GS: Gosthan Sarovar

Known distribution range: Andhra Pradesh, Assam, Bihar, Jharkhand, Maharashtra, Odisha, Rajasthan, Tamil Nadu, Chennai, Uttar Pradesh, West Bengal

IUCN status: This taxon has not yet been assessed by the IUCN Red List.

Results

The collections have been made from seven different locations from Andhra Pradesh and Telangana (Table 1). At present study, a total of 25 species includes 13 species from land snail and 12 species from freshwater molluscs were identified. The observed species from land snail belonged to 2 order and 6 families and freshwater molluscs belonged to 5 order and 8 families. A perusal of analysis suggest that the maximum abundance of mollusca irrespective of whether freshwater or land, were recorded from Ethipothala Hill (n=13) and lowest from Bovikonda Hill (n=1) (Figure 2). Since, the survey was not uniform and time constrained as well the faunal collections also targeted at other groups, the results are not comparable. However, the fact remain is that the possibility of diversity of mollusca in Ethipothala Hill could be due to the vegetation cover, conducive environment and minimum human disturbance, which was evident during the field documentation.

Discussion

Needless to mention that, the land snails and freshwater molluscs are challenging from taxonomic point of view but are interesting in terms of their habits. The Andhra Pradesh and Telangana being a tropical moist deciduous forests with mixed climatic condition and moderate rainfall, which offers prevailing conditions and provide ample microhabitat for the molluscan diversity, thus can be called as an ecologically complex and sensitive area for mollusca. Land snails in particular are considered to be a good indicator of soil health (Madhyasta *et al.*, 2004). The documentation of 13 species of land snails within a time constrained surveys and selected locality is evident of conducive environment for land mollusca in Deccan Peninsular region of the country and indicative of a good health of the forest area, also suggests an important link in the terrestrial food chain and that the soil is rich in calcium (Mitra *et al.*, 2005). A rich freshwater mollusca (12 out of 217 species) recorded during the survey, also indicative of water bodies present in the area, supporting molluscan diversity and there by good indicator of aquatic environment. Nevertheless, the present study is a time constraint and within selected localities, and therefore, the result could be more of a conservative in nature in

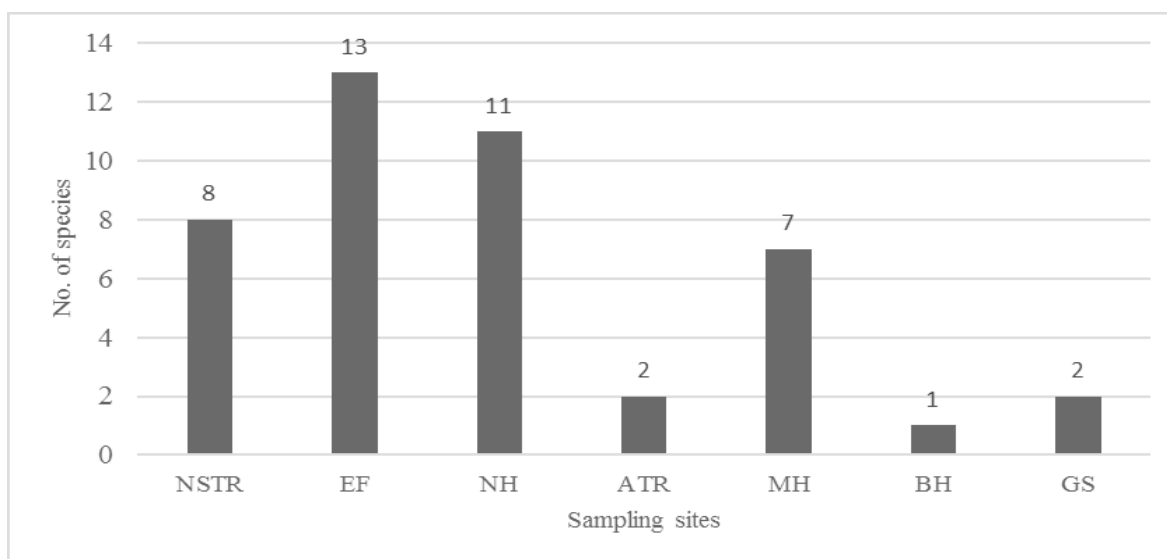


Figure 2. Number of Mollusca recorded in different locations in the study sites [NSTR: Nagarjunasagar-Srisailem Tiger Reserve EF: Ethipothala Falls, NH: Nallamala Hills ATR: Amrabad Tiger Reserve, MH: Maradumilli Hills, BH: Bavikonda Hills, GS: Gosthan Sarovar].

terms of diversity and distribution of land snails and freshwater molluscs in the surveyed areas of Andhra Pradesh and Telangana. Therefore, more substantial information is necessary to establish a strong linkage for supporting the ecosystem of Eastern Highlands and Central Plateau province of India as biodiversity hotspot of India and may receive the recognition as Eastern Ghats as a separate entity.

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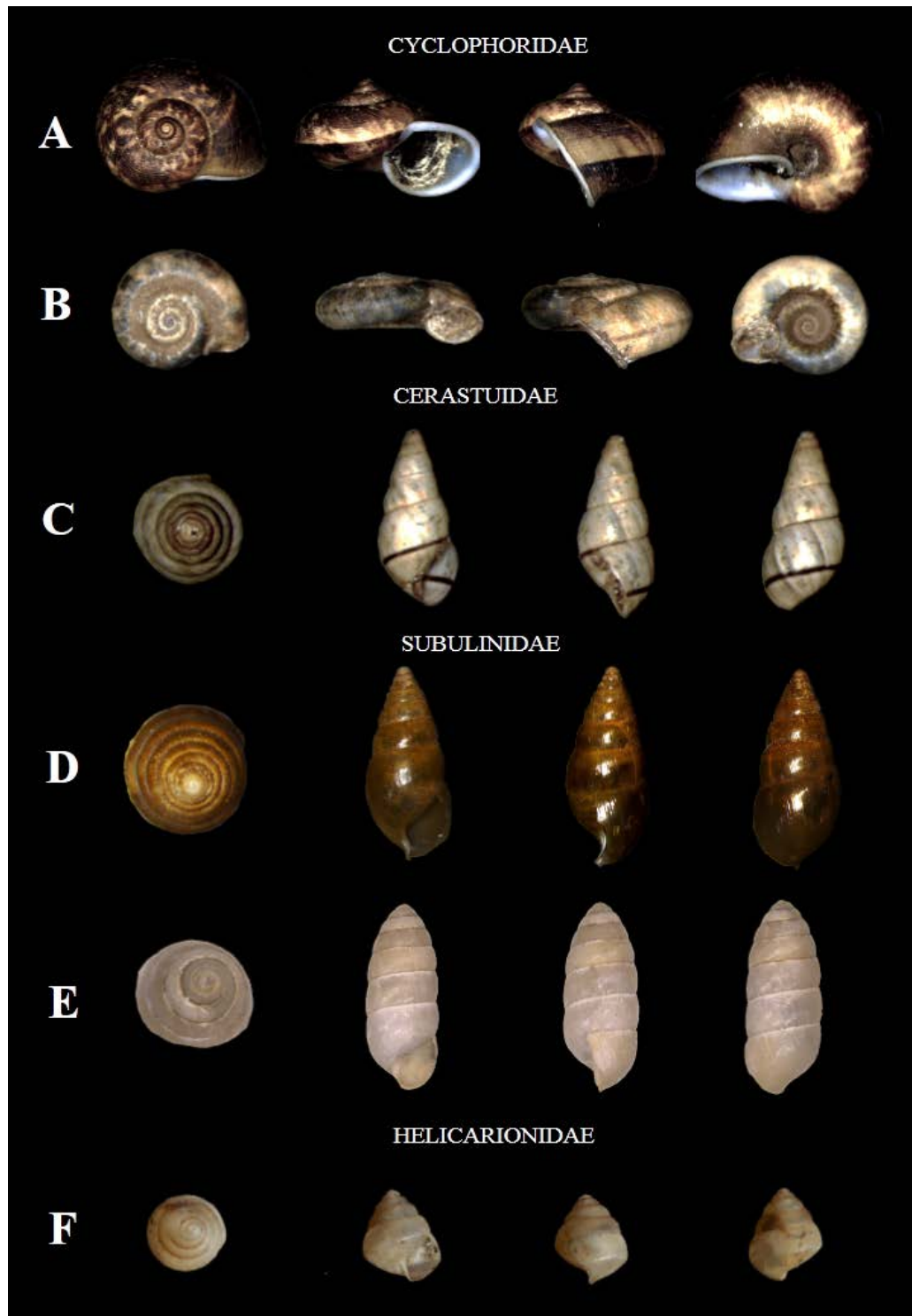


Plate 1. A *Cyclophorus polynema* (Pfeiffer, 1854); B. *Pterocyclus rupestris* Benson, 1832; C. *Rachis punctatus* (Anton, 1839); D. *Glessula subtornensis* Gude, 1914; E. *Zootecus insularis* (Ehrenberg, 1831); F. *Kaliella barrakporensis* (Pfeiffer, 1852)

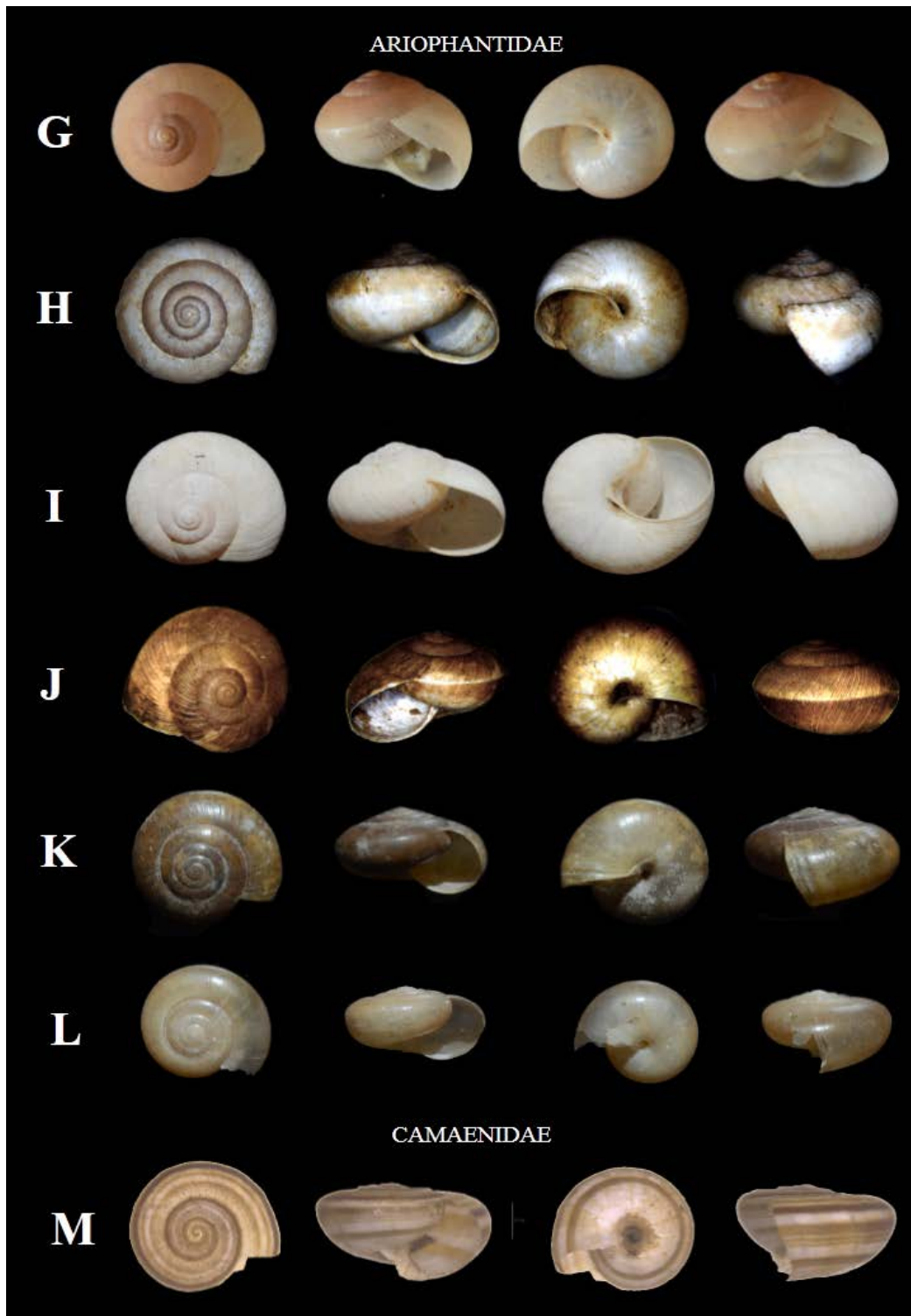


Plate 2. G. *Cryptozona belangeri* (Deshays, 1834); H. *Cryptozona ligulata* (Férussac, 1921); I. *Cryptozona semirugata* (Beck, 1837); J. *Ariophanta interrupta* (Benson, 1834); K. *Macrochlamys indica* (Blanford & Godwin-Austen, 1908); L. *Macrochlamys perplana* Godwin-Austen, 1883; M. *Trachia asperella* (Pfeiffer, 1846)

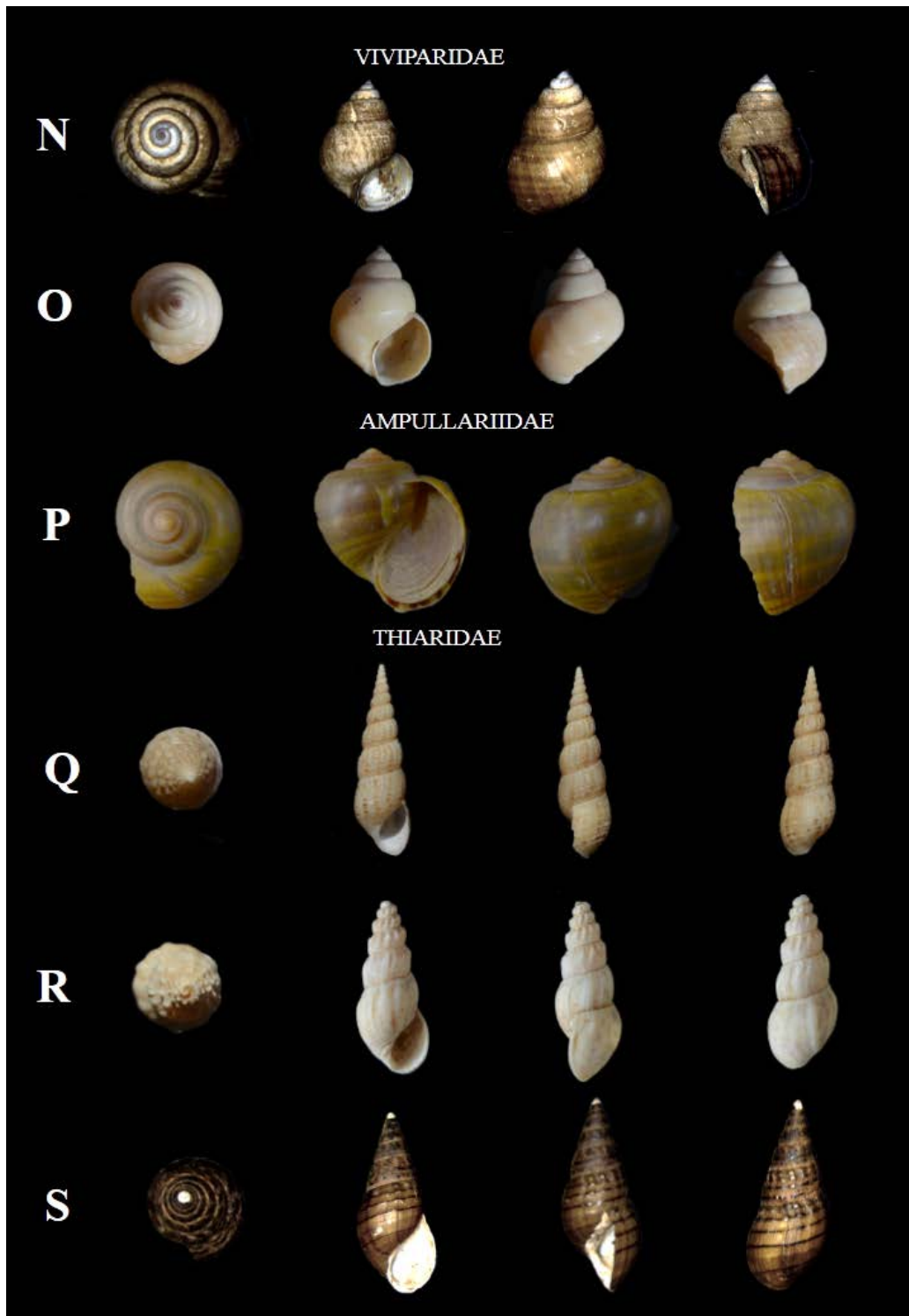


Plate 3. N. *Bellamyia bengalensis* f. *annandalei* (Kobelt, 1909); O. *Idiopoma dissimilis* (Müller, 1774); P. *Pila virens* (Lamarck, 1822); Q. *Melanoides tuberculata* (Müller, 1774); R. *Thiara (Thiara) scabra* (Müller, 1774); S. *Tarebia lineata* (Gray, 1828)

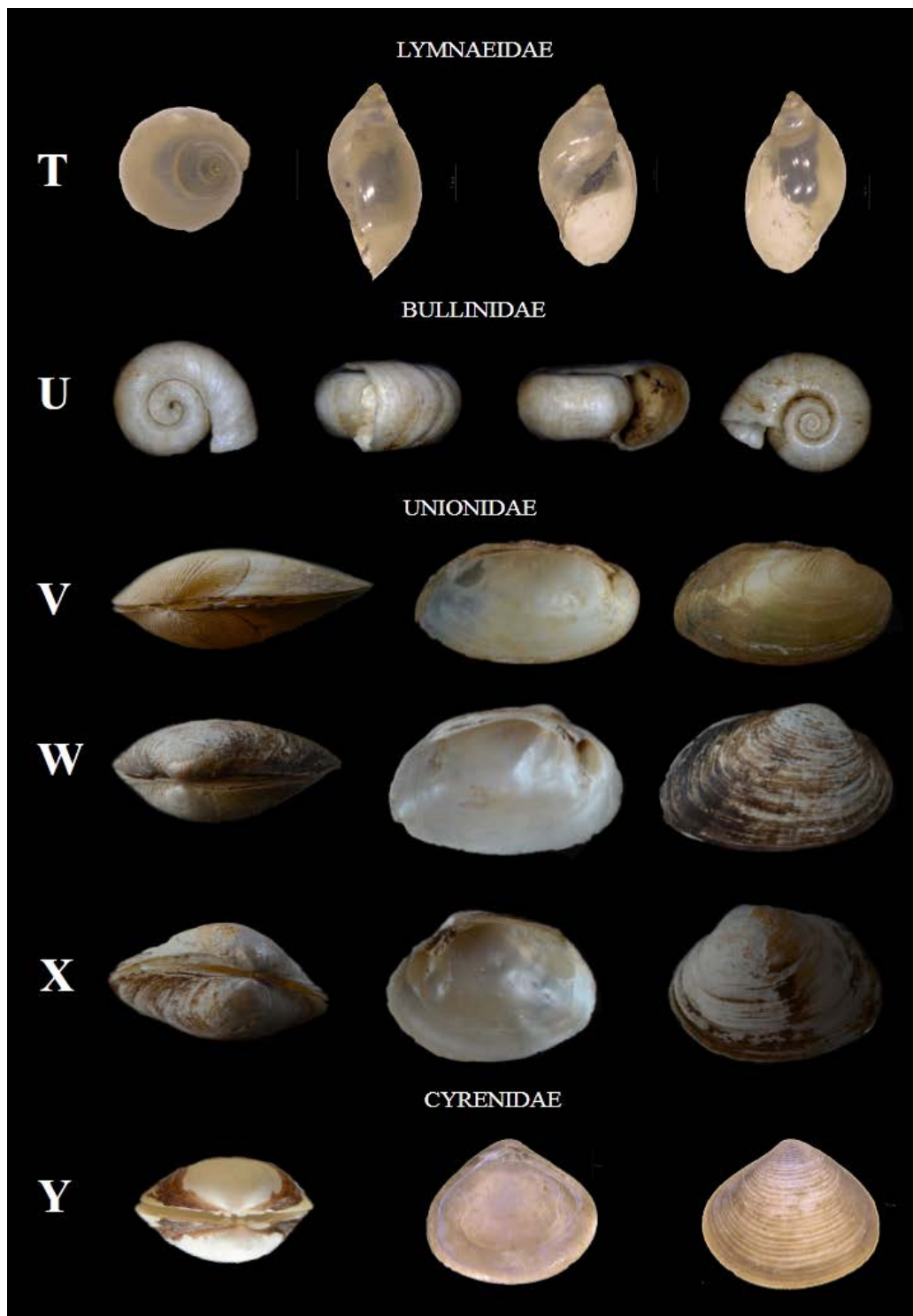


Plate 4. T. *Lymnaea (Pseudosuccinea) acuminata* (Lamarck, 1822); U. *Indoplanorbis exustus* (Deshayes, 1834); V. *Lamellidens marginalis* (Lamarck, 1819); W. *Parreysia favidens* (Benson, 1862); X. *Parreysia (Parreysia) corrugata* (Müller, 1774); Y. *Corbicula striatella* Deshayes, 1854